Electric School Bus INITIATIVE

Electric School Bus Market Overview: Landscape and Trends

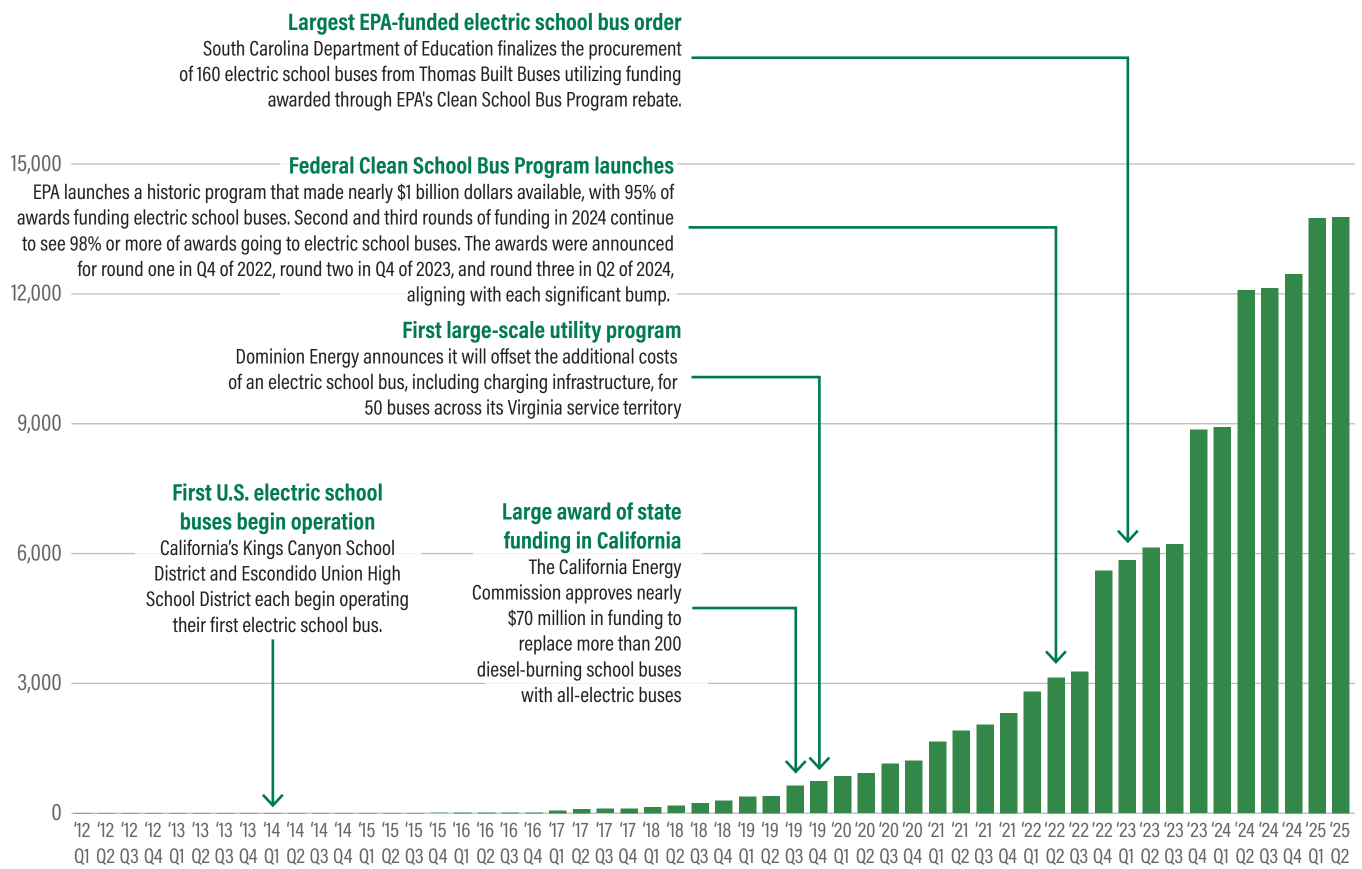
Status of Electric School Bus Adoption

The electric school bus (ESB) market was established in 2014, when three California school districts—Kings Canyon USD, Escondido Union High School District and Gilroy USD—became the first school districts to operate ESBs. Since then, the market has come a long way.

As of June 2025, fleet operators in 49 states, Washington DC, U.S. territories and dozens of Tribal Nations have committed to procuring ESBs. There are now 13,874 ESB commitments across 1,551 districts (or private operators), representing around 2.9% of the current fleet size. To date, 5,269 ESBs have been delivered or are in operation in 49 states.

See the *Electric School Bus Initiative's Data Dashboard* at electricschoolbusinitiative.org/data-dashboard for a detailed breakdown of ESB adoption.

FIGURE 1 | Cumulative number of electric school buses committed by quarter in the United States (2014–2025)



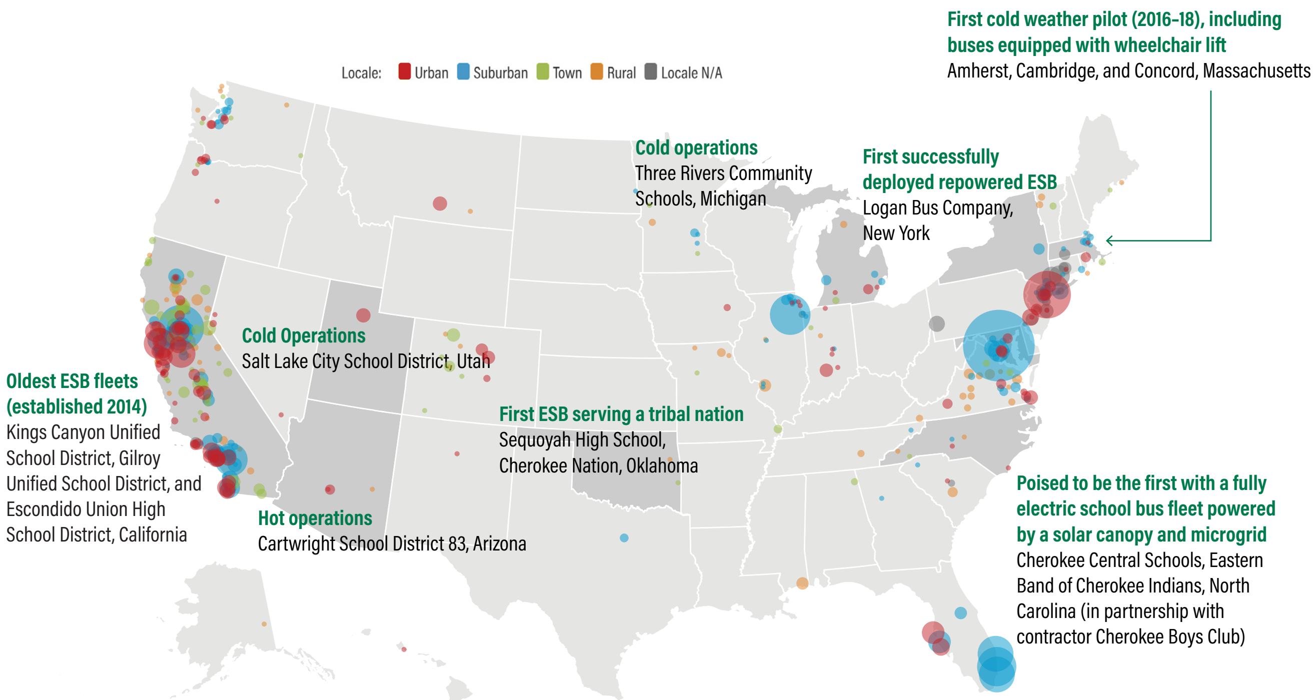
Notes: We define "commitment" to include electric school buses (ESB) across four stages: those that have been awarded funding for purchase, have a formal purchase agreement with a dealer or manufacturer, have been delivered to school districts or fleet operators, or are in operation. This graph depicts ESB commitments at the earliest confirmed phase in the commitment process; 131 ESBs were excluded due to unknown dates of their commitment stages. EPA = Environmental Protection Agency. ESB = electric school bus. Q = quarter.

Source: Lazer, L., L. Freehafer., and Zepka, B. June 2025. "A Dataset of Electric School Bus Adoption in the United States." Washington, DC: World Resources Institute.

Market Demand for Electric School Bus Adoption

School districts and communities across the country are becoming part of the transition to ESBs, driving demand nationwide. Today, electric school buses are successfully operating in a variety of settings and conditions—including in mountain cold and desert heat.

FIGURE 2 | **Committed electric school buses in the United States operating across a wide range of settings and conditions**



Source: Laser and Freehafer 2023; NCES n.d.a., n.d.b.; examples gathered by authors.

Compared to diesel-burning school buses, ESBs have the potential to reduce operations and maintenance costs for fleets—and they do so with zero tailpipe emissions, resulting in health and climate savings. Each electric school bus can reduce carbon dioxide emissions by 181 metric tons compared to a diesel-burning school bus, delivering an estimated $40,400 in climate-related benefits and approximately $43,800 in health-related savings[1] that is driven by improved air quality and associated reductions in mortality and childhood asthma. If equipped with bidirectional charging technology that is available on most new models, ESBs can provide additional benefits, such as supplying mobile emergency power.

Communities and policymakers motivated by ESB benefits—including health benefits for children—are advocating for ESBS, resulting in an increasing number of commitments to electric transition goals, which now cover which now cover some 37% of all school buses riders and over 162,000 buses. Implementation of these commitments is aided by grants and incentives to bring down the upfront purchase cost, with the aim of driving benefits for underserved communities.

Scaling Supply: Available Electric School Bus Models

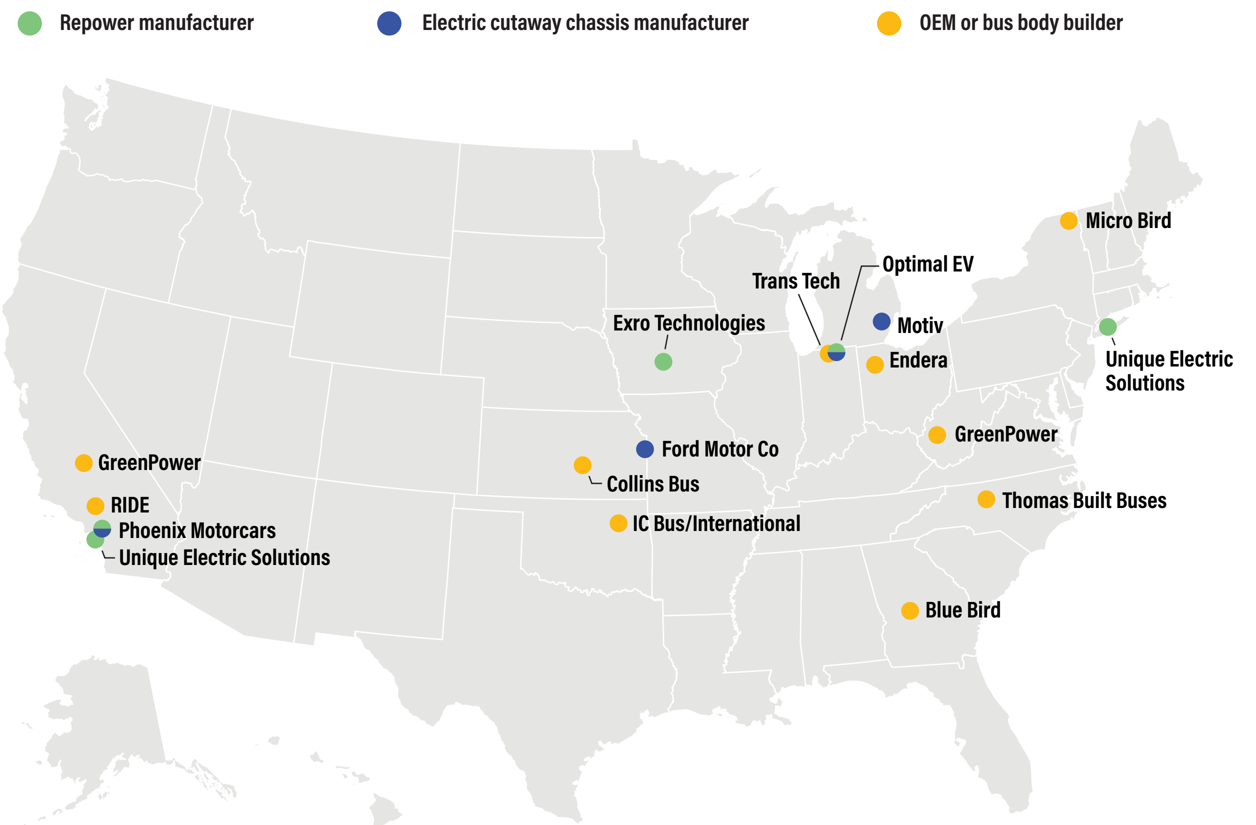
Today, more than 20 ESB models are available across Types A, C, and D school buses, with many original equipment manufacturers (OEMs) now producing third, fourth, or later generation vehicle models with longer range, improved safety and more advanced features. ESBs are being built with ranges of between 100 miles and 300 miles, which can meet the demands of most school bus routes.

To meet the growing demand for ESBs, OEMs are ramping up production. While Lion Electric entered into bankruptcy proceedings in 2024 and has closed its U.S. facility, other OEMs are expanding their operations with the construction of new and expanded manufacturing facilities.

In 2021, Micro Bird expanded its Quebec facility, making space for over 1,000 ESBs per year. In 2024, Micro Bird opened a new plant in New York that will create 350 new jobs, further doubling capacity.[2] In 2022, Thomas Built Buses added 280 employees in North Carolina to help grow ESB production, setting the company up for its 1,000th ESB delivery in March 2024.[3] In 2023, Blue Bird Corporation opened an EV Build-Up Center on its Georgia manufacturing campus —putting electric Type C and D production on track to reach a capacity of 5,000 buses annually, a fivefold increase.[4] In addition to new buses, electric repowers—fossil-fuel buses converted to electric—show promise to bolster supplies.

Looking ahead, Blue Bird, with nearly $80 million in U.S. Department of Energy funding, will convert a dormant manufacturing location to produce ESBs. The 600,000-square-foot facility will add 400 jobs and provide workforce training.[5] In addition, RIDE is constructing an ESB facility adjacent to the company's existing bus manufacturing plant in Lancaster, California, with capacity for 4,000 ESBs per year.[6]

FIGURE 3 | **Map of electric school bus manufacturing facilities in the United States**



Note: Additional North American manufacturing in Canada not included in this map includes: Lion Electric Company, Micro Bird, and Ecotuned.

Source: WRI authors based on publicly available information.

As ESBs continue to gain market share, it will be crucial to advance sustainability and social equity conditions across the supply chain. For the batteries, vehicle manufacturers generally offer an 8-to 10-year warranty, extendable to 12 years. Once an ESB battery's capacity drops to between 70 percent and 80 percent, there are second-life opportunities for an estimated seven to 10 additional years in low-demand applications, such as stationary storage.[7]

Manufacturing workers in the school bus industry have made progress and secured benefits through union contracts. Most notably, the United Auto Workers negotiated a new contract for employees at Thomas Built Buses, and the United Steelworkers ratified a collective bargaining agreement with Blue Bird. As of 2025, the majority of ESBs coming off the manufacturing line are produced by union labor.

School bus electrification is rapidly scaling, and the student transportation industry has made considerable progress since the first ESBs were deployed in 2014. In particular, the ESB model range has grown. The buses used during King Canyon's, Escondido's, and Gilroy's 2014 deployments had a range of 40 miles to 100 miles. Today, ESBs have a range of 100 miles to 300 miles, depending on bus type and model. These vehicles were once limited to a handful of pilot programs, but by June 2025, the number of school districts procuring electric models and integrating them into their fleets had grown to 1,551.

Like any new technology, there are still barriers to adopting these buses, such as a high upfront bus cost and new infrastructure needs, reliability issues with older bus models, and limited specialized maintenance and workforce training support. However, ESBs provide a number of benefits, such as reduced operations and maintenance costs; lower pollution and emissions; the potential to improve driver, technician and student health outcomes; and improved resilience.

FIGURE 4 | Sample of electric school bus benefits and considerations

Lower operations and maintenance costs

ESBs have lower maintenance and fuel costs over time, and our research suggests that compared with a new diesel school bus, a new ESB can save an average of $7,000 every year on operational expenditures, depending on circumstances.[a] Today, these savings alone are insufficient to cover the vehicle price differential without additional grant funding or subsidies, but experts anticipate significant price declines over the next decade as battery costs decrease, development of new battery chemistries advances, and the electric vehicle industry achieves efficiencies of scale in component markets and manufacturing.[b] Market experts anticipate that the lifetime total cost of owning an ESB will achieve cost parity with diesel-burning school buses by the middle of this decade.[c]

Health benefits

There is evidence that children are particularly susceptible to the negative health impacts of diesel exhaust, which has been linked to increased risk for asthma.[d] There is also evidence that reducing this exposure can improve not only respiratory health but also standardized test scores, especially for elementary-age students.[e] Although there has not been extensive research measuring the air quality benefits of ESBs specifically, these results strongly suggest that adopting these vehicles—which have zero tailpipe emissions—would have positive effects on students' health and academic outcomes, particularly for low-income students, Black students, and children with disabilities, who are more likely than their peers to ride a school bus.[f]

Climate benefits

For school buses, electricity emits half as many greenhouse gas emissions annually as the next-best fuel.[g] Electricity is the only viable fuel that will reduce greenhouse gas emissions over time as the grid integrates more renewables. Buses can also be paired with on-site renewable energy.

Resilience and grid potential

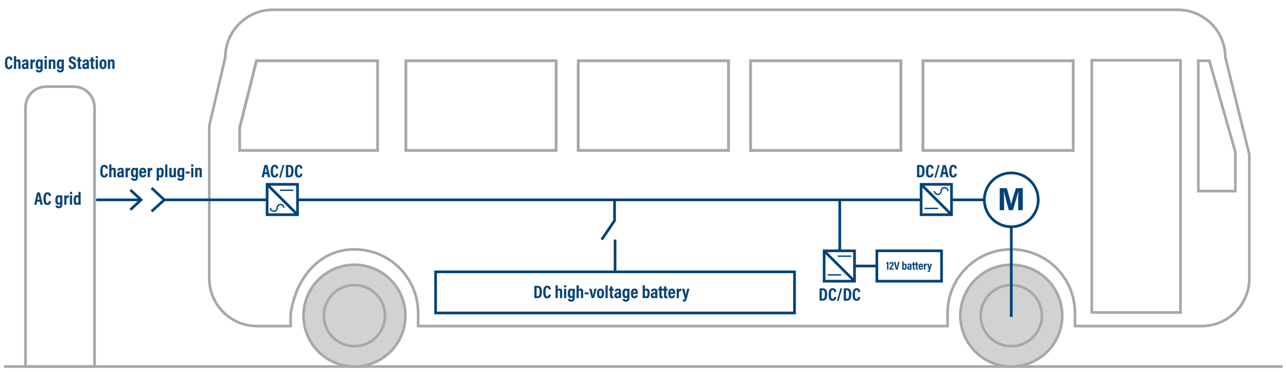
ESBs have the potential to serve as mobile power units for buildings during outages (V2B), for the grid during high energy demand (V2G), or for another load (V2L)—collectively identified as V2X.[h] Manufacturers are continuing to improve V2X technology and telematics and studying the impacts of the frequency and intensity of charge and discharge cycles on battery life. Charging ESBs during off-peak hours and under managed charging conditions produces grid benefits today by not charging when energy demand is highest or by charging when renewable energy is abundant.

Summary of Available Technology: Vehicles, Charging Infrastructure and Charge Management Software

Vehicles

As school districts embrace ESBs, fleet managers, bus drivers and maintenance technicians will need to familiarize themselves with elements that vary between diesel and electric.

FIGURE 5 | **Electric school bus diagram**



Notes: Abbreviations: AC = alternating current; DC = direct current; M = AC electric motor..

Source: Adapted from Ainsalu et al. 2018.

Although many elements of the body and cabin are similar, there are two key features of the electric model that differ from the diesel model: the presence of high-voltage electrical systems and the absence of internal combustion-related components (transmission, exhaust system, engine system and fuel system).

ESBs contain high-voltage systems powered by a large lithium-ion battery pack mounted to the chassis. These batteries meet rigorous safety standards and are extensively tested. Power from the high-voltage battery is distributed to the electric motor and other systems using high-voltage cables (bright orange), alternating current/direct current (AC/DC) inverters and DC/DC converters. The high-voltage battery pack is supported by a thermal management system that maintains battery health and longevity by keeping the batteries within an optimal temperature range regardless of external temperature, which is vital to ESBs' ability to operate in both cold and hot climates.

Charging Infrastructure

As school districts consider procuring ESBs, they must also think about the corresponding infrastructure needed to charge these buses. Infrastructure can be broken into hardware and software components.

For charging hardware, there are three levels available today:

- Level 1 alternating current (AC)
- Level 2 AC
- Level 3 direct current with various power ranges from low-powered DC (24–30 kW) to fast-powered DC–DCFC (direct current fast charger) (50+ kW)

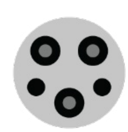
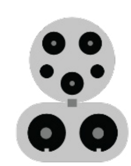
There is a trade-off between charger costs and charging speeds. As the charger power increases and allows for faster charging, so do the costs. L2 chargers typically can be purchased for under $5,000 per unit, whereas L3 DCFCs can be five times that or more.

Like an appliance's plug fits into a household wall outlet, a bus's charging port must be physically compatible with the charger connector, which delivers electric current from the charger hardware to the vehicle battery. There are two connector types used for ESBs—J1772 and CCS (Combined Charging System). While the light-duty electric vehicle market is moving toward the J3400/NACS (North American Charging Standard) for charging, this change has not proliferated into the medium- and heavy-duty vehicle market. ESBs remain largely powered by J1772 or CCS connections.

Early and frequent engagement with the school district's electric utility is crucial, and it is incumbent on utilities to provide resources to ease the transition to electric fleets as part of their obligation to serve customers' electricity. This engagement is necessary for evaluating existing power supply and identifying required system upgrades. Charging infrastructure and installation can take approximately 12 to 24 months depending on the scope of upgrades needed.

See the *Electric School Bus Initiative's Power Planner* at electricschoolbusinitiative.org/all-about-working-your-electric-utility for guidance on how to work with your electric utility.

FIGURE 6 | Charging plugs type

	Level 2	Direct current fast charger
PLUG TYPE	SAE J1772	Combined Charging System
IMAGE		

Source: AFDC n.d..

Box 1. Charging infrastructure

Charging infrastructure will be a new frontier for almost all districts.[a] When evaluating charger assortment,[b] districts should keep in mind questions such as the following:

Where will chargers be located? Conduct a preliminary site assessment that allows you to identify elements such as traffic flow, parking, ideal bus port location (e.g., nose or driver's side rear), and the most economical spot for a new service drop from the utility.

Will electric utility upgrades be needed? Confirm available power (open capacity) from your building infrastructure as well as available capacity from your electric utility, as there may be site limitations. Finalize the location of a new service drop. You should begin conversations with your electric utility and your school district's electrical engineer as soon as possible. Engage them on a regular basis throughout the process.

What utility demand charges and tariffs will you pay? Utility demand charges can increase significantly with usage and electric vehicle charging can result in raised demand charges if charging infrastructure is not properly planned. Electric utilities also use time-variant tariffs to send price signals to customers when using electricity is more or less expensive. Tariffs will depend on your region and electric utility—for instance, midday charging may be cheaper or more costly depending on your utility's tariff structure. Similarly, utilities may offer lower "off-peak" prices for most of the night, making overnight, lower-power charging an effective solution. Some utilities may even offer "super-off-peak" prices for a few hours during some periods, allowing a DCFC to take advantage of a short supersaver period if programmed (this approach requires a network-connected charger to begin and end charging at the appropriate times). Some utilities may also offer specific rates for electric vehicles (EVs). Given this variation, understanding your utility's tariff structure is critical to making your charging as cost-effective as possible and maximizing your electricity savings.

Consider if you will be using an existing utility meter or installing a new service. Connecting behind an existing meter can foster the discharge of electricity to electrical panels installed behind the same meter (e.g., vehicle-to-building, vehicle-to-load). Strategic service meter usage can also help keep utility demand charges low.

How do your routes operate? Conduct a route analysis to select and match the bus battery pack size with the appropriate power charging station. Factors include weather (and how much air conditioning or heat is used), terrain, total miles, and schedules (including dwell time between routes, early release schedules, and field trips), among other variables. Buses running longer routes (i.e., those that reduce the state of charge below the level needed to complete both morning and afternoon routes) may need to charge after their morning route and before their afternoon route (likely with a DCFC), but others may be able to complete their entire daily route without a midday charge.[c] Your district may decide to hire an external consultant to run a charging analysis or contract charging out entirely through a "charging as a service" firm.[d]

Have you evaluated managed charging? Assess software offerings that may take advantage of cheaper energy during off-peak hours.[e] Smart chargers (those equipped with charge management software) can be programmed to begin and end charging at the appropriate times to take advantage of the cheapest electricity rates. In addition, managed charging can allow you to control your electricity use (demand) and expand the number of buses your facility can support by staggering charging times or distributing charging across multiple chargers and vehicles.

What about pairing ESBs with solar? Electric bus adoption can also be paired with new or existing on-site solar.[f] This approach could further decrease energy costs while providing a power source for charging during service disruptions. Installing on-site solar also helps districts contribute to wider school district, city, or state emissions reductions or sustainability goals and directly offsets fossil fuel consumption.

Notes and sources:

a. Personal communication between authors and Todd Hawkins, Senior Vice President, Maintenance, First Student, Cincinnati, OH. April 12, 2023.

b. More information on charger offerings can be found in the "Technology Catalog" on EnergIIZE's website at https://www.energiize.org/infrastructure?section=infrastructure.more-details.technology or on the Electric Power Research Institute's website regarding the Electric Vehicle Supply Equipment (EVSE) Working Group at https://www.epri.com/pages/sa/evse-qualification-working-group/evse.

c. CTE (Center for Transportation and the Environment). 2023. "Electric School Bus Analysis Reveals Four Key Lessons for Electrification." https://cte.tv/electric-school-bus-analysis-reveals-four-key-lessons-for-electrification.

d. More information on electric as a service, which includes charging as a service, can be found on the Electric School Bus Initiative's website at https://electricschoolbusinitiative.org/school-bus-electric-service-eaas-directory.

e. Electric School Bus Initiative, World Resources Institute. 2022. "12 Tips on Electric School Bus Adoption. https://electricschoolbusinitiative.org/12-tips-electricschool-bus-adoption.

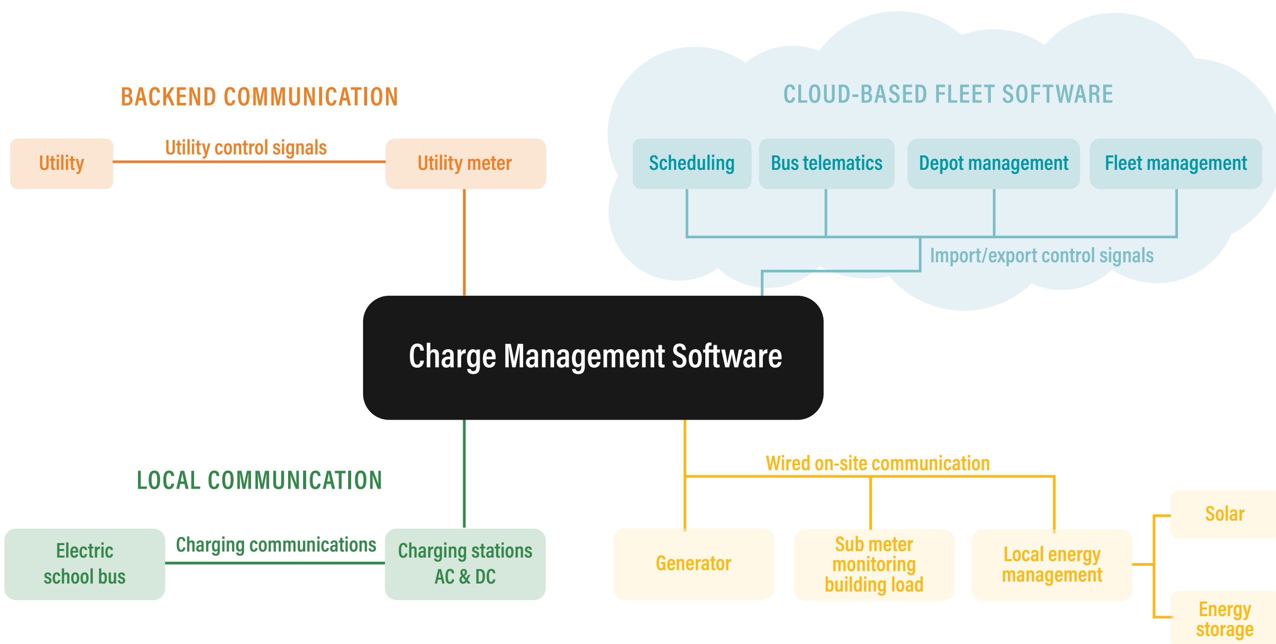
f. "'Worked Better than I Expected': Tok's Electric School Bus Passes Cold Weather Test." KUAC. November 18, 2020. https://fm.kuac.org/local-news/2020-11-18/worked-better-than-i-expected-toks-electric-school-bus-passes-first-cold-weather-test.

Charge Management Software

Charge management software (CMS) can be integrated into electric school bus operations and helps save time and money when charging. Managed charging is the process in which the time and power level of charging are controlled (often via software) to optimize charging schedules, costs and bus performance while considering the electric grid. Using CMS to manage charging can provide reduced electricity bills for the fleet and lower overall operational costs. It allows for scheduling charging times for when electricity prices are lowest or turning off charging to preserve battery life and the power level without making manual adjustments, even if the bus is plugged in continuously. For this reason, managed or smart charging can help realize energy cost savings. These benefits can be seen for both small and large fleets, and it is a scalable solution across large operations.

Moreover, managed charging can reduce infrastructure upgrades, and therefore also reduce the capital cost of installing more charging infrastructure and speed up timelines for infrastructure deployment. For example, site capacity upgrades are often necessary to meet the charging demand of new electric vehicles. While capacity upgrades can be costly and time-consuming, using managed charging can utilize the site's existing capacity to smartly charge the fleet's EVs and reduce needed upgrades.

FIGURE 7 | **Communication among bus, charger, and network**



Notes: Abbreviations: AC = alternating current; DC = direct current..

Source: Hill-Cristol 2024.

There are a number of CMS providers whose software is proven compatible with electric school bus charging infrastructure, including a few charging station vendors that offer their own CMS. See the *Electric School Bus Initiative's Charge Management Software Catalog* at https://electricschoolbusinitiative.org/charge-management-software-catalog for more information about CMS options for school bus fleets, including information on compatibility, cost, data accessibility, and renewable energy integration.

Learn more

To find more information about ESBs, the state of the market and how to bring ESBs to your district, visit electricschoolbusinitiative.org.

ENDNOTES

1 "Electric School Buses May Yield Significant Health and Climate Benefits, Cost Savings," Harvard T.H. Chan School of Public Health, November 22, 2024, https://hsph.harvard.edu/news/electric-school-buses-may-yield-significant-health-and-climate-benefits-cost-savings/

2 "Micro Bird Plant Expansion to Boost Electric School Bus Production." *School Bus Fleet*, February 5. https://www.schoolbusfleet.com/10136207/micro-bird-plant-expansion-to-boost-electric-school-bus-production.

3 "Thomas Built Buses Celebrates 1,000th Electric School Bus Delivery," March 13. https://thomasbuiltbuses.com/resources/news/thomas-built-buses-celebrates-1-000th-electric-2024-03-13/.

4 "Blue Bird Celebrates Grand Opening of Electric Vehicle Build-Up Center." Business Wire, May 15. https://www.businesswire.com/news/home/20230525005557/en/Blue-Bird-Celebrates-Grand-Opening-of-Electric-Vehicle-Build-up-Center.

5 DOE (Department of Energy, Office of Manufacturing and Energy Supply Chains). 2024. "Domestic Manufacturing Conversion Grant Program." https://www.energy.gov/mesc/domestic-manufacturing-conversion-grant-program.

6 CEC (California Energy Commission). 2022. "GFO-21-605."

7 en:former. 2023. "Electric Bus Batteries Are Given a Second Life as Energy Stores." https://www.en-former.com/en/electric-bus-batteries-are-given-a-second-life-as-energy-stores/.

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