WORKING PAPER

Needs assessment for equitable school bus electrification in US school districts

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Suggested Citation: Brown, C.T., and E. Jackson. 2025. "Needs assessment for equitable school bus electrification in US school districts" Working Paper. Washington, DC: World Resources Institute. Available online at doi.org/10.46830/wriwp.20.00111.

Executive summary

Highlights

- School districts have an unprecedented opportunity to invest in clean rides for students by transitioning to electric school buses (ESBs); however, this transition will not look the same for every district.
- The research team investigated motivators for and barriers to ESB adoption for priority districts and non-priority districts—defined on the basis of districts' racial diversity, percentage of low-income students, Tribal status, and exposure to pollutants—in various geographies and locations (Worker and Coursar 2023).
- District geography (i.e., census region) and locale (e.g., urban or rural) appeared to have a greater impact on districts' needs than their priority status, so regional- or locale-based working groups may provide more effective technical assistance.
- Respondents to our survey saw better health for children and bus drivers, reduced operating expenses, and cleaner air as the main benefits of ESBs.
- Districts with ESBs were motivated by the availability of funding, air quality benefits, climate benefits, exposure to districts with ESBs, and interest in testing a new technology.
- Districts were concerned about cost, infrastructure, technological readiness, maintenance, and route length.
- Most districts did not consider equity during the electrification process. The ones that did focused on deploying buses in underserved areas and prioritizing students with disabilities.

Background

World Resources Institute's (WRI's) Electric School Bus (ESB) Initiative aims to promote equitable electrification of the US school bus fleet. Its approach is centered around equity—the guarantee of fair treatment, access, opportunity, and advancement while striving to identify and eliminate barriers that have prevented the full participation of some groups and acknowledging that there are historically underserved and underrepresented populations—and intersectionality—an analytical framework for understanding how aspects of a person's social and political identities combine to create different modes of discrimination and privilege (Moses and Brown 2022).

This paper updates and expands on the 2022 "Needs Assessment for Equitable School Bus Electrification in U.S. School Districts" (Brown and Jackson 2023), which provided preliminary recommendations regarding technical assistance for the ESB Initiative's "priority outreach districts" (or "priority districts") (see Box ES-1). The ESB Initiative prioritizes them in providing technical assistance and policy recommendations to remediate systemic inequalities that exist within the US education system.

Box ES-1 | Definition of priority districts

Priority outreach districts, called priority districts in this paper, are the school districts in each state that are in the top quartile statewide for percentage of households below 200 percent of the federal poverty level, the top quartile statewide for percentage of residents who identify as non-white and/or Hispanic, or the top quartile statewide for either average levels of ozone or PM2.5 pollution,[a] or they are Tribal districts.[b] These districts are prioritized for many reasons, including that low-income communities, Tribal Nations, and communities of color have faced historic disinvestment and under-resourcing, and that Black and Brown communities often bear the brunt of harmful on-road air pollution created by predominantly white communities.[c]

These priority districts are a narrower list than the federal government's priority districts for the Clean School Bus Program as the ESB Initiative designed the list to help prioritize their technical assistance resources. It also differs from the Clean School Bus Program list in that it includes race and air quality, which are not used in the program criteria.

Source: [a] PM2.5 refers to particulate matter of 2.5 micrometers or less in diameter; Worker and Cousar 2023. [b] Pinto de Moura and Richmond 2019.

This 2023 update pulls from a broader set of districts to examine the benefits of and barriers to school bus electrification one year into the US Environmental Protection Agency's (EPA's) Clean School Bus Program (CSBP) (see Box ES-2). It reexamines the needs of priority districts compared with those of other districts and expands the scope to compare needs across different geographies and locales.

Box ES-2 | Overview of federal funding for electric school buses

This paper features two key federal policies that impact electric school buses:

The EPA's Clean School Bus Program: As part of the Bipartisan Infrastructure Law, the CSBP provides $5 billion over five years (fiscal years 2022–26) to replace existing school buses with zero-emission and clean school buses. This money is given out in both rebate and grant form (EPA 2022).

The 45W tax credit: The Inflation Reduction Act of 2022 created a tax credit for qualified commercial clean vehicles that will be available through December 31, 2032. The provision calculates the amount of the potential tax credit per vehicle by determining a percentage of the cost basis at "15% for a plugin hybrid and 30% for an electric vehicle or the incremental cost increase for the new vehicle when compared against that of a comparable vehicle." Once these calculations are finalized, whichever number is the lesser of the two becomes the qualified commercial clean vehicle credit. The proposal also institutes a limitation on the amount of the credit: "$7,500 for vehicles weighing under 14,000 lbs [pounds] and $40,000 for vehicles weighing over 14,000 lbs."[a]

Source: [a] Akopian 2024.

About this working paper

This working paper includes select findings from the 2022 assessment, new findings from a 2023 survey conducted by Bobit Business Media, and new findings from a 2023 series of focus groups conducted by Equitable Cities and WRI. The surveys and focus groups assessed US-based school districts' needs and interests related to school bus electrification.

The 2023 survey team gathered quantitative data to document existing interest in and understanding of school bus electrification as well as challenges to adoption. Post-survey focus groups provided qualitative data on US school district staffs' familiarity with electric school buses, their interest in ESBs, what they saw as the benefits of and barriers to adoption, their interactions with internal and external stakeholders, their interest in financing, and their thoughts on centering equity in ESB adoption.

This paper builds on questions examined in the 2022 assessment but makes some modifications based on changes in the ESB landscape. For example, instead of asking about general ESB awareness, the 2023 survey looked at specific programs launched the year before that could not have been measured by the 2022 survey.

Both elements of the needs assessment support the ESB Initiative's equity framework (Moses and Brown 2022). They reveal unique challenges that may confront priority districts, districts in different geographies, and districts in different locales, and show how school districts view equity in the transition.

Key findings

The updated findings illustrate differences between priority and non-priority districts as well as those among districts in disparate localities and geographies. They indicate that creating regional cohorts or tailoring advice by locale may be helpful because differences based on locale and region are the most pronounced.

Funding availability was the primary stated motivator for ESB adoption, followed by air quality, climate impacts, exposure to other districts going through the process, and the desire to be a role model. School districts saw health benefits, reduced operating expenses, and cleaner air as the top advantages of ESBs.

Despite funding being a main motivator, the survey indicates that not all of the respondents were aware of all of their funding options. While over 80 percent of districts were aware of the CSBP, only 32 percent of districts knew about 45W. This lack of awareness could contribute to budget constraints being the main barrier to ESB adoption, in both the 2022 and 2023 studies. Concerns over cost were followed closely by those over infrastructure and maintenance.

Box ES-3 | **Equity definitions**

Below are a few types of equity referenced throughout the paper. These definitions are taken directly from the Electric School Bus Initiative's equity framework:[a]

Procedural equity: Inclusive, accessible, authentic engagement and representation in processes to develop or implement programs and policies.

Distributional equity: The result in the fair distribution of benefits and burdens across all segments of a community, prioritizing those with the highest need.

Structural equity: Decisions made in recognition of historical, cultural, and institutional dynamics and structures that have routinely advantaged privileged groups in society and resulted in chronic, cumulative disadvantage for subordinated groups.

Source: [a] Moses and Brown 2022.

The 2023 survey offered some new barriers for respondents to choose from and revealed concerns over range as a top barrier for districts. Despite hypothesizing that priority districts might face different or greater barriers, the survey team found that non-priority districts selected more barriers overall than the priority districts. While priority districts are often given preference for clean school bus grants, that does not alone explain why they are selecting fewer barriers.

As for equity, the survey indicated that most districts were not considering equity in their ESB projects. The minority that did focused mainly on distributional equity, such as prioritizing ESB deployment in low-income areas. Focus groups in 2022 and 2023 also generally pointed to distributional equity considerations. In 2023 focus groups, districts expanded the conversation to include students with disabilities. While a few districts mentioned sharing project outcomes with community members, most districts did not discuss procedural equity (see Box ES-3). See Appendix D for a full breakdown of how findings differed between 2022 and 2023.

Recommendations

This study offers ideas for how policymakers, individuals within school districts, nongovernmental organizations, and other interested parties can help advance school bus electrification. The full set of recommendations can be found in the later section "Recommendations." Here are the highlights:

- Provide information to parents, teachers, transportation department staff, school boards, and superintendents to address concerns and dispel myths, increase awareness of funding programs, and motivate districts to invest in ESBs.
- Support districts looking for funding and financing options, advocate for government programs and transition requirements, and work with original equipment manufacturers to reduce costs.
- Collaborate with dealers, utilities, districts, and other stakeholders to improve maintenance and operations, guide districts through infrastructure deployment, and create resources to help districts work with contractors.
- Help more districts consider equity when transporting students and expand their interest in equity beyond route selection to include other dimensions such as investing in procedural equity during planning and considering the systemic impacts of workforce development, facility citing, and supply chain sustainability.

Introduction

In collaboration with partners and communities, World Resources Institute's (WRI's) Electric School Bus (ESB) Initiative aims to build unstoppable momentum toward an equitable transition to an electric US school bus fleet. The fleet would bring health, climate, and economic benefits to children and families across the country and normalize electric mobility for an entire generation. The ESB Initiative will not only scale pathways to electrification but also help address racial, cultural, educational, safety, health, and socioeconomic disparities in school bus transportation across the United States. Often these disparities overlap, as documented in the ESB Initiative's equity framework (see Moses and Brown 2022), so this initiative is committed to leading with equity and centering intersectionality as its fundamental approach.

As part of this equity work, the ESB Initiative prioritized a few thousand districts for outreach and technical assistance, defined in Box ES-1. They are a focus of this research paper as well as the 2022 school district assessment based on the initiative's desire to understand and center the needs of districts that likely could benefit the most from electric buses but have fewer resources to procure them.

In addition to adopting the equity framework, the ESB Initiative published the *Electric School Bus Initiative Advocacy Stakeholder Analysis* (Brown and Curran 2023). The objective of that report was to gather and analyze qualitative data about how advocacy stakeholders view the transition to ESBs in the United States.

The 2023 needs assessment builds off of that from 2022 and contributes to the previous two documents by gathering additional information on school districts' interests and concerns when it comes to equitable school bus electrification (Brown and Jackson 2023). It also allows the team to make comparisons across several dimensions—priority and non-priority; Northeast, West, South, and Midwest; and urban, rural, suburban, and town—to provide more tailored technical assistance.

This working paper has nine sections, including a methodology, six sections detailing the findings of the surveys and focus groups, a discussion of the findings, and recommendations for future action.

Methodology and respondent characteristics

Part 1. US school district needs assessment survey

To understand perceptions of ESBs, identify common barriers to ESB adoption, and find potential solutions, the ESB Initiative administered the first needs assessment survey to 66 US school districts between June and August 2022, during the first round of the US Environmental Protection Agency's (EPA's) Clean School Bus Program (CSBP) Rebates application period (see Box ES-2).

The team conducted a second survey in 2023 and partnered with a contractor to reach a larger number of school districts. That third party, Bobit Business Media, sent an invitation and three reminders to all individuals in its School Bus Fleet database (n = 11,491, or 59 percent of the districts in the United States) to participate in an online survey. The first 250 districts to respond received a US $25 Amazon gift card as an incentive. The WRI team sent some additional invites to districts not included in the School Bus Fleet database to expand the number of priority districts contacted.

The criteria for participation were that the respondent was US based and represented a unique public or private school district. Bobit collected 289 responses between March 27 and May 21, 2023. Because not all districts completed every question, most questions had 248 responses instead of the full 289.

The survey also collected some internal monitoring, evaluation, and learning information for WRI and not every question on the survey appears in this working paper. A selected list of survey questions can be found in Appendix B.

Characteristics of 2023 survey respondents

Respondents held jobs such as transportation director (171), bus driver (14), driver trainer (9), maintenance manager (23), superintendent/administrator (13), operations manager (8), other manager (5), and other (46). A vast majority represented public schools but a few represented private schools. Given that the survey was shared via email and labeled as an electric school bus survey, there was certainly some self-selection from the districts. While using a third-party service may have reduced this selection bias, it did not remove it. Some categories are overrepresented while others are underrepresented. The researchers did not apply any additional statistical analysis to correct for these differences.

After the survey, the team divided districts by geographic region, locale, priority/non-priority, and ESB/no ESB. They identified priority districts and district locales by matching the respondents' district names with WRI's internal database.

The team then matched local education agency identification numbers (LEAIDs) to the names of school districts provided by survey respondents, using the process of Fuzzy matching in Microsoft Excel. Fuzzy matching joins two datasets based on imperfect string values. In this case, the team merged reported district names with WRI's internal dataset of school districts and associated LEAIDs. Fuzzy matching used a similarity threshold to indicate how similar two school district names were in each dataset. A similarity score indicated if two values were a match. The score represented the similarity between 0 and 1 of the two values analyzed by the matching process. Once a match was identified, the team joined the LEAID with the school district. The remaining categories were identified on the survey.

WRI identified priority districts defined above as school districts in each state that met the following criteria: They were in the top quartile statewide for percentage of households below 200 percent of the federal poverty level (this is also how "top quartile low-income districts" was determined; see Table 1), the percentage of residents who identified as non-white and/or Hispanic was in the top quartile (this is also how "districts in the top quartile of students of color" was determined), and they were in the top quartile for either average levels of ozone or PM2.5 pollution[1] (this is also how "districts in the top quartile for air pollution" was determined); or they were Tribal districts (defined as districts funded by the Bureau of Indian Education), as detailed data were not available to establish quartiles. Worker and Coursar (2023) provide further detail on the calculations.

Table 1 | **Distribution of district characteristics by priority, demographics, and geography**

DISTRICT CATEGORY	SUBCATEGORY	NUMBER OF RESPONDENTS	TOTAL POPULATION[a]
Priority districts	Priority	30	1,508
	Non-priority	218	18,010
Districts in the top quartile of students of color	Top quartile	72	3,295
	All others	176	16,223
Top quartile low-income districts	Top quartile	48	3,294
	All others	200	16,224
Tribal districts	Tribal	2	174
	Non-Tribal	246	19,344
Districts in the top quartile for air pollution	Top quartile	111	5,188
	All others	137	14,330

DISTRICT CATEGORY	SUBCATEGORY	NUMBER OF RESPONDENTS	TOTAL POPULATION[a]
Districts with ESBs in fleet	1+ ESB (at time of survey)	19	927
	No ESB	229	18,591
Geography	Northeast	40	4,112
	Midwest	91	6,451
	South	40	4,225
	West	47	4,922
Locale	Urban	36	3,718
	Suburban	79	4,529
	Town	42	3,061
	Rural	91	8,248
Total	Total	248	19,518

Note: [a] At the time of the survey. ESB = electric school bus.
Sources: Authors; NCES n.d.a; Lazer n.d.

The regions were based on the four US census regions: The Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The South includes Alabama; Arkansas; Delaware; Florida; Georgia; Kentucky; Maryland; Mississippi; Missouri; North Carolina; Oklahoma; South Carolina; Tennessee; Texas; Virginia; Washington, DC; and West Virginia. The Midwest includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The West includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

The locales use National Center for Education Statistics definitions. *Urban* is defined as located inside an urbanized area with more than 100,000 residents, *rural* means located 2.5 miles or more from both an urban area and an urban cluster, *suburban* means located outside an urbanized area with a population over 100,000, and *town* means located 10 or more miles outside an urban cluster (NCES n.d.b). Districts with ESBs self-identified that they had at least one ESB, which could mean that they were just ordered, ordered and delivered, or ordered and operating.

Part 2. 2023 postsurvey focus groups

After the survey, the research team conducted five focus groups: four focus groups based on geography (defined in Table 1) and one focus group for school districts with ESBs regardless of geography. The research team drafted questions for each focus group (see Appendix C). The focus groups were each 1.5 hours long and held over Zoom. Charles T. Brown of Equitable Cities conducted the interviews.

The purpose of the 2023 focus groups was to obtain qualitative information that would complement the data gathered via the online survey and offer participants an opportunity to provide feedback in their own words and voices.

Participants volunteered themselves during the survey responding either "yes" or "maybe" when asked if they would be willing to participate in a virtual focus group in exchange for an honorarium. Participants provided their e-mail addresses and phone numbers. The research team e-mailed all the "yes" districts first and then emailed the "maybe" districts in regions where fewer than six districts responded. In some cases, the research team followed these e-mails up with a phone call.

In the Northeast focus group, there were three participants who filled out the consent form, in the South there were five, in the West there were five, in the Midwest there were three, and in the ESB group there were four. Focus group participants held a wide range of jobs and included superintendents, transportation directors, bus drivers, and maintenance workers.

Limitations

The 2023 school district needs assessment update has a few limitations. While the survey captured a greater number of districts, it posed slightly different questions and did not include all the districts from the original survey. This means we cannot directly compare the surveys as the respondents were different and the overall representativeness is different.

The 2023 survey went to staff that held some position related to transportation, including superintendents, transportation directors, drivers, and mechanics, among others. This diversity of positions means that some district responses could have been influenced by which staff member responded to the survey more than reflecting differences among districts.

Additional limitations include the level of detail of responses and the scope of the paper. The majority of the 2023 survey questions did not often provide respondents with the opportunity to explain their answers in detail—a typical limitation of quantitative research. Although the focus groups allowed for more insights into some districts' answers, they did not cover all districts, so the research team cannot apply conclusions from the focus groups to all districts. In addition, neither the survey nor the focus groups analyzed the needs of Tribal districts. Furthermore, the focus groups did not have equal representation across each geography, which means that the diversity of voices was higher in some areas than in others.

Even with these limitations, data from the survey provide several insights:

- The results offer a dataset of school district administrators' thoughts on ESBs one year into the EPA's CSBP.
- The breakdown by geography, locale, priority/non-priority, and ESB/non-ESB can offer more granular insights into how to offer different types of technical assistance to different districts than the original priority/non-priority analysis.

Measuring awareness of and interest in ESB funding programs

2023 survey findings on awareness of and interest in ESB funding programs

Knowing school districts' general understanding of and interest in ESBs is an important first step in addressing the barriers to ESB adoption. In the 2022 US school district needs assessment survey, the team asked districts explicitly about their familiarity with electric school buses. In this updated 2023 survey, which surveyed a larger set of districts, the team instead asked respondents about their familiarity with the two national funding programs, the Clean School Bus Program and the Qualified Commercial Vehicle 45W tax rebate (45W)—defined in Box ES-2. Both launched around the time of the 2022 survey; they were therefore not good metrics during that survey window. District familiarity with these programs might correlate with a general level of awareness for clean school bus options. Interest in pursuing the funding opportunity might correlate with a general interest in ESBs.

Awareness of ESB programs

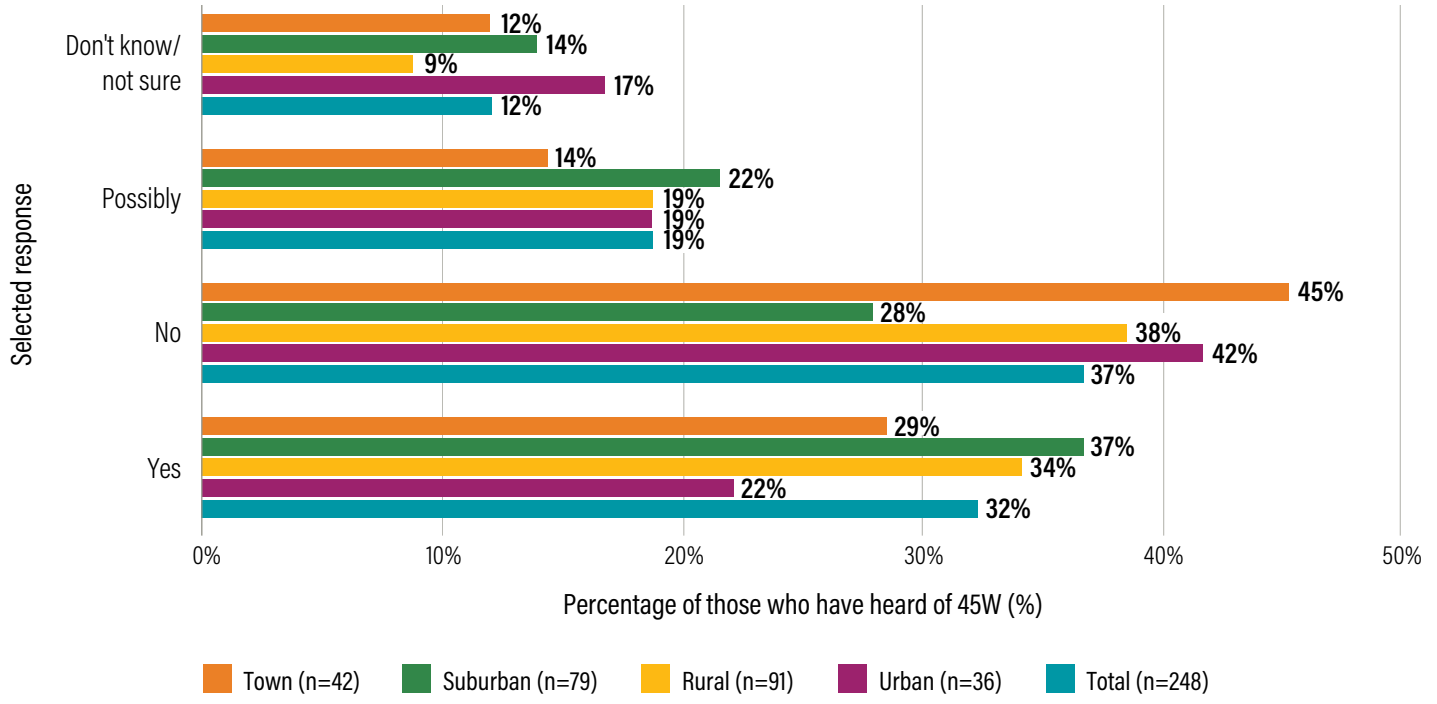
In the 2022 survey, 62 percent of districts in the sample were extremely, moderately, or somewhat familiar with ESB technology (Brown and Jackson 2023). In the 2023 survey, 88 percent of districts were aware of the CSBP while only 32 percent of districts were aware of the 45W tax credit.

In addition to sample size and representativeness, the difference between 62 percent awareness of ESB technology in 2022 and 88 percent awareness of the CSBP in 2023 may have to do with increased marketing for the CSBP program. Meanwhile, the relatively lower 45W awareness may indicate that the CSBP received better publicity, that districts were more likely to look for grant opportunities than tax rebates, or something simpler like the study was not done during tax season.

When it comes to CSBP awareness, there were few variations among district types. Northeastern (95 percent), non-priority (89 percent), and suburban (93 percent) districts were slightly more likely to have heard of it than the overall percentage of districts that were aware of it (88 percent).

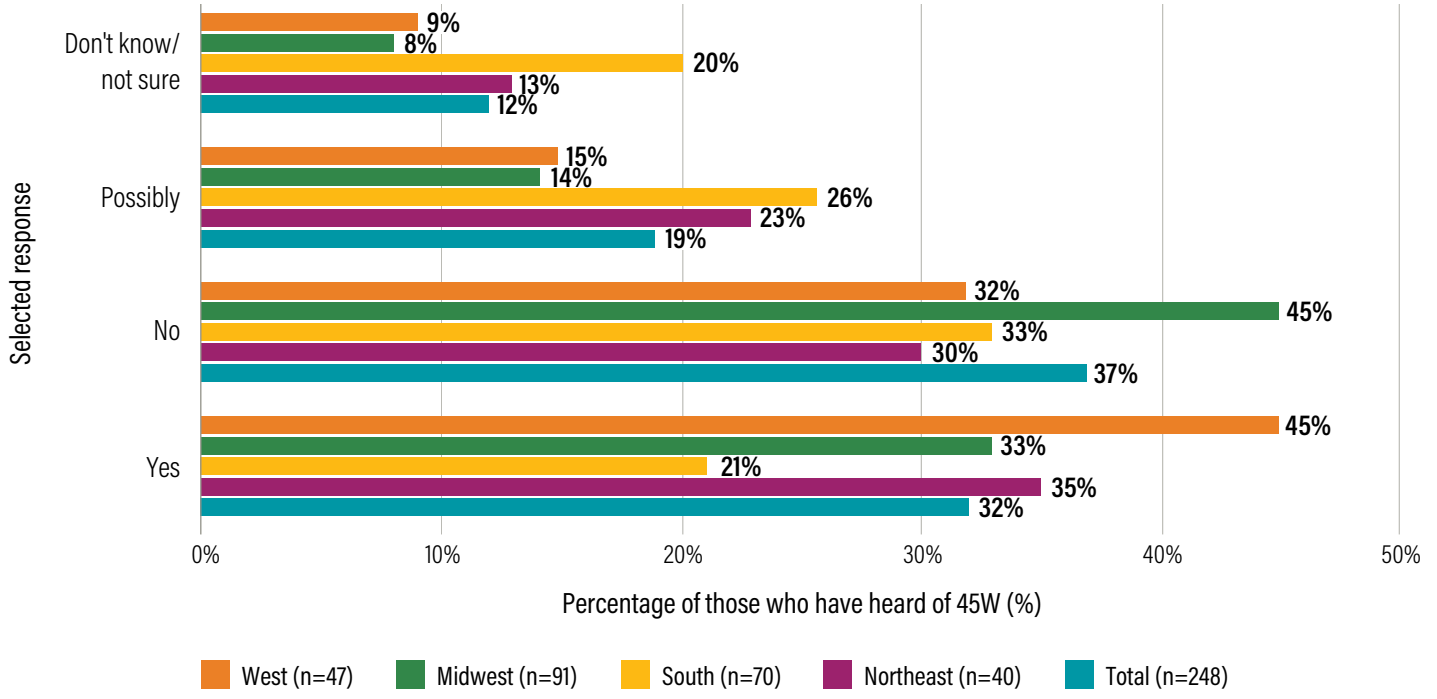
As for the 45W tax credit, priority and non-priority districts were just as likely to have heard of the tax credit. However, suburban and rural districts were more likely to have heard of the tax credit than town and urban districts. Districts in the West were by far the most likely to have heard of 45W while districts in the South were the least likely. These numbers indicate that there are geographical differences when it comes to 45W awareness, as shown in Figures 1 and 2 (see Appendix A for a full list of figures).

Figure 1 | **District awareness of 45W tax credit by locale**



Source: Authors.

Figure 2 | **District awareness of 45W tax credit by geography**



Source: Authors.

Interest in ESB programs

Despite 88 percent of districts being aware of the CSBP in the 2023 survey, only 42 percent reported interest in pursuing the program. This lack of interest from surveyed districts may come from the negative perceptions around ESBs, as seen in the "Understanding barriers to school bus electrification" section of this report, or from understaffing, making it difficult to finish a more involved application. In 2023, 83 percent of schools reported challenges hiring for non-teaching positions, which includes transportation (NCES 2023). On the flip side, while only 32 percent of districts had heard of 45W, 22 percent of districts reported interest in 45W, meaning the discrepancy between awareness and interest is lower for 45W.

When it came to being interested in the CSBP, priority districts were slightly more likely than non-priority districts to express interest in the program (46 versus 41 percent). Rural districts were the least likely locale to be interested in the CSBP with 29 percent of rural districts saying "no" compared with the average 42 percent. One barrier for rural districts could be the requirement to electrify between 15 and 50 buses per district given that rural districts often have smaller fleet sizes. Other barriers may include longer routes and less robust grid infrastructure.

As for 45W, priority districts and non-priority districts had similar levels of interest (25 versus 22 percent); however, urban districts were substantively more interested than the average across all locales (53 versus 22 percent). Similarly, the West and South were more interested than the Midwest and Northeast (36 and 33 percent versus 12 and 9 percent).

2023 focus group findings: Interest in funding and financing

The research team dug into the 2023 focus groups members' funding and financing preferences. Districts with ESBs had leveraged federal grants and state funding as the main methods for purchasing new buses. Districts with ESBs were also all very aware of the costs and trends in the school bus market, paying particular attention to maintenance costs. While none of the focus group members said that they had used financing mechanisms, one member said they would consider leasing an electric bus if grants stopped being available. For the focus group respondents without ESBs, some had applied to ESB funding opportunities but none of them were interested in financing options like green bank loans.

All districts shared concerns about how budget constraints can impact their ability to provide student transportation services. When making procurement decisions, they prioritize cost effectiveness. Some districts noted that things like student enrollment and ridership numbers play a major role in determining the transportation budget. Other respondents mentioned that not all districts are required to provide student transportation and that higher electric school bus costs could lead to service cuts for students, which would have major implications for equitable transportation.

Motivating factors and perceived benefits for pursuing school bus electrification

Survey findings on motivating factors and perceived benefits

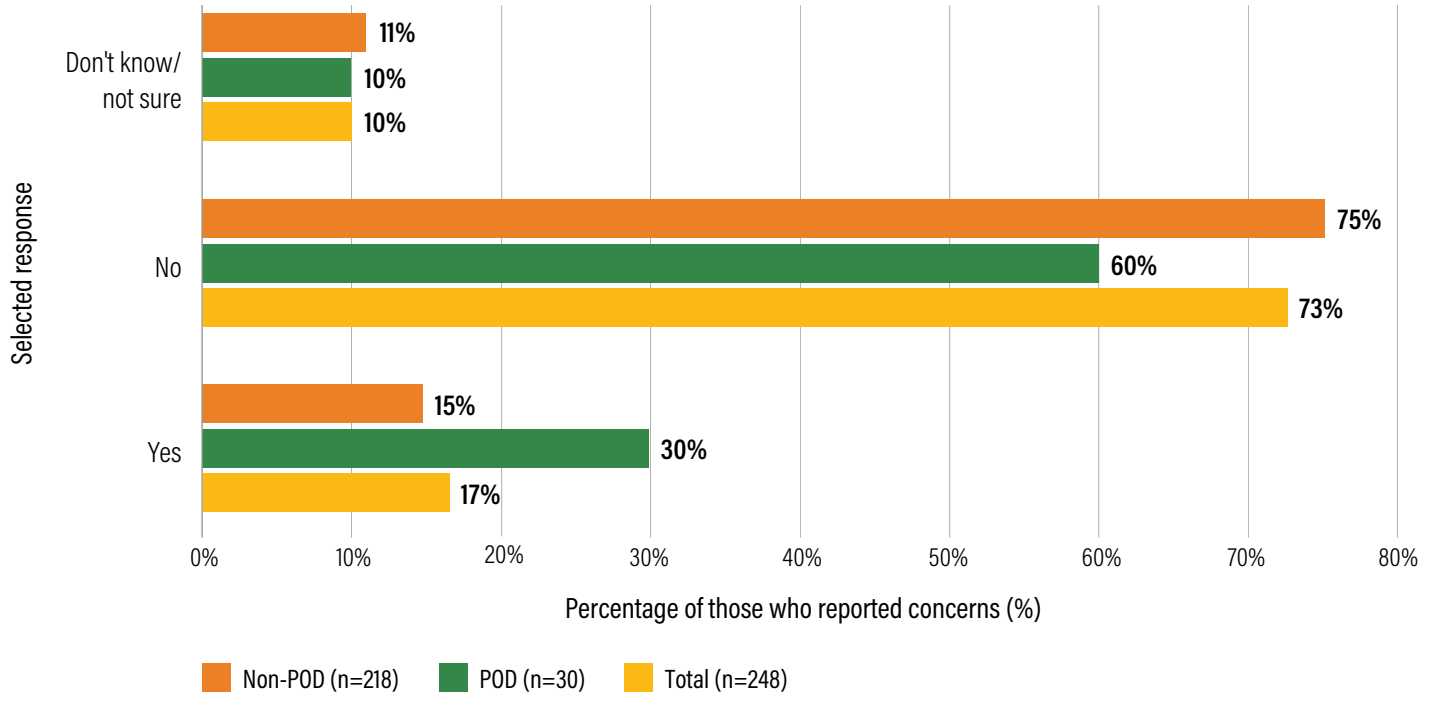
Understanding what motivates districts to electrify and what benefits they perceive in ESBs can help advocates and policymakers share more compelling ESB stories and help ensure ESBs meet district needs. In the 2022 survey, respondents who had ordered or were planning to order ESBs provided short answers summarizing their motivations including maintenance cost savings; state transition requirements; concerns over climate change; a desire to improve air quality; the appeal of quieter rides; an interest in new technology; the availability of funding; potential fuel cost savings; and the need for new buses. Overall, availability of funding, climate change, and air quality were the most common responses. When discussing air quality in their answers, respondents often linked air quality to improvements in the health of their students and communities (Brown and Jackson 2023).

In addition to understanding district motivators, the research team wanted to see if districts were hearing concerns about air quality from their communities. The team hypothesized that such concerns were spurring districts' interest in ESBs and sought to determine if projects centered on existing community needs found more success. Despite air quality being a key message across the ESB campaign and a critical motivator in 2022, with over 50 percent of surveyed districts selecting it as a benefit, in 2023, only 17 percent of respondents said that air quality concerns had been raised by anyone in their communities such as parents, other family members, students, colleagues, or other residents; 10 percent said they were not sure; and 73 percent said no concerns had been raised. Further research could be done to dig into how the communities raised these concerns with the districts and what kinds of forums districts provide for this type of community feedback.

As for comparing community concerns over air quality across districts, a higher percent of the 2023 priority districts compared with non-priority districts had heard air quality concerns from community members, as seen in Figure 3. Similarly, a higher percentage of urban and suburban respondents reported community concerns about air quality than respondents from rural and town districts, as seen in Figure 4 (see Appendix A for full list of figures).

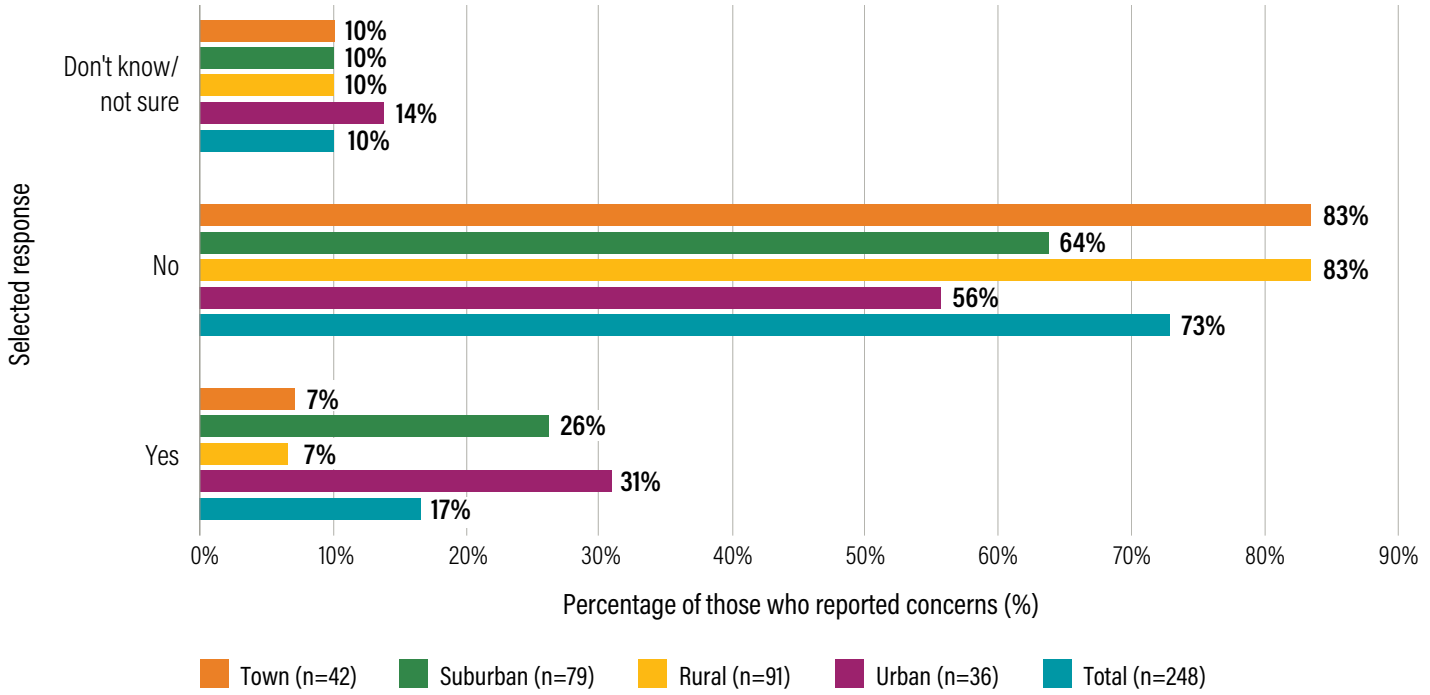
While only 17 percent of respondents were aware of air quality concerns being raised in their communities, 42 percent were interested in CSBP funding. This gap could indicate that school districts have other motivations for applying for the funding, that they are not in close communication with communities, or that communities have raised concerns about diesel buses unrelated to air quality. Additional research is needed to identify the differences between district motivation and community motivation when it comes to ESBs.

Figure 3 | **Air quality concerns raised by communities by priority district**



Note: POD = priority district.
Source: Authors.

Figure 4 | **Air quality concerns raised by communities by locale**



Source: Authors.

Focus group findings on ESB benefits and motivators

During the 2022 and 2023 focus groups, the team dug deeper into district motivations and asked participants what sparked their interest in ESBs. In 2022, participants mentioned the improved environment outside and inside the buses, their exposure to ESBs at conferences, and the opportunity to serve as a role model for nearby school districts. When describing the environment inside and outside the buses, they cited improved air quality, less noise pollution, and "better smells."

In 2023, focus group participants with ESBs mentioned being motivated by the availability of grants and the opportunity to pilot new technologies. They also noted that they were able to be early adopters due to support from local leaders and partners. Like the 2022 participants, 2023 focus group members were motivated by serving as role models and piloting new technologies.

While funding appeared to be the main motivator for district staff, the 2023 group reported tracking a number of benefits including carbon reduction, community perception, health benefits for students, and a reduction in operational costs (e.g., fuel). When discussing the benefits of ESBs, one participant shared an extremely positive effect of the quiet and clean air. They noted that one of their special needs teachers had reported that a student who had often struggled after bus rides was no longer agitated getting off the bus once they started riding electric.

Incorporation of equity principles

Survey findings: Equity

The ESB Initiative's goal, captured in its equity framework, is to center equity and intersectionality. Therefore, the survey asked respondents whether equity principles had been incorporated into their efforts to electrify school buses. In 2022, 15 percent of respondents said "yes," 18 percent responded "no," and 67 percent said that they did not know (Brown and Jackson 2023). Those who answered yes cited actions like operating vehicles in low-income neighborhoods and putting their first ESBs on routes at historically underserved schools.

In the 2023 survey, respondents were asked the same question. More than two-thirds of the respondents said that they had not and did not plan to incorporate equity into their electrification processes, as seen in Figure 5. The survey did not ask why; however, the focus group discussions may provide some clues.

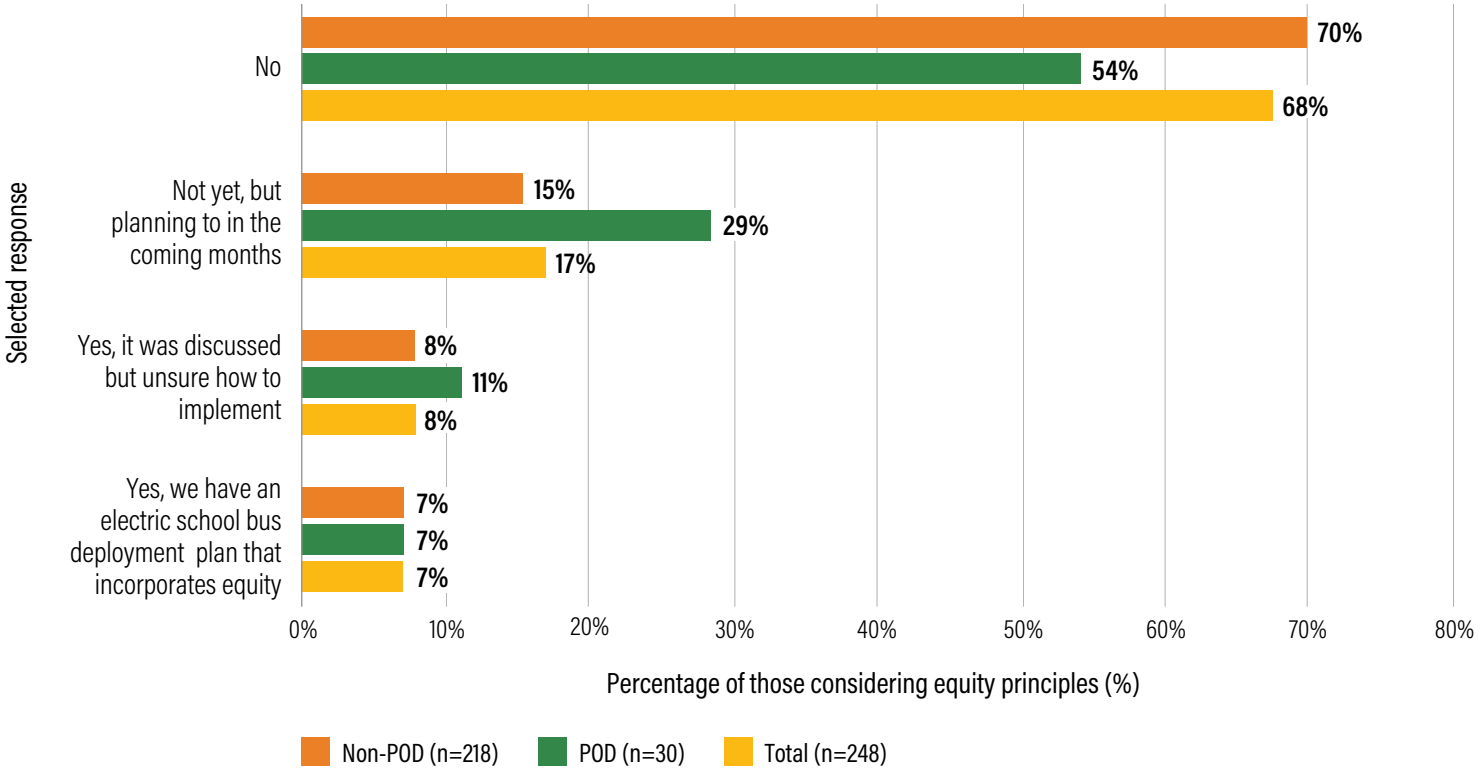
A higher portion of priority districts were planning to incorporate equity than non-priority districts (29 percent versus 15 percent). As for geography, Midwestern respondents (85 percent) were least likely to have plans to consider equity versus the average (68 percent). The West (18 percent) was the most likely to have already incorporated equity versus the average at 7 percent. Urban districts were by far the most likely to be thinking about equity principles with 57 percent of respondents thinking about this at some point (see Appendix A for details).

Focus group findings: Equity

In 2022, focus group participants were asked, "By a show of hands, how many of you have incorporated equity principles into your efforts to electrify school buses?" Only one of the four participants raised their hand. The participant noted that the district had done work around equity and inclusion and planned to use the first fleet of ESBs in low-income neighborhoods (Brown and Jackson 2023).

As for the respondents that were not incorporating equity principles, one participant stated that "equity is not a huge concern for [their] school district given that one part of town is not substantially different from the [other parts of town]. It's more street by street." Another participant agreed, stating that their municipality, or school district, is "very evenly spread in terms of income disparity," so they do not see it as a challenge to

Figure 5 | **Incorporating equity principles by priority district**



Note: POD = priority district.
Source: Authors.

be equitable given the demographics of the area. One participant added that equity has a negative political connotation in their area (Brown and Jackson 2023).

In 2023, focus group participants were asked what they thought about when they thought about equity in ESB deployments. Every focus group talked about equity in route planning and some mentioned distributional equity as it related to prioritizing routes in low-income areas.

Each focus group had their own unique dimensions of equity to add. Districts in the South talked about special considerations for students experiencing homelessness. The Midwest group discussed language barriers when sharing information with parents, providing services for students with disabilities, and including special routes for students who remain in school until they are 21 to attend a vocational program. In the Northeast, respondents talked about using a rotational system for bus replacements where they replace the oldest bus first and the newest bus last thus tackling equity from a bus driver's perspective as opposed to a student's perspective, and giving the drivers with the dirtiest buses the first crack at a new bus.

Districts with ESBs looked into distributing ESBs based on wealth (measured by income and Title I status) and prioritizing disadvantaged areas. A respondent whose district had only one ESB also mentioned that they had chosen to rotate the bus through different routes so that more students could experience it and surveyed their students to get a sense of what they knew about the ESB.

Overall, respondents are committed to serving students and to providing them with safe, efficient, and healthy transportation. While they place an emphasis on providing all students with equal access to their services, their responses suggested that they may not be aware of some of the intersectional barriers that impact different populations (Thomas 2022). For example, districts discussed income inequality and disability, but they were not as explicit in how they address racial, ethnic, and gender inequality or intersections among these categories. Focus group respondents also did not mention some of the potential impacts outside of the districts themselves, such as the impacts of depot siting on surrounding communities, critical mineral mining practices on Indigenous communities, or job loss and job creation in different communities (Moses and Brown 2022). Just as districts focused primarily on low-income students and students with disabilities and were less likely to mention race or gender, they also tended to focus on distributional equity versus procedural or structural equity (see Box ES-3).

Resources such as The Greenlining Institute's *Clean Mobility Equity: A Playbook* provide examples regarding how policymakers can design programs that make equity a central component (Creger et al. 2021). The playbook evaluated 21 state programs in California selected based on their equity commitments. After evaluating the programs on their effectiveness at delivering their outcomes, they selected 12 case studies that delivered consistently. From these case studies, the report provided recommendations around ensuring equity outcomes and around program administration, reemphasizing the importance of procedural equity. Their recommendations for equity included emphasizing anti-racist solutions, prioritizing multi-sector approaches, delivering intentional benefits, building community capacity, being community driven at every stage, and establishing paths toward wealth building. As it provided these recommendations, the report acknowledged that equity-first projects require both time and resources. While some districts may be equipped to make these changes themselves, state and federal grant programs requiring both procedural and distributional equity and providing resources to help districts fulfill those requirements will be key for making the school transportation sector more equitable.

The focus group responses provided a good example of a federal program making the school transportation sector more equitable. When discussing equity, many members mentioned having routes to serve students with disabilities. Prioritizing students with disabilities may be a primary equity focus for school transportation directors in part because these students are protected under the Individuals with Disabilities Education Act, which established a series of rights for disabled students in kindergarten through 12th grade, including regarding transportation (O'Neil et al. 2018). Without this policy, districts may not be incentivized to provide vital, specialized transportation for students with disabilities, who make up 15 percent of the population of US public schools (Schaeffer 2023).

While this law creates a good platform for including students with disabilities in school transportation, it is not enough to create a transportation system that works for students with disabilities. Even with laws, safety requirements, and safety training for bus monitors, not all students get the services they need. Whether from a lack of enforcement or a lack of training, some students with disabilities continue to be excluded from field trips; isolated in the backs of buses; or put in dangerous, sometimes deadly, situations due to improper harness placement (Shorter et al. 2024). These examples demonstrate that, while equity starts with good policy, these policies alone do not create an equitable transportation system. Shorter et al.'s (2024)

research on students with disabilities in school transportation makes a case for investing heavily in accessible ESBs to ensure all students have access to all the buses (i.e., distributional equity) and bringing disabled students into electrification conversations early and frequently (i.e., procedural equity).

Understanding barriers to school bus electrification

Survey findings: Barriers

With a baseline understanding of respondents' general interest in ESBs established, the surveys dove into better understanding the barriers to adoption. In 2022, respondents were asked to select all barriers that applied from a list of 15. Non-priority districts selected an average of 4.7 barriers, while priority districts selected an average of 3.0. The most frequently reported barriers for both groups were "infrastructure" and "cost" followed by "maintenance and operations" and "working with manufacturers" (Brown and Jackson 2023).

In 2023, respondents were also asked to select all barriers that applied from a list of 15 (see Appendix B for the full list). For 2023, the research team replaced COVID-19–related barriers with new options ("hesitation due to our climate" and "hesitation due to our long bus routes") based on concerns they had heard over the course of the year.

The top 2023 barriers were "building out infrastructure and working with utilities" at 53 percent, "hesitation due to our long bus routes" at 47 percent, "cannot currently afford electric school buses" at 41 percent, and "maintaining the bus" at 36 percent. These barriers align with those identified in 2022, with the exception of the hesitation due to long routes, which was not an option in 2022. On average, respondents selected only 3.3 barriers in 2023 with urban districts and priority districts selecting an average of 2.3 and 2.5 barriers, respectively.

Priority districts and non-priority districts showed a few key differences in their perceived barriers. Fewer priority districts (31 percent) than non-priority districts (49 percent) selected "hesitation due to our long bus routes." Fewer priority districts (23 percent) selected "cannot currently afford electric school buses" than non-priority districts (44 percent). The latter difference might indicate that prioritization in the CSBP and other programs is working as intended and priority districts are accessing funding.

The locale of a respondent also impacted the types of barriers they faced. Rural districts were more likely to select "hesitation due to our long bus routes" than urban districts (57 percent to 25 percent). More rural districts also reported concerns over "maintaining the bus" at 46 percent compared with an average of 36 percent across categories.

Finally, geography seemed to influence the types of barriers faced by districts. Districts in the West were less likely to select "cannot currently afford electric school buses" than the average (21 percent versus 41 percent). Meanwhile, the Northeast was less hesitant about longer bus routes (35 percent versus 47 percent) but more likely to be concerned about building out infrastructure and working with utilities (68 percent versus 53 percent). These differences, based on both locale and geography, may indicate that providing assistance by region or locale type could be useful (see Appendix A for figures).

Focus group findings: Barriers to electric school bus adoption and potential solutions

When asked about barriers, both 2022 and 2023 focus group participants mentioned cost, installing infrastructure, technician training, school bus contractors, driver shortages, range, limited land for infrastructure, and supply chain issues. According to one participant, cost is a huge barrier because "without the grants, none of [the participants] would be here [present at the meeting or interested in electric school buses]." Cost also posed a potential political concern if their district needed to raise taxes to cover the cost of an ESB compared with buses that use other fuels, such as propane.

When it comes to comparing technologies, 2022 participants mentioned propane and compressed natural gas (CNG) infrastructure as a pro. One participant stated, "propane or CNG have quick, temporary infrastructure you can bring in to get up and running. Since they are almost as clean, this makes them appealing."

In 2023, the perception that propane and CNG would be an easier transition when it came to infrastructure remained. In 2023, participants expressed concerns about the grid's capacity to accommodate new electric vehicles in addition to other demands. They felt that utilities would need to keep burning fossil fuels to generate new energy for the grid, saying it "doesn't add up."[2] They also expressed frustration around the perpetual "next best thing." One participant noted that advocates promoted CNG, then propane, now ESBs. The participant asked, "is this just the latest clean and green? If it's just a flash in the pan, we're the ones who are going to pay for that."

In 2022, the focus group mentioned contractors as an additional complication. Between 30 and 38 percent of school districts contract their school transportation services, meaning a private company owns and operates the school buses (First Student n.d.; NSTA n.d.). Although the school districts do pay for and work with the contractors, the contractors are independent companies, which adds an additional layer to the decision-making process. Focus group members discussed challenges associated with aligning procurement, grants and rebates, and other contractual timelines; convincing contractors that it is worthwhile to invest in ESBs; and investing in infrastructure to support the electrification of the school bus fleet without the certainty of long-term commitments by contractors. Some 2023 participants mentioned needing to convince their contractors of the benefits of ESBs.

Each of the focus groups in 2023 described unique barriers that seemed related to geography. One participant noted that charging buses on routes that covered over 100 miles would make it difficult to charge between runs. Districts in the Midwest had concerns about building out infrastructure for buses parked at drivers' homes. The West noted trouble getting warranties when outside of big cities, concerns about being a guinea pig on dirt roads, and lost investment due to renting property. The Northeast respondents voiced concerns about safety and about the grid not being able to keep up with demand.

Specific geographic concerns came up in 2022 as well. One participant shared concerns about the need to travel long distances through Tribal Nations, with some trips covering more than 200 miles. He also alluded to potential safety concerns, stating that drivers would have "no cell phone service, no help, [they're] in a different country," and that he "would be worried sending an electric bus [deep into Tribal Nations]." If it broke down at the wrong time, he said, the driver could not call for help given the lack of cell service and likely would not be near other services.

Despite these barriers, participants in both 2022 and 2023 offered a number of potential solutions. When the 2022 focus group was asked about effective ways to advance their knowledge of ESBs, participants said that webinars, workshops, reports, and access to experts for one-off questions would be helpful. They also provided the following suggestions:

- **Give advice on negotiating with contractors.** In response to the conversation about contractors, one participant cited the need for technical assistance or templates (or both) on how to negotiate with outside contractors. Participants stated that there was not clear guidance on how to manage the distribution of the cost savings from grants between the school district and the contractor. One participant suggested that "any route with an ESB should be 20 percent off [reduction in cost owed to a private contractor] if the school district got the grant in the first place" (Brown and Jackson 2023).
- **Help districts calculate the total cost of ownership.** Participants in 2022 were also interested in tools that could help school districts understand the total cost of ownership (TCO) and how much they would save by buying ESBs. Two participants stated that this type of tool would help convince decision-makers and ensure that all parties would better understand their finances and the costs and savings associated with ownership (Brown and Jackson 2023). In response, the ESB Initiative created a TCO calculator (ESB Initiative 2023).
- **Connect with districts that are already electrifying.** Finally, the 2022 participants asked for more access to hands-on experience with ESBs. One participant noted the importance of being able to find someone and say, "Hey! Please tell me more about this [electric school] bus" (Brown and Jackson 2023).
- **Allow for some overlap between electric bus delivery and diesel bus scrappage.** The 2023 focus groups added a new recommendation as well: keeping the old buses as backups during the deployment of the ESBs just in case.

Unpacking barriers

While all of the concerns the districts raised are important to address given that districts report experiencing them, some of these barriers apply to more districts than others and some of them may stem from misinformation. Barriers such as maintenance, the complexity of infrastructure, and high upfront cost are key barriers impacting many districts. Questions about range and overall affordability vary greatly by district. Meanwhile, while districts were concerned about overall grid-readiness and about increased greenhouse gas (GHG) emissions, research indicates that these concerns are largely misconceptions. A 2022 study found that the grids nationwide will be able to meet demand for ESBs, particularly if districts pursue smart charging options, and a WRI analysis showed that ESBs have the lowest GHG emissions across their life cycle compared with diesel and propane buses (Horrox et al. 2022; ESB Initiative 2022; Todd and Zepka 2023). Table 2 dives further into each of the barriers that school districts brought up through the focus groups and survey.

Table 2 | **A breakdown of concerns raised during the survey and focus groups**

CONCERNS RAISED BY DISTRICTS	FACTORS CONTRIBUTING TO THE BARRIER	SOLUTIONS TO SHARE WITH DISTRICTS AND THEIR PARTNERS IN ELECTRIFICATION
Cost – Districts stated that cost was their top barrier and that they would not be able to afford ESBs without grants.	▪ The upfront purchase price for an electric school bus is currently about 3 times higher than that for its fossil fuel–burning counterparts. ▪ However, when funding and savings are considered, the total cost of owning an ESB can be hundreds of thousands of dollars less than that of a diesel-burning bus.[a]	▪ Advocates can help districts estimate lifetime savings and show them that they should expect to see over $100,000 in lifetime fuel and maintenance savings.[b] ▪ Until ESBs reach TCO parity, which they're projected to do by the end of the decade, advocates can encourage districts to use grants and tax rebates to lower the upfront price.[c] ▪ Advocates could also share the financial risks associated with buying another round of diesel-, natural gas–, and propane-burning school buses, which all pose the risk of becoming a stranded asset for school districts, as municipalities roll out zero-emission requirements.
Infrastructure installation – Districts expressed concerns over complex infrastructure installation.	▪ Installing electric vehicle charging infrastructure is a newer, more complex task for school districts. They're not just buying a new bus, they're undertaking a technological transition. ▪ To complete this transition, districts will need to make decisions about types of chargers and software, charging management, electric utility rates, construction timelines, and site power.	▪ Advocates can help districts partner with utilities early and communicate often to overcome knowledge gaps.[d] ▪ They can also work with districts to facilitate communication with their electrician, dealer, manufacturer, software company, and other third-party partners, which can supplement utility guidance on charging. ▪ Districts will also need to work with the ESB manufacturer to triple check that the chargers are compatible with the bus.[e] ▪ Advocates and utilities can help districts plan for future uses such as the potential to switch to bidirectional charging or install additional chargers.
Maintenance – Districts rated maintenance as a key barrier on the survey.	▪ There is a national shortage of automotive mechanics.[f] ▪ There is a shortage of convenient and affordable training options for diesel mechanics looking to go electric.[g] ▪ There is limited standardization for ESB mechanic training.[h]	▪ Advocates and districts may work with technical schools, bus manufacturers, dealers, and others to create more standardized training programs. ▪ Trainers can reference the electric school bus training standards to inform the creation of their curriculums.[i] ▪ Advocates or districts could partner with local community colleges and technical programs to train technicians on electric vehicle technology and ensure equal opportunity for women, BIPOC communities, and people with disabilities. ▪ Manufacturers and dealers can work with districts to implement staff training and a bus maintenance strategy that meets the specific needs of their facilities. ▪ Districts can look for publicly available electric vehicle training programs to provide training to new or existing staff, outside of training supplied by the manufacturer or dealer. The Electric School Bus Initiative has a database to help find these trainings.[j]
Range – Respondents believed range would be a barrier to their operations.	▪ While one study on route length found the average route was 32 miles, some districts have routes over 100 miles.[k] ▪ Rural school districts often have longer routes. ▪ Charging networks aren't yet fully built out in many areas.	▪ Advocates could help districts evaluate route requirements and create a plan for midday charging with Level 2 or Level 3 chargers as needed to achieve service or look at shorter routes first as an option for electrification. ▪ Advocates can work with districts to invest in driver training up-front to ensure maximum range efficiency. ▪ Advocates can help establish cooperative charging agreements with nearby districts to allow for longer trips. ▪ Most districts should not be concerned about range and should check their bus specifications—modern electric school buses have nameplate ranges of up to 300 miles on a single charge.[l]

CONCERNS RAISED BY DISTRICTS	FACTORS CONTRIBUTING TO THE BARRIER	SOLUTIONS TO SHARE WITH DISTRICTS AND THEIR PARTNERS IN ELECTRIFICATION
Grid-readiness – Some respondents believed that the grid will not be able to support a full transition.	▪ Despite some variation across depots, the grids nationwide will be able to meet demand for ESBs, particularly if districts pursue smart charging options.[m] ▪ Even so, districts should be aware that grid capacity varies by location and should work with their utilities to determine the appropriate power level and best siting for their charging depots.	▪ Advocates can help connect utilities and districts so that they understand available grid capacity, site charging depots, and choose chargers in a way that avoids overtaxing the grid.[o] ▪ Utilities and advocates can work with districts to explain how pursuing smart charging, where software controls charging time to reduce the impact on the grid and the cost, or vehicle-to-grid, where energy stored in bus batteries can later be discharged onto the grid or the site, gives ESBs the potential to expand grid capacity by 61.5 GWh if planned and implemented properly. That is enough to power 200,000 American homes for a week.[p] ▪ Advocates can ask districts and utilities to prioritize flexible connections and automated load management, which can also help with capacity by utilizing existing connections and capacity but avoid grid and site peaks.
GHG emissions – Some respondents believed that ESB emissions were just as bad as diesel buses over their life cycle.	▪ Life-cycle GHG emissions are not a concern for ESBs. ESBs have the lowest GHG emissions across their life cycle.[q] On average, ESBs are responsible for half the life-cycle GHG emissions of propane-burning and diesel-burning school buses.	▪ Advocates should provide additional education for students, teachers, and administrators to help districts understand the net climate benefits of ESBs. ▪ Advocates could highlight that as the electric grid transitions to renewable energy sources, the GHG emissions from ESBs will continue to decrease over time—which is not true for propane and other fossil fuel–burning school buses.

Notes: This table is based on internal WRI research, much of which is cited in the table, and conversations with experts in the field. In the table, "advocates" refers to anyone, including nonprofits, policymakers, and district employees, interested in furthering school bus electrification. ESB = electric school bus; TCO = total cost of ownership; BIPOC = Black, Indigenous, and people of color; GWh = gigawatt-hour; GHG = greenhouse gas.

Sources: [a] Curran 2023; [b] Curran 2023; [c] Curran 2023; [d] Stafford and Henderson 2024; [e] Stafford and Henderson 2024; [f] Ly et al. 2023; [g] Ly et al. 2023; [h] Ly et al. 2023; [i] Ly et al. 2024; [j] Winn et al. 2024; [k] Duran and Walkowicz 2013; [l] Wang et al. 2024; [m] Horrox et al. 2022; [n] Budzynski et al. 2023; [o] Yang et al. 2024; [p] Horrox et al. 2022; [q] ESBI 2022.

Discussion

The purpose of this study was to document existing challenges and opportunities that school districts encounter in procuring, operating, and maintaining ESBs and to identify ways that WRI and other organizations can strengthen and tailor their assistance for priority districts and for different geographic regions and locales.

One striking finding is that overall awareness of the CSBP, and by extension ESBs, appeared to be high among all respondents with little variation among district types. However, awareness of the CSBP did not equate to interest in it, with particularly low interest from rural respondents. Awareness of 45W was lower than awareness of the CSBP (33 percent compared with 88 percent), but respondents that were aware of 45W tended to be interested in it.

When asked why they were interested in ESBs, respondents with ESBs in their fleets cited access to funding, being able to act as a role model, seeing air quality and health benefits for kids, interest in carbon reduction, and the potential decrease in operational costs.

Despite many respondents seeing the benefits of ESBs, as evidenced by the 42 percent of respondents being interested in the CSBP, respondents continued to face or perceive barriers to electrification. In 2022 and 2023, cost, maintenance, and infrastructure were three of the top barriers to ESB adoption. When it came to cost, the focus group participants went as far as to say that without grants, electrification would not be possible. The 2023 survey gave respondents the option to select longer routes as a barrier and this came in second place, beating out both cost and bus maintenance. While these concerns should be taken seriously, the focus group analysis indicated that some of these issues may come from misconceptions about ESBs including those related to capacity, reliability, range, overall emissions, and cost.

Most respondents thinking of going electric, or doing it, said they were either not considering equity or looking only at distributional equity. Those that were considering distributional equity generally talked about one group at a time, such as prioritizing routes with low-income students, supporting students with disabilities, or prioritizing routes for their most senior bus drivers. Most respondents did not describe making intersectional considerations or using dimensions of equity

such as environment, gender, race, ethnicity, geography, health, income, language, and mobility. Respondents did not spend much time discussing procedural equity either.

The 2023 survey found that rural districts, compared with urban ones, tended to be less interested in the CSBP, less aware of community concerns over air quality, and more worried about route length. Urban districts were more interested in 45W than rural districts, more aware of air quality concerns from the community, and more likely to have already incorporated equity principles.

Districts in the West were more likely to have heard of 45W, more likely to be interested in the CSBP, more likely to have incorporated equity, and less likely to say they could not afford ESBs, compared with other geographies. Districts in the South were also more likely to be interested in both the CSBP and 45W. Western respondents were less likely to select "cannot currently afford electric school buses," which might indicate that they have more funding opportunities available. For context, 51 percent of the districts categorized as West are from California, and of the 342 state funding programs available in the United States, 42 are in California (Levinson and Achury 2024). The combination of a high overall concern for cost compared with low concern over cost in districts with more funding available could indicate that the state and federal funding opportunities are making these buses affordable.

Just as in the 2022 assessment, there were not many differences between priority districts and non-priority districts in 2023. A higher percent of priority districts reported hearing community concerns about air quality, and a lower percentage of priority districts selected "cannot currently afford electric school buses" as a barrier. They selected fewer barriers overall with an average of 2.3 barriers per priority district compared with the average 3.3.

Recommendations

These recommendations are meant to help policymakers, advocates for school bus electrification, utilities, financial institutions, and others interested in helping more school districts achieve equitable ESB adoption:

- **Increase awareness and track outreach.** While 88 percent of respondents were aware of the CSBP, only 32 percent knew about the 45W tax credit. This difference may indicate that districts know of some but not all funding opportunities and advocates should conduct more outreach. In addition to conducting outreach, stakeholders should track outreach to help refine messaging and clarify which districts are receiving ESB information.
- **Answer common questions.** The focus group findings indicate that more work could be done to address common questions and concerns around ESBs (as seen in Table 2). For example, they could campaign to decrease range anxiety, provide advice on infrastructure installment, share advice from other districts, and expand ride-and-drive events.
- **Motivate districts.** Given that districts reported being motivated by funding opportunities, health benefits from improved air quality, and climate impacts, messaging around these topics could be used to motivate other districts. Future research could be done around how the health and air quality benefits relate to community interests. Focus group respondents also felt motivated by a desire to pilot new technology and act as role models for their regions. When talking to districts, stakeholders can highlight the potential to be a model school, which may be persuasive to district staff.
- **Support government programs that contain requirements for both equity and electrification.** While government electrification requirements are not always popular, they remained top motivators for districts planning to electrify. Similarly, programs that require and fund both procedural and distributional equity yield more equitable outcomes. States interested in improving their air quality, reducing fleet emissions, and creating more equitable school transportation could consider pursuing policies outlined in the Alliance for Electric School Buses' policy playbook (Chacon et al. 2024).
- **Reduce costs.** Funding alone cannot solve the cost problem. The Electric School Bus Initiative's TCO model currently shows that without funding, ESBs are about $100,000 more expensive over their lifetime than diesel buses, including fuel and maintenance savings, due largely to the ESBs' much higher upfront cost (Curran 2023). With a CSBP rebate, the TCO for an ESB is about $208,000 compared with $414,000 for diesel. While ESBs are projected to reach total lifetime cost parity with diesel, including charging infrastructure, by 2029, districts need help with the upfront cost in the meantime (Levinson and Curran 2022). Based on

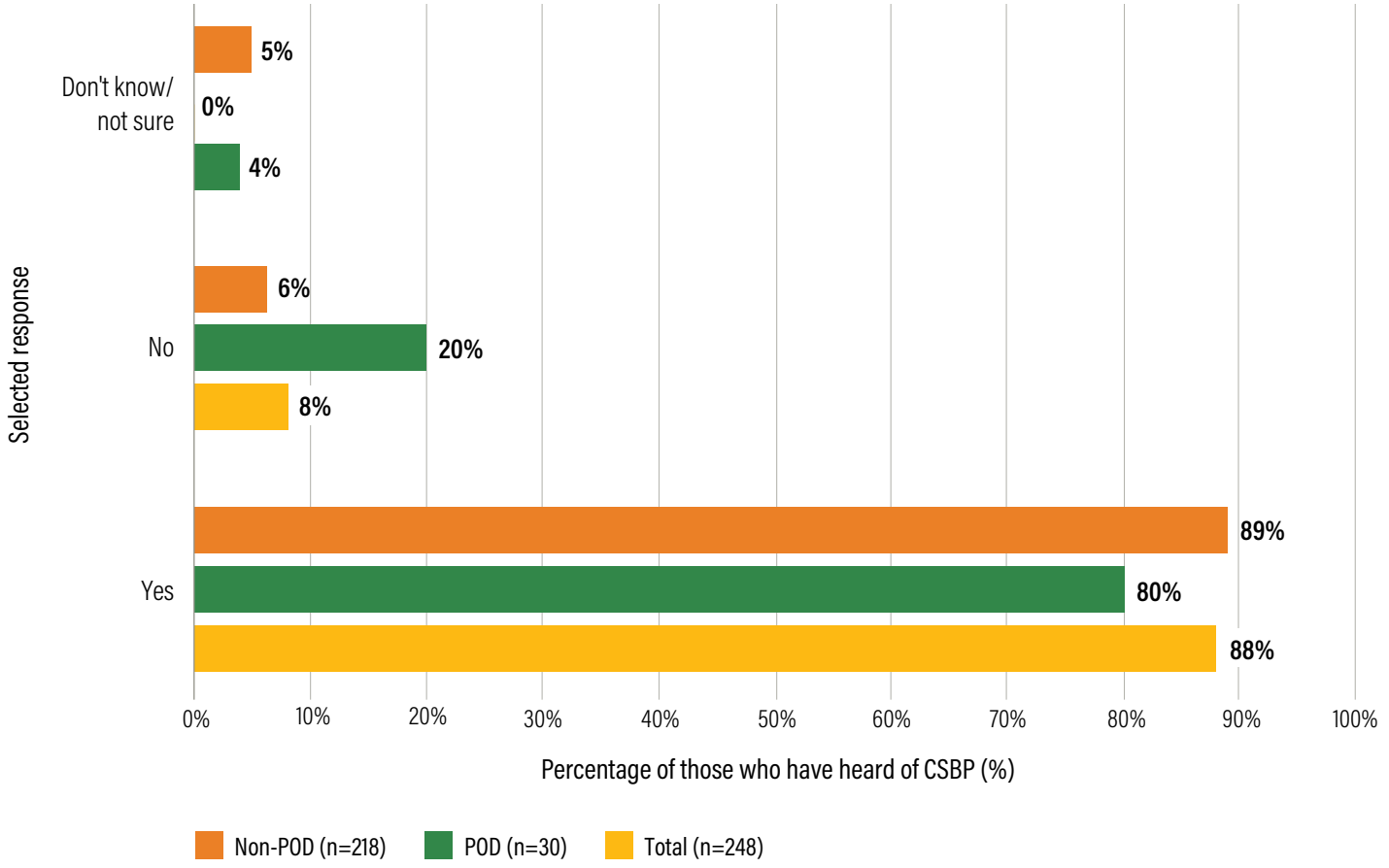
the survey responses, districts appear to be relatively unaware of and uninterested in financing options; however, sharing more of these options could increase perceived affordability.

- **Make infrastructure more approachable.** Building out charging infrastructure was another commonly mentioned barrier to ESB adoption. The Electric School Bus Initiative captures some of this advice in a blog on eight charging tips (see Stafford and Henderson 2024). ESB champions and policymakers could begin to make infrastructure more approachable first by defining what "approachable" means to different staff members and different districts, taking into account ability, social context, language, and culture. Next, utilities and advocates can come together with utilities to give clear guidance during installation and help districts understand where their energy is coming from.
- **Create resources for school districts about how to work with contractors.** The focus groups indicated that school districts working with contractors may face unique challenges when deciding if they should electrify and when applying for grants. ESB advocates can create resources with guidance for school districts on how to negotiate with contractors on timelines and cost savings.
- **Improve operations and train mechanics.** The lack of mechanics and perceptions around reliability and maintenance were cited as reasons for not considering ESBs. ESB proponents could work to address these concerns by helping school districts incorporate workforce training into their requests for proposals, connecting districts with mechanics in the area, encouraging standardized training for maintenance workers to expand training program availability, helping original equipment manufacturers reduce routine bus issues, and connecting districts with nearby districts that have successfully electrified for hands-on advice. The Electric School Bus Initiative's Technician Training Database could help districts find a training program that works for them (Winn et al. 2024).
- **Increase education around procedural equity.** ESB advocates could help districts expand their equity work by encouraging them to focus on procedural equity by including a diverse group of students, drivers, parents, mechanics, and other community members in their planning processes. As districts begin their projects, they can look to these communities or to existing frameworks for ideas on how to ensure that ESBs equitably distribute their benefits, from improving air quality and creating green jobs to enhancing services for students with disabilities by investing in ESBs with wheelchair lifts.
- **Encourage districts to incorporate distributional equity outside of route planning.** School districts looking to center equity in their projects could think about investing in co-benefits for ESBs, such as providing backup power in emergency situations; working with manufacturers and community colleges to expand access to green jobs in historically marginalized communities; and buying from manufacturers that prioritize sustainability across the entire supply chain, from their mining practices to their battery disposal plans, thus reducing climate and social impacts on overburdened communities (Kothari 2023; Ly et al. 2023; Rogerson and Narayan 2020).
- **Connect districts interested in electrification with those going through the process.** Focus group respondents expressed the importance of being able to see ESBs firsthand and to talk with experts and peers who were going through the implementation process. Facilitating connections among these districts, both online and in person, will be key. The Electric School Bus Initiative's data dashboard can help districts identify districts with electric buses to reach out to (Lazer and Freehafer 2024).
- **Consider a district's locale, geography, and priority status when providing technical assistance.** Overall, the study found that districts have different levels of knowledge and motivation around electrification and are experiencing distinct barriers to pursuing electrification. Based on these differences, creating regional cohorts or urban and rural cohorts could help districts share lessons learned, overcome their unique barriers, and identify funding opportunities. Advocates may also want to be cognizant of a district's locale and geography to help the district preempt barriers. For example, when working with rural districts, technical assistance providers may spend more time solving challenges related to route length, but when working with urban districts they may spend more time discussing air quality benefits and routing based on air quality improvements.

Appendix A. Survey analysis by district category

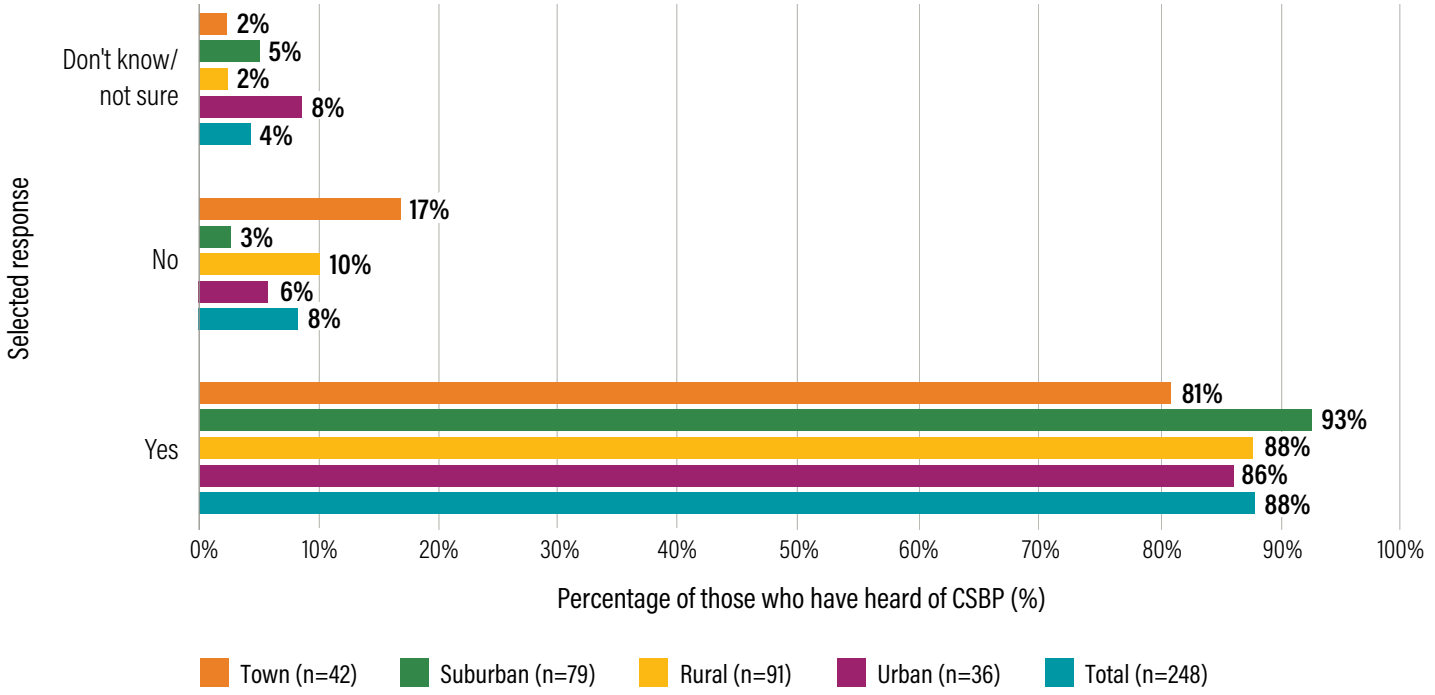
Figures A-1 to A-13 depict the 2023 survey responses encapsulating districts' awareness of and interest in ESBs and their associated funding programs.

Figure A-1 | **Priority district awareness of the Clean School Bus Program**



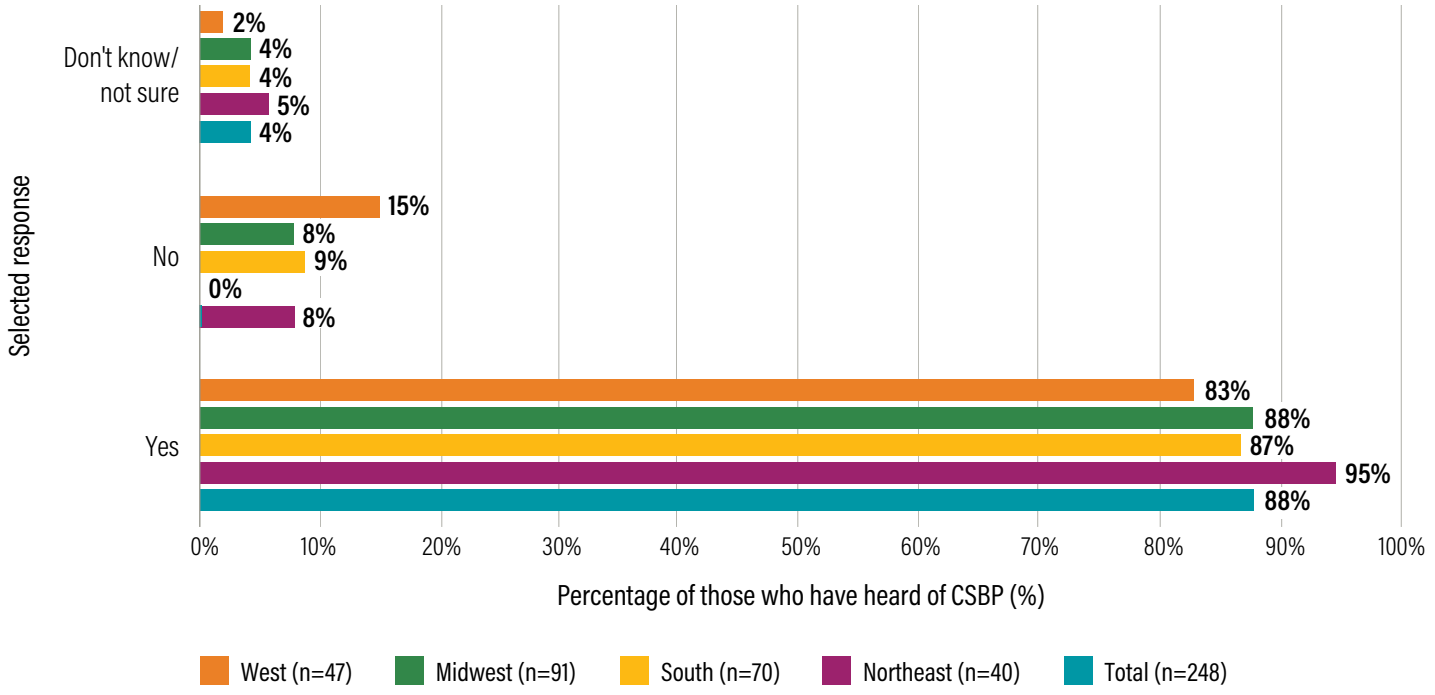
Note: POD = priority district; CSBP = Clean School Bus Program.
Source: Authors.

Figure A-2 | **District awareness by locale of the Clean School Bus Program**



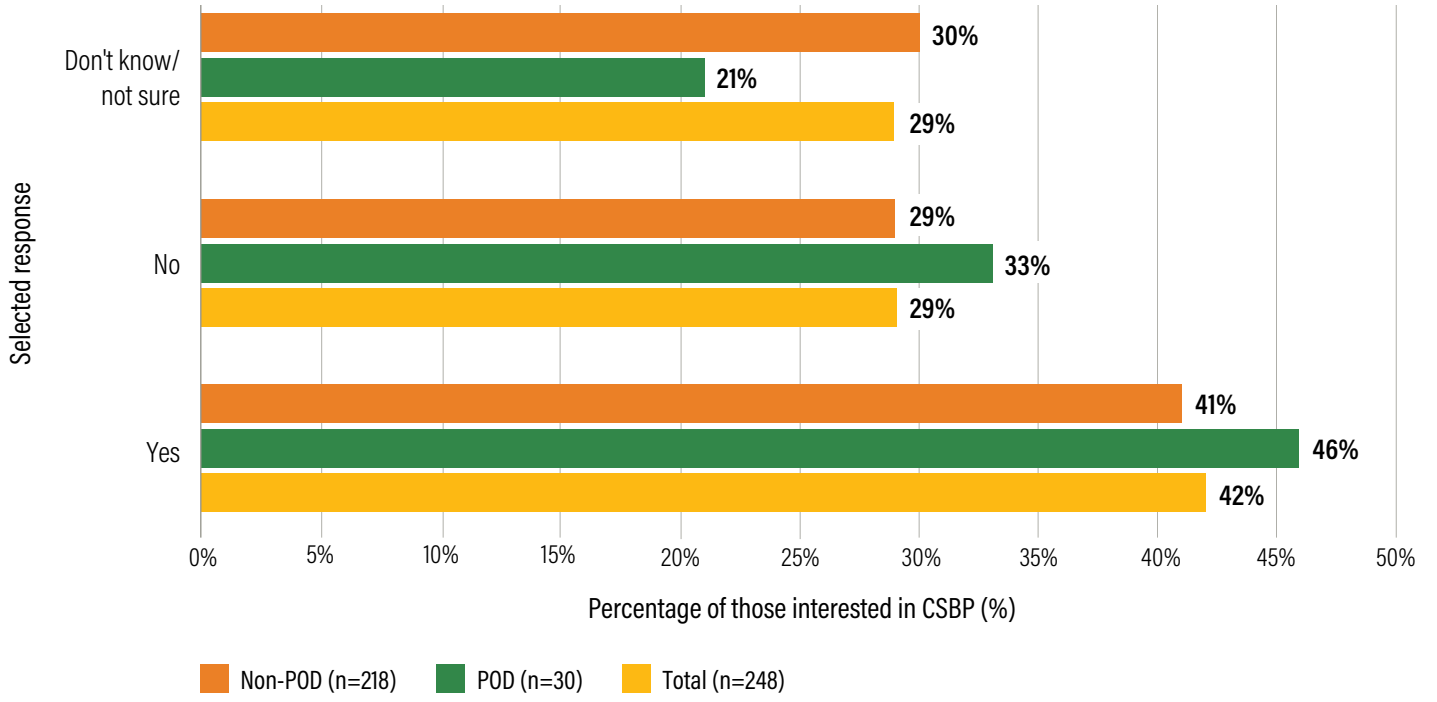
Note: CSBP = Clean School Bus Program.
Source: Authors.

Figure A-3 | **District awareness by geography of the Clean School Bus Program**



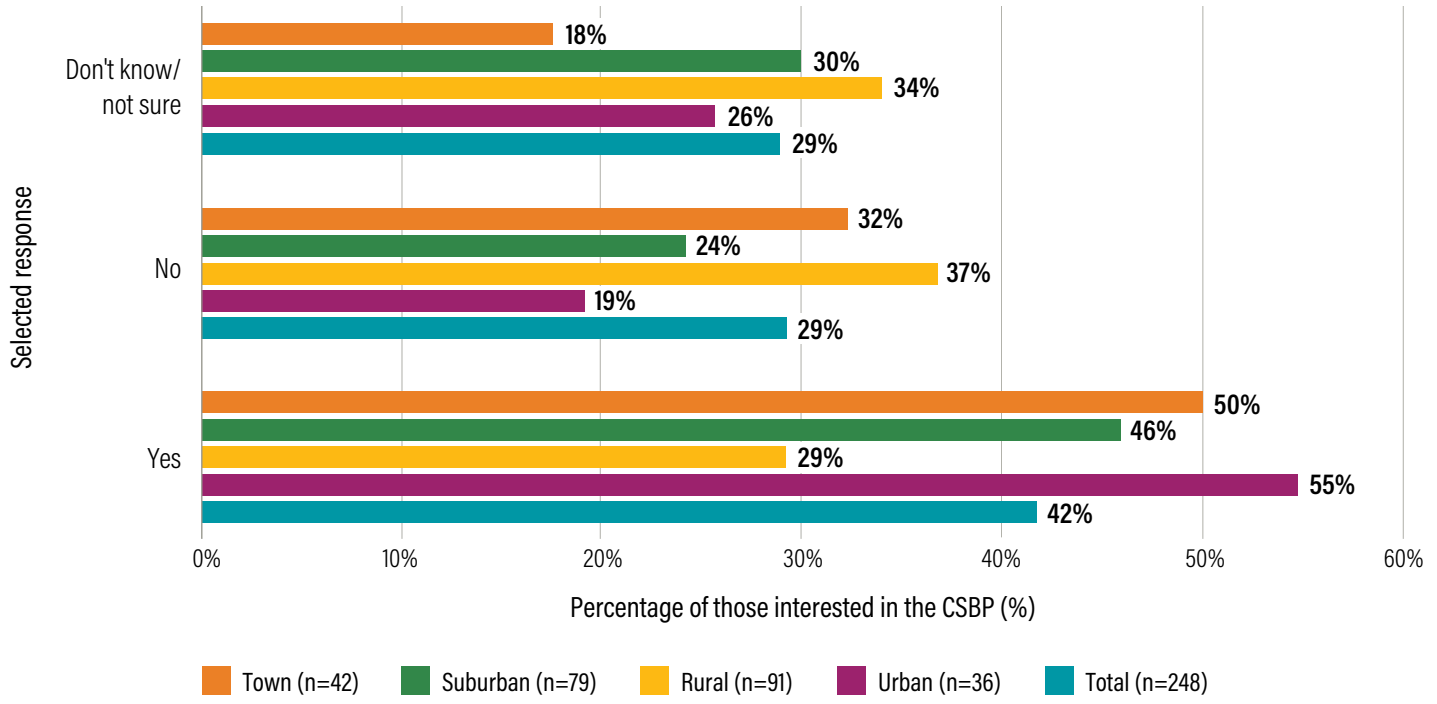
Note: CSBP = Clean School Bus Program.
Source: Authors.

Figure A-4 | **Priority district interest in Clean School Bus Program**



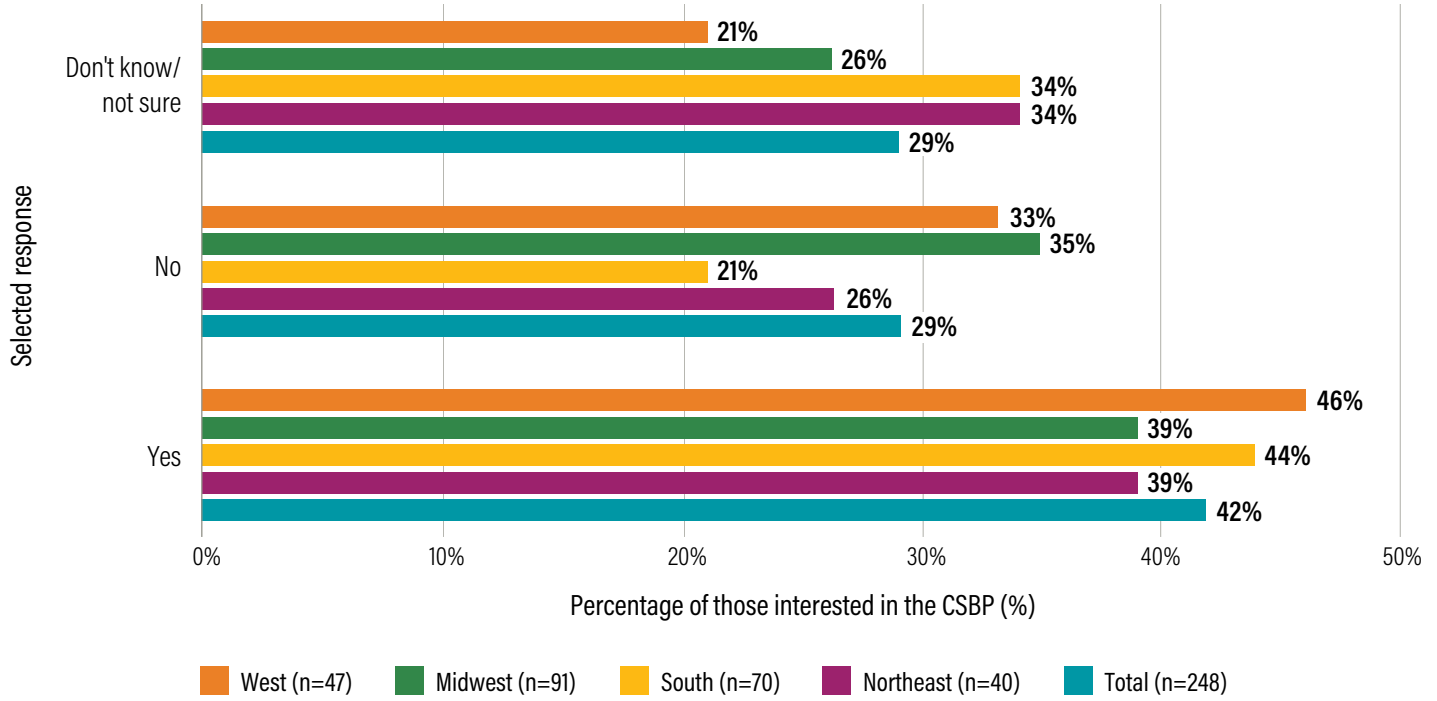
Note: POD = priority district; CSBP = Clean School Bus Program.
Source: Authors.

Figure A-5 | **District interest in Clean School Bus Program by locale**



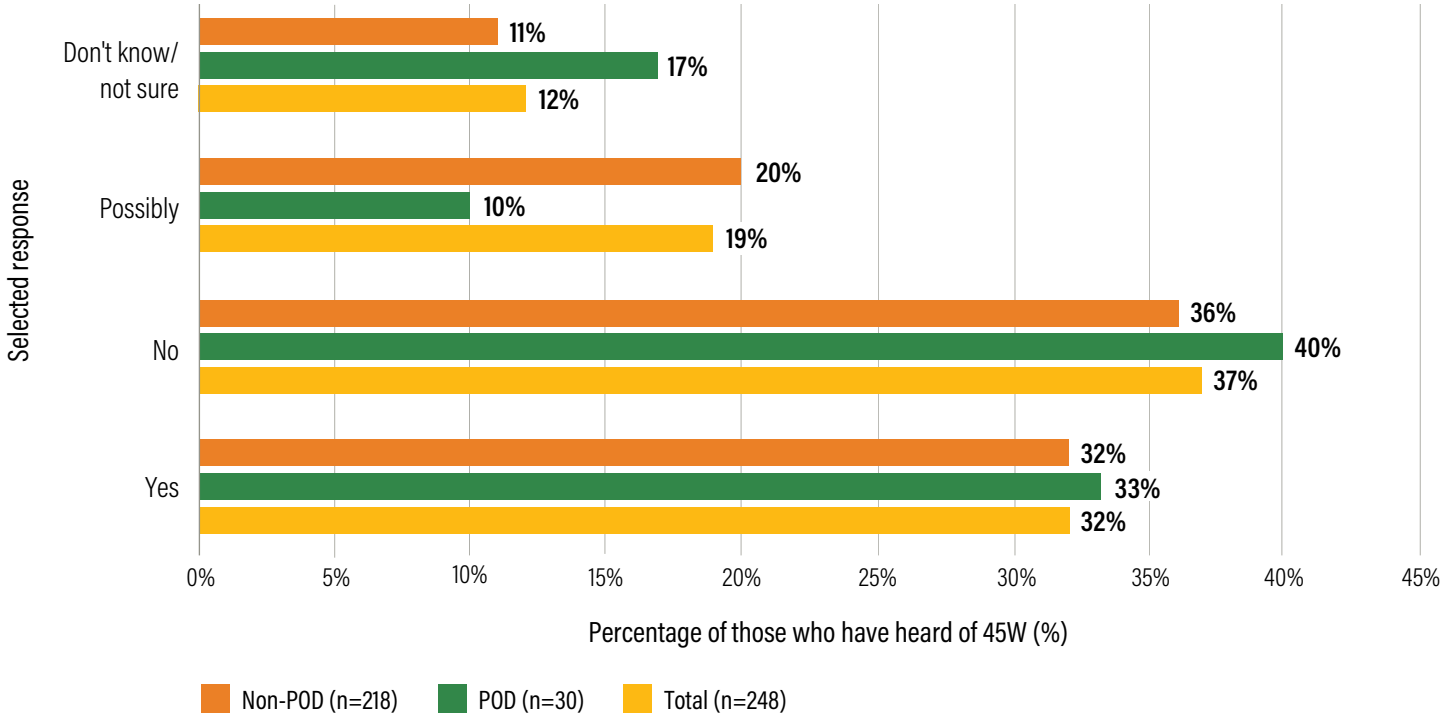
Note: CSBP = Clean School Bus Program.
Source: Authors.

Figure A-6 | **District interest in Clean School Bus Program by geography**



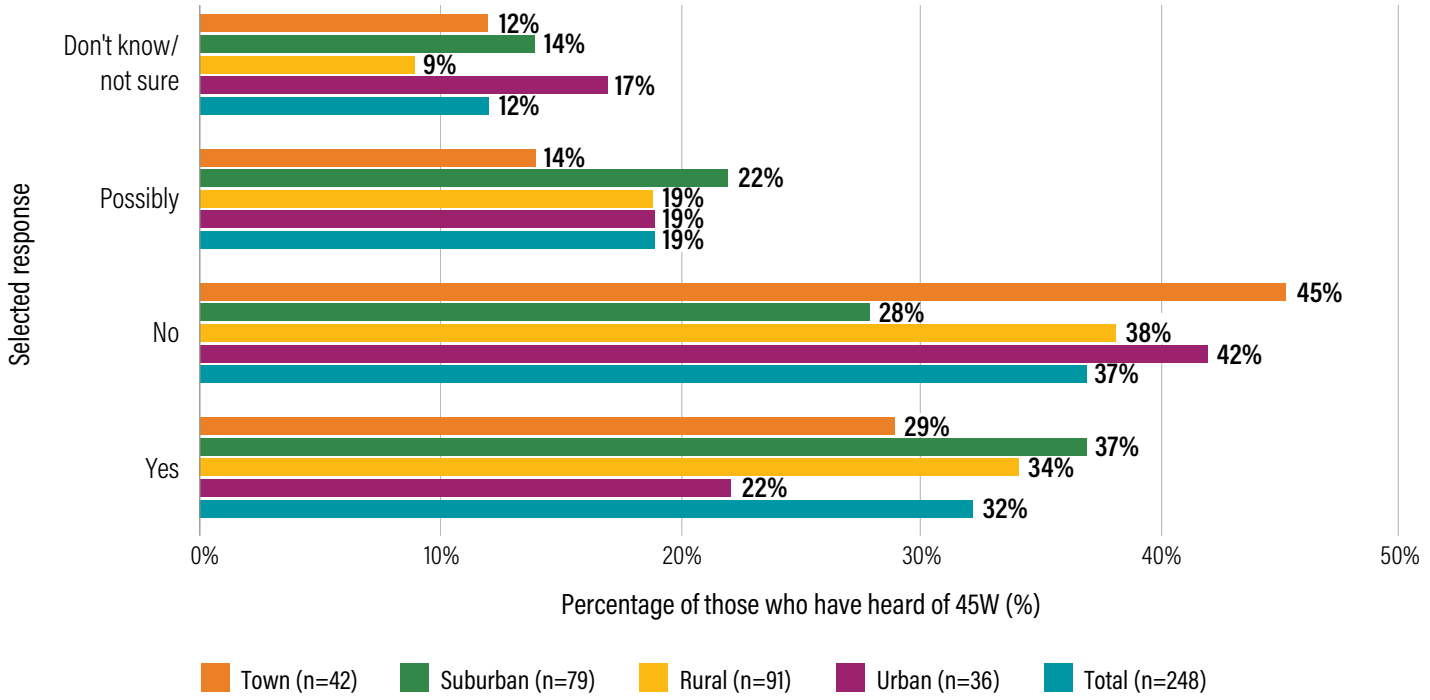
Note: CSBP = Clean School Bus Program.
Source: Authors.

Figure A-7 | **Priority district awareness of 45W**



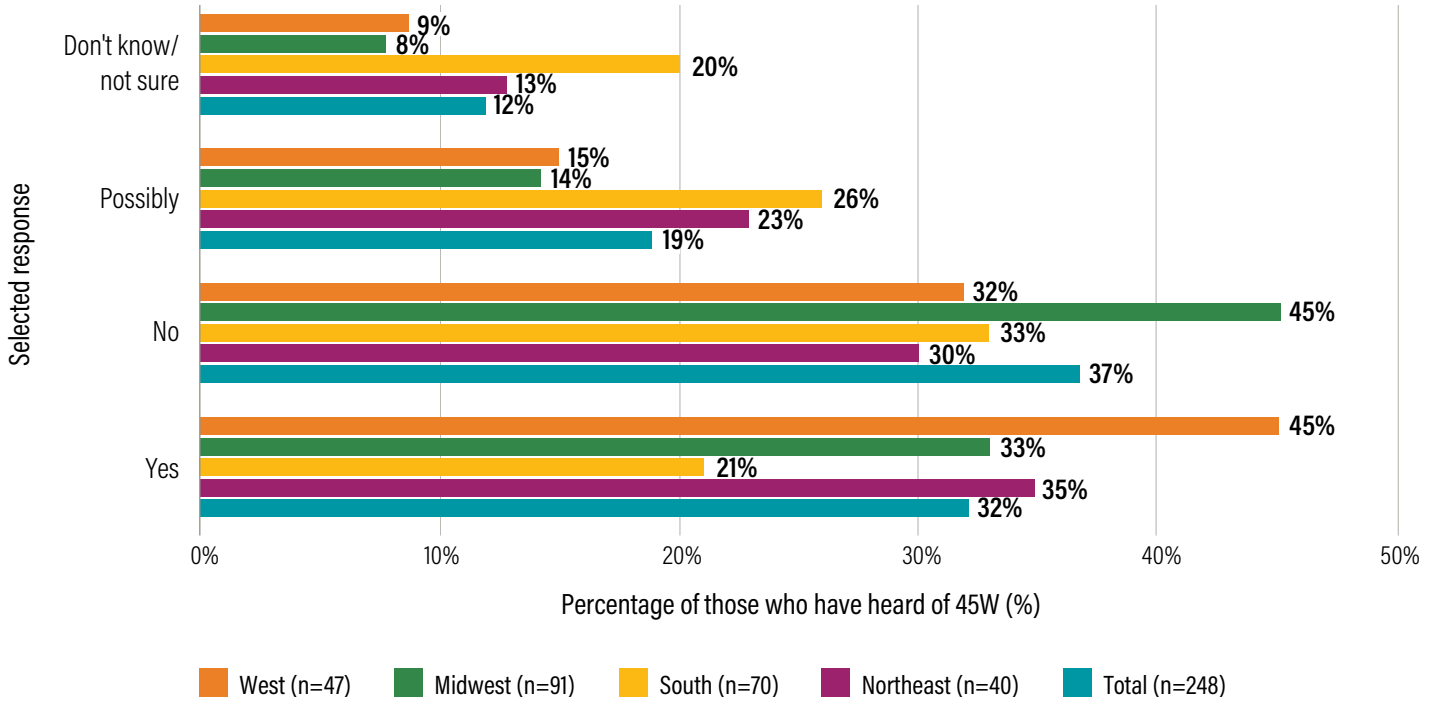
Note: POD = priority district.
Source: Authors.

Figure A-8 | **District awareness of 45W by locale**



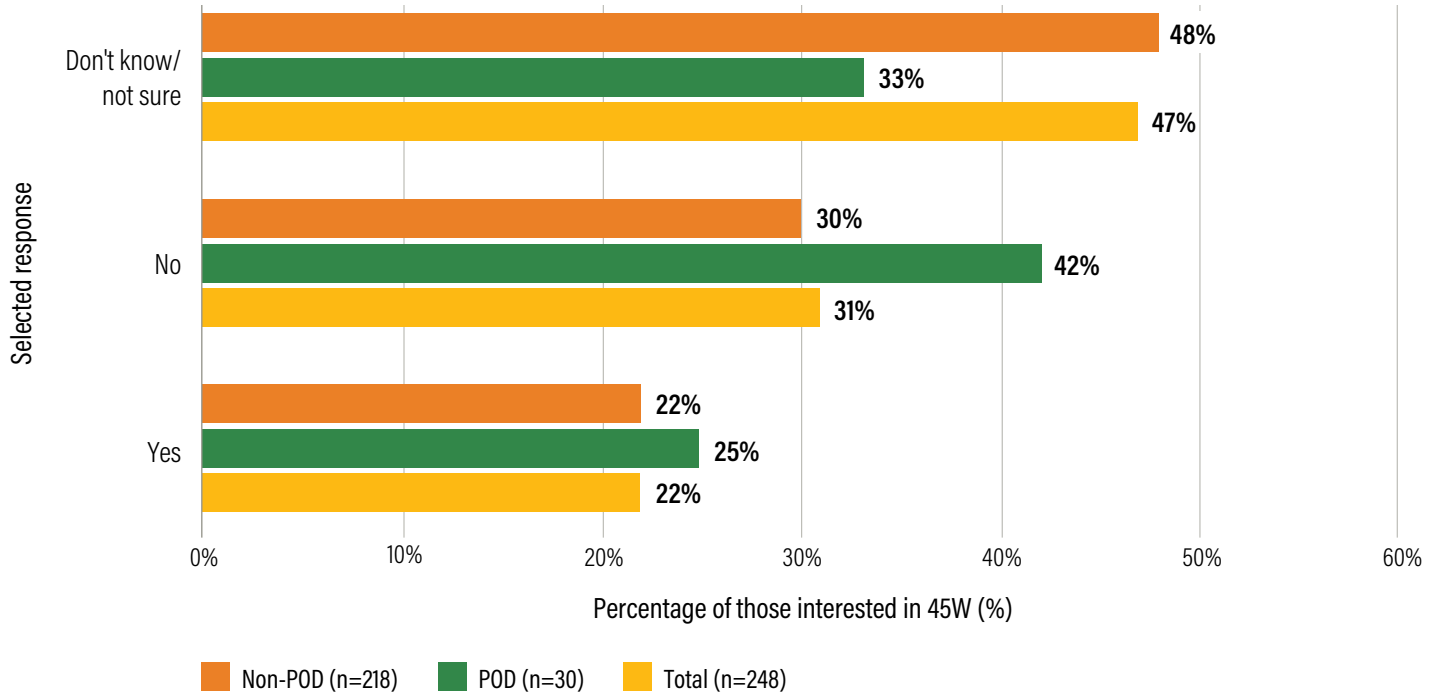
Source: Authors.

Figure A-9 | **District awareness of 45W by geography**



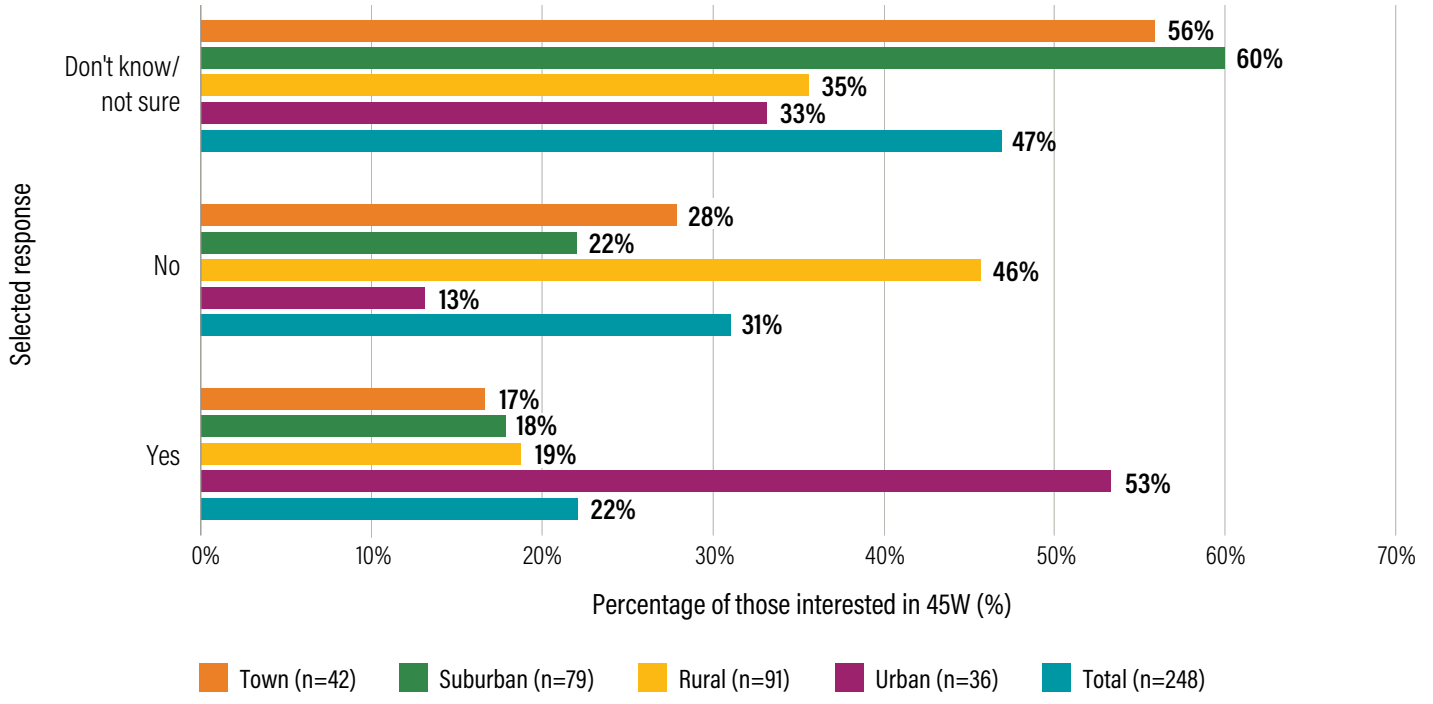
Source: Authors.

Figure A-10 | **Priority district interest in 45W**



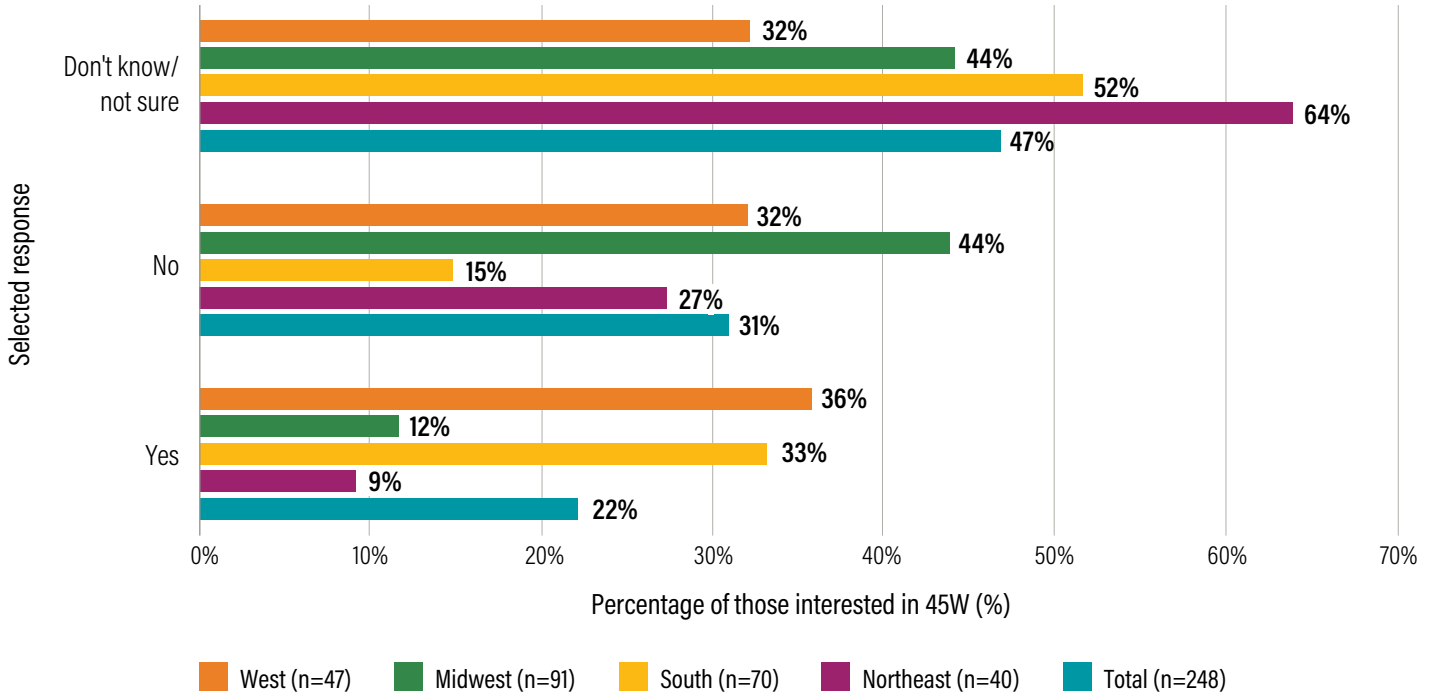
Note: POD = priority district.
Source: Authors.

Figure A-11 | **District interest in 45W by locale**



Source: Authors.

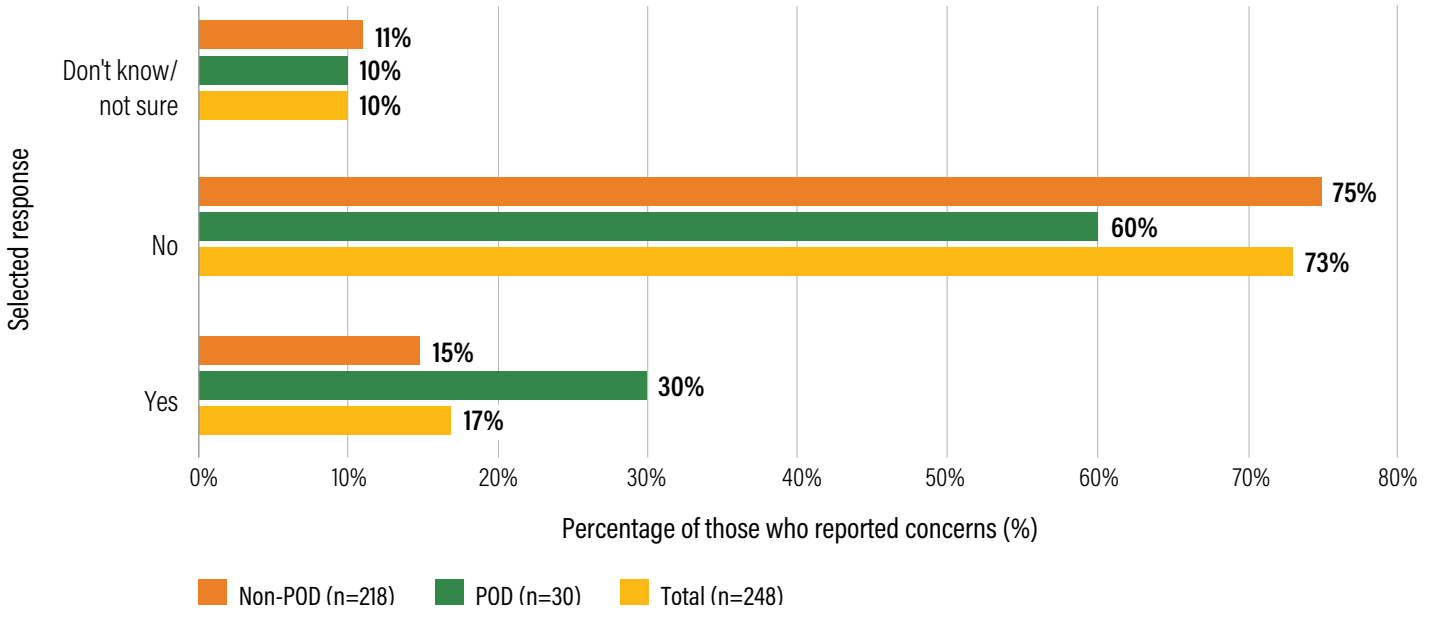
Figure A-12 | **District interest in 45W by geography**



Source: Authors.

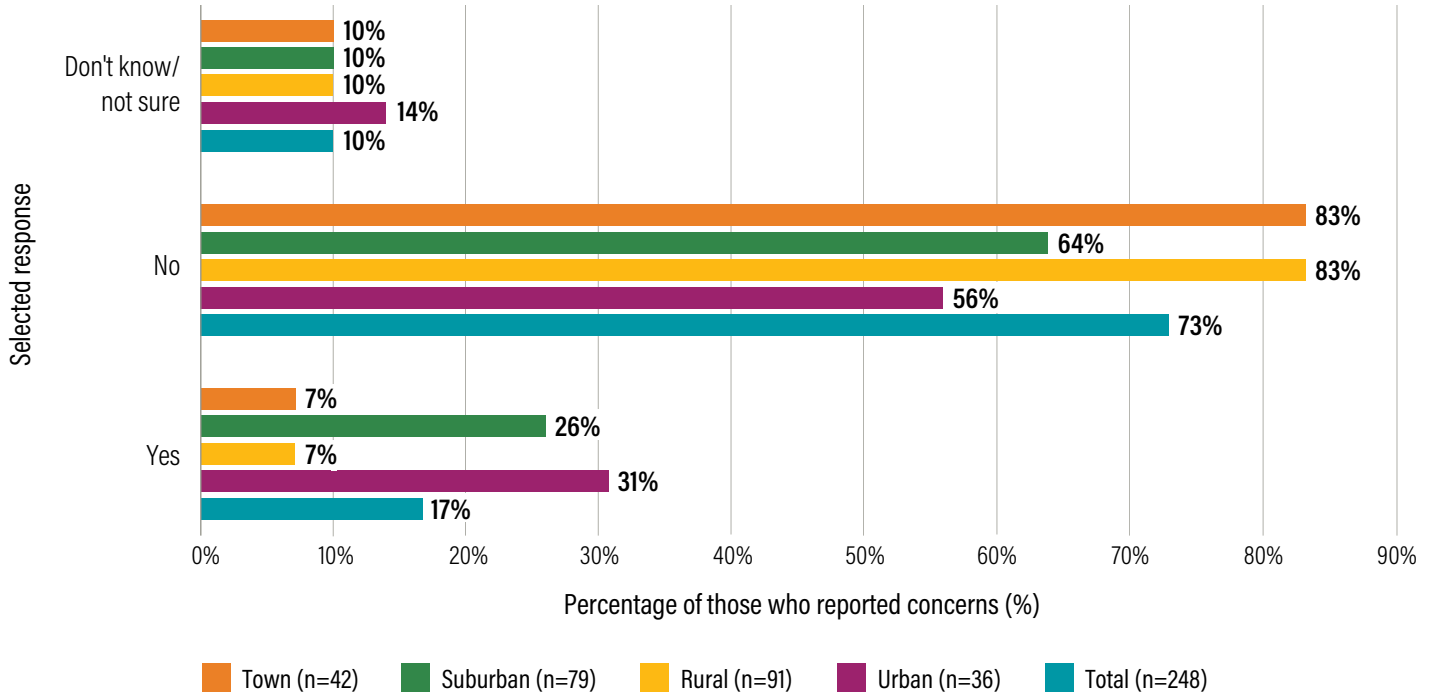
Figures A-13 to A-15 depict the 2023 survey responses regarding the motivating factors for and perceived benefits of pursuing school bus electrification.

Figure A-13 | **Priority district community concerns about air quality**



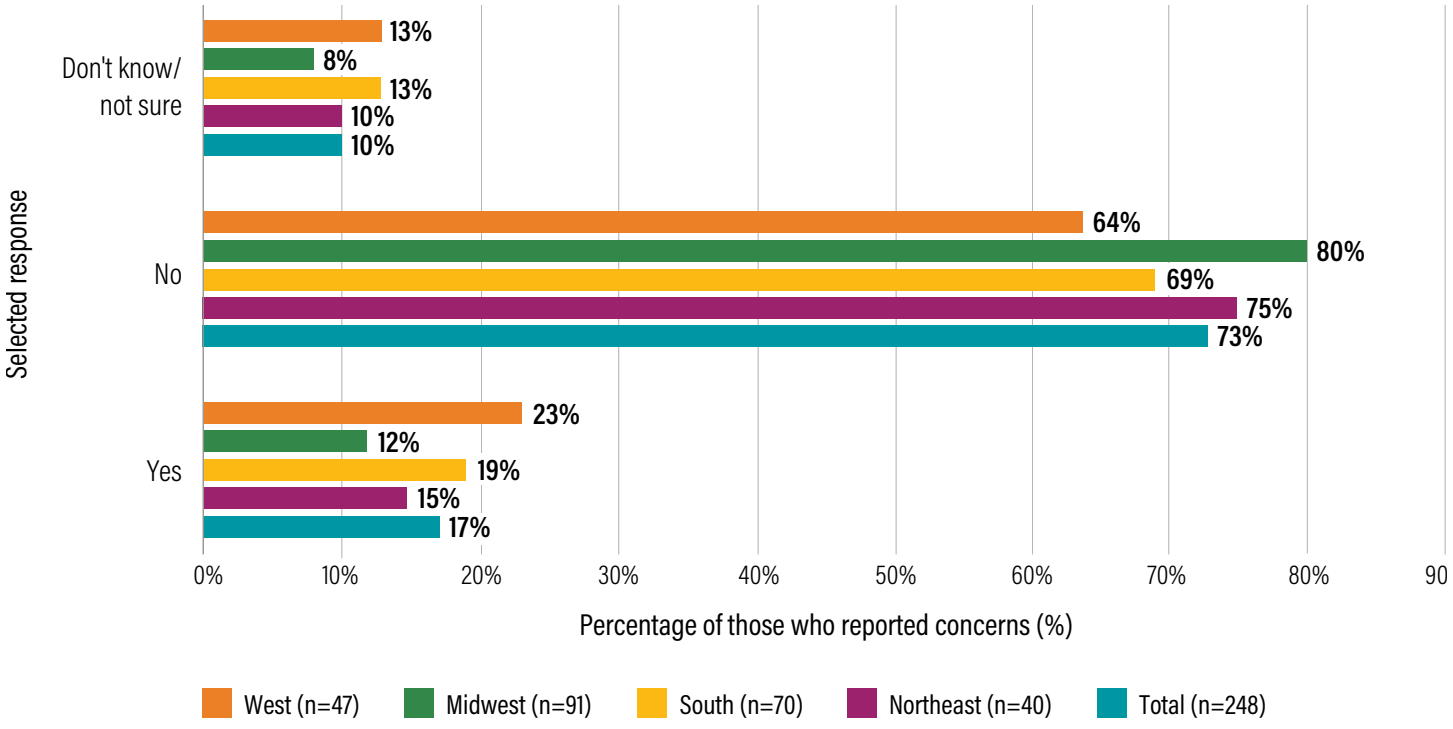
Note: POD = priority district.
Source: Authors.

Figure A-14 | **Community concerns about air quality by locale**



Source: Authors.

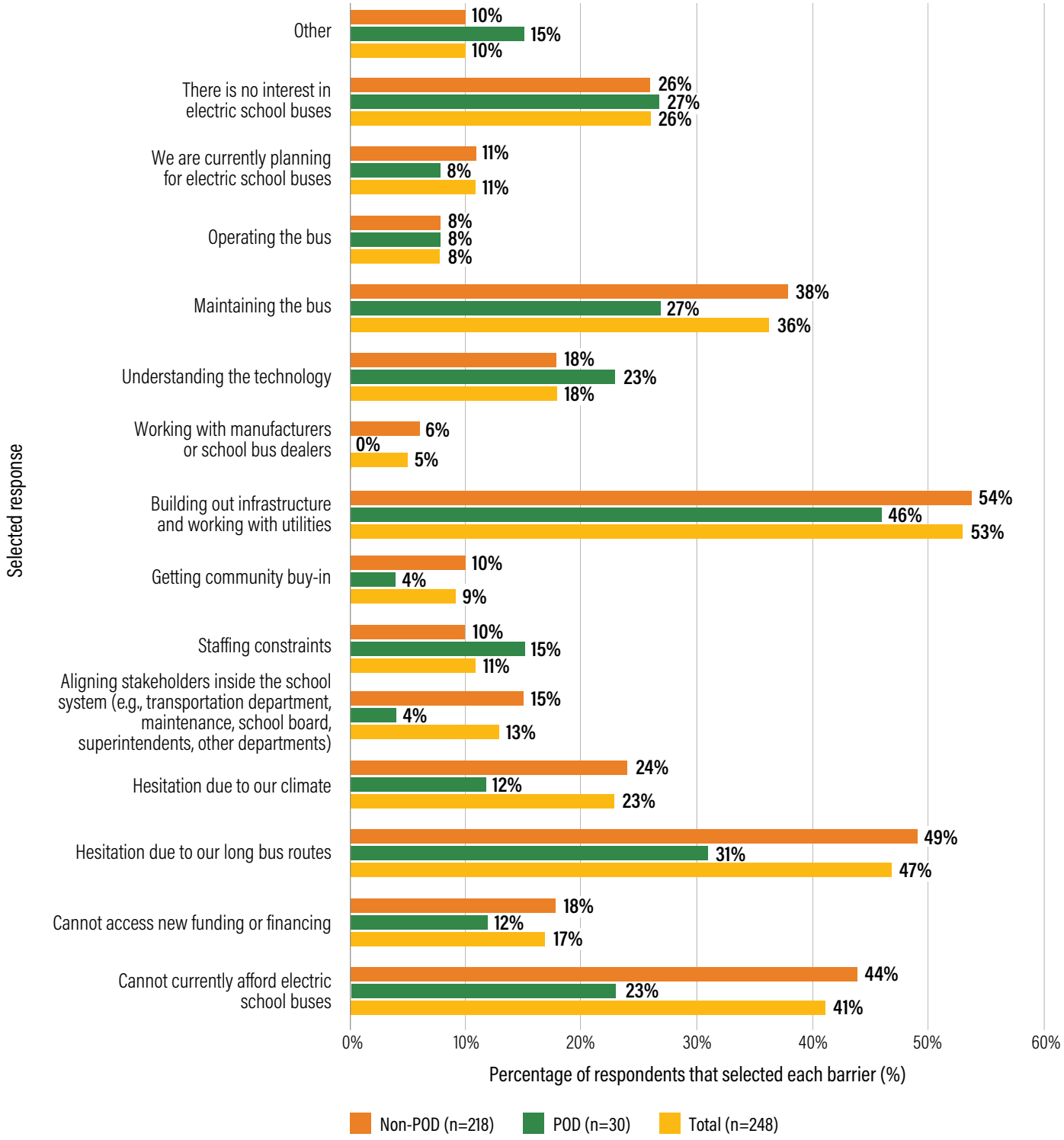
Figure A-15 | **Community concerns about air quality by geography**



Source: Authors.

Figures A-16 to A-18 depict the 2023 survey responses for understanding barriers to ESB adoption.

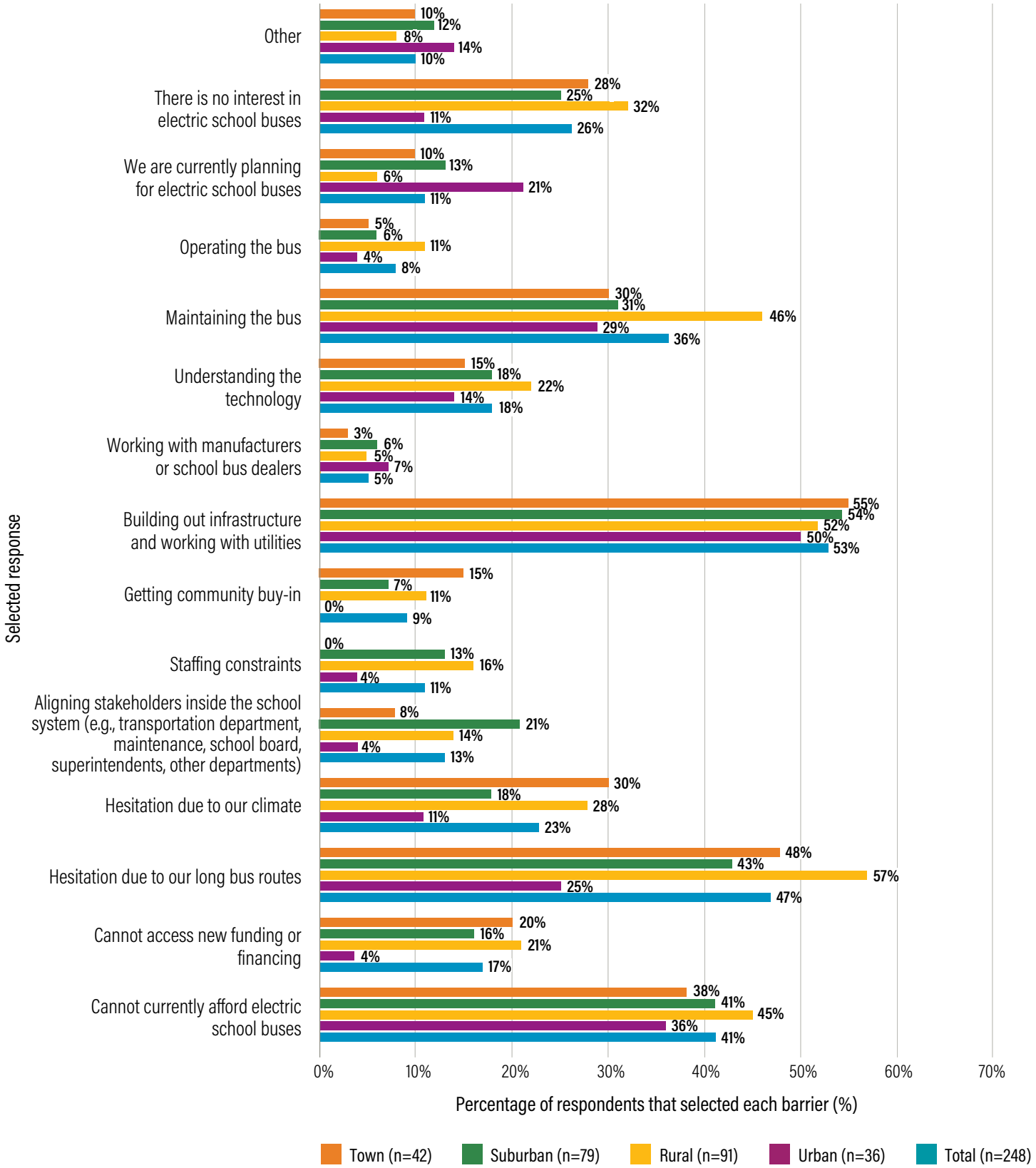
Figure A-16 | **Priority district barriers to electrification**



Note: ESB = electric school bus; POD = priority district.

Source: Authors.

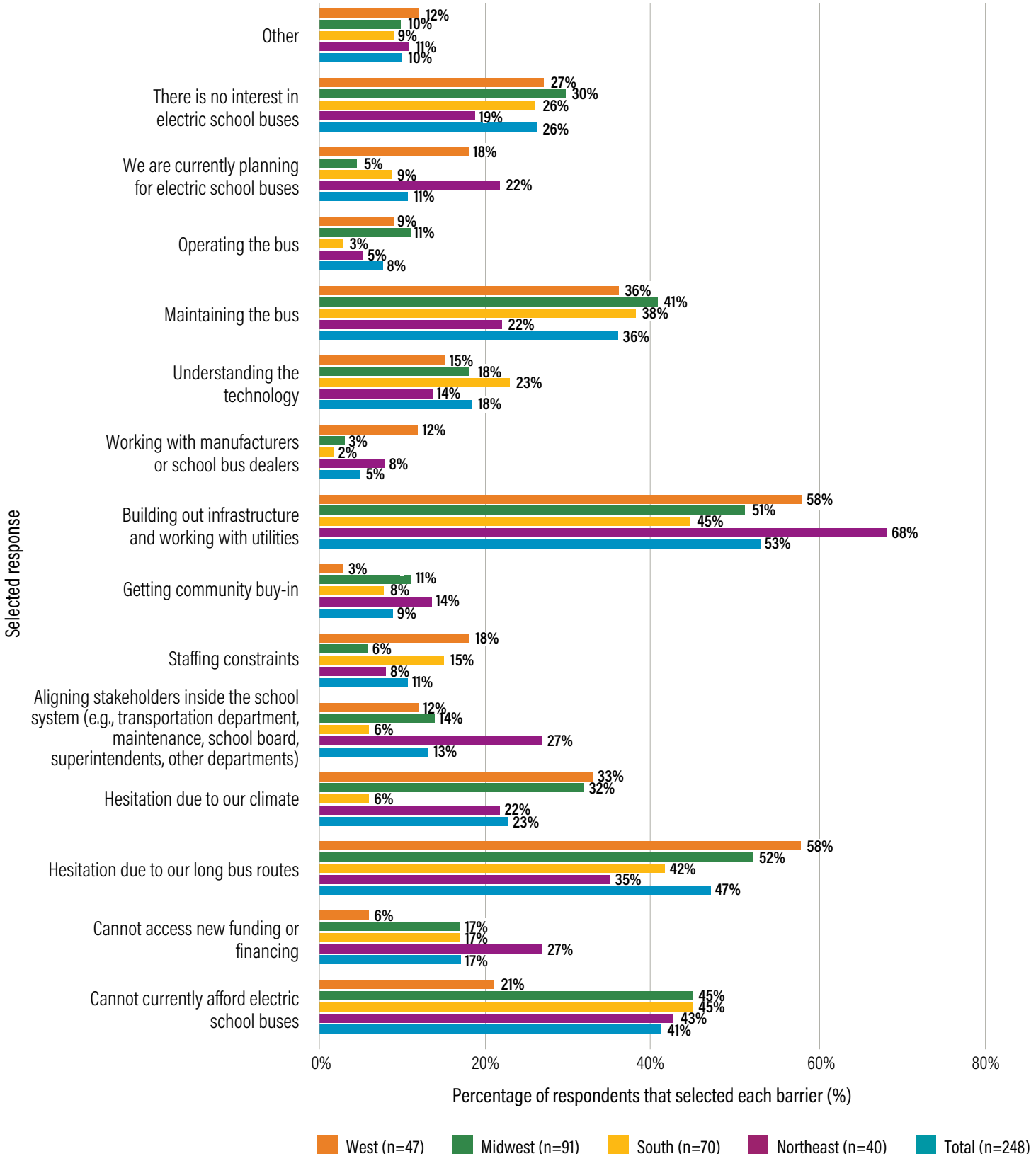
Figure A-17 | **Barriers to electrification by locale**



Note: ESB = electric school bus.

Source: Authors.

Figure A-18 | **Barriers to electrification by geography**

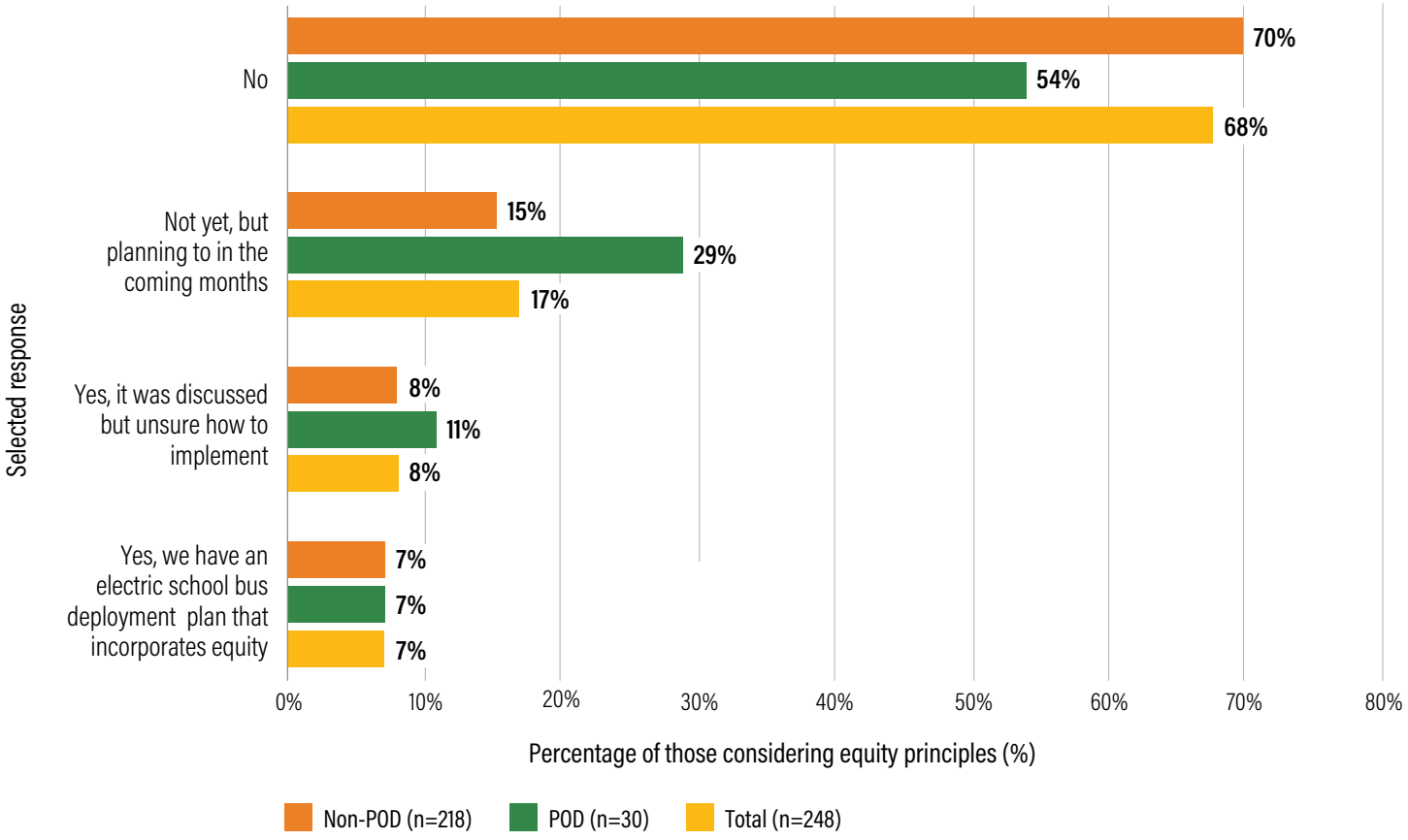


Note: ESB = electric school bus.

Source: Authors.

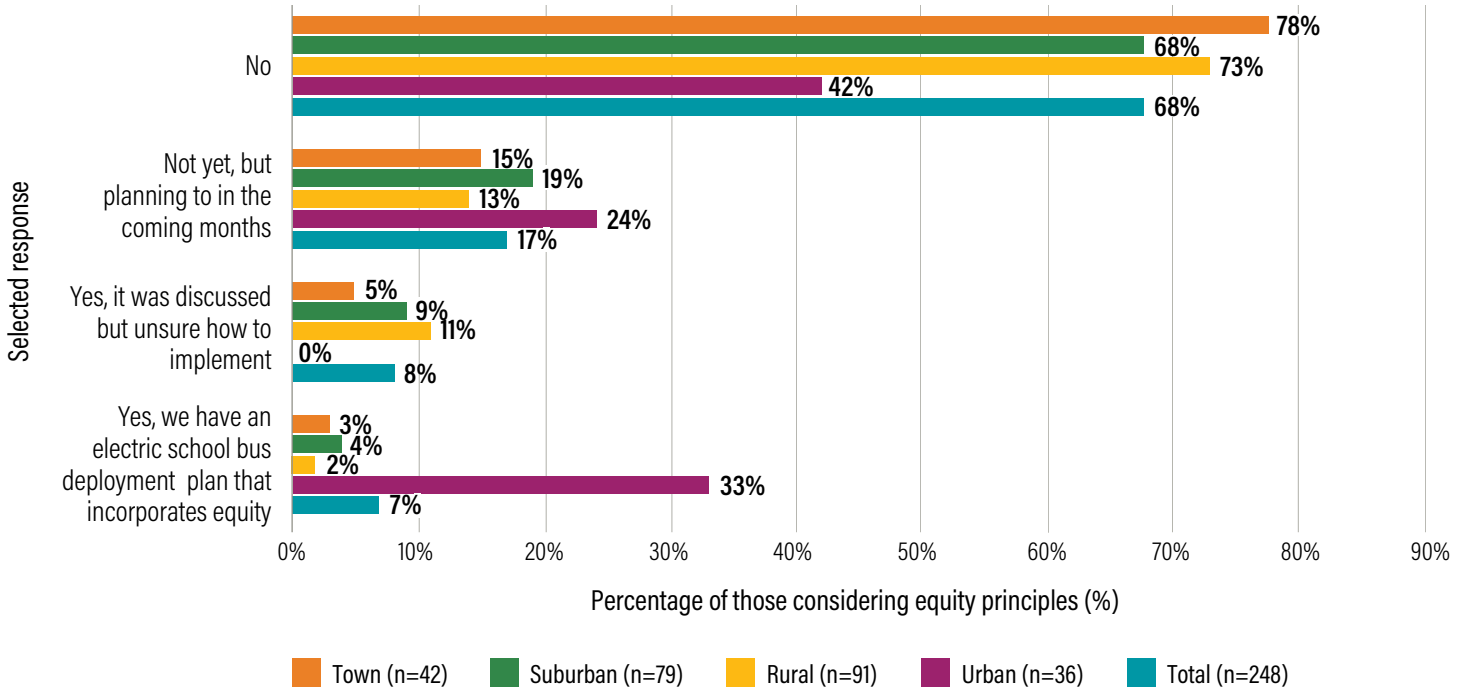
Figures A-19 to A-21 depict the 2023 survey responses regarding whether respondents plan to incorporate equity into their efforts to electrify school buses.

Figure A-19 | **Priority district incorporation of equity principles**



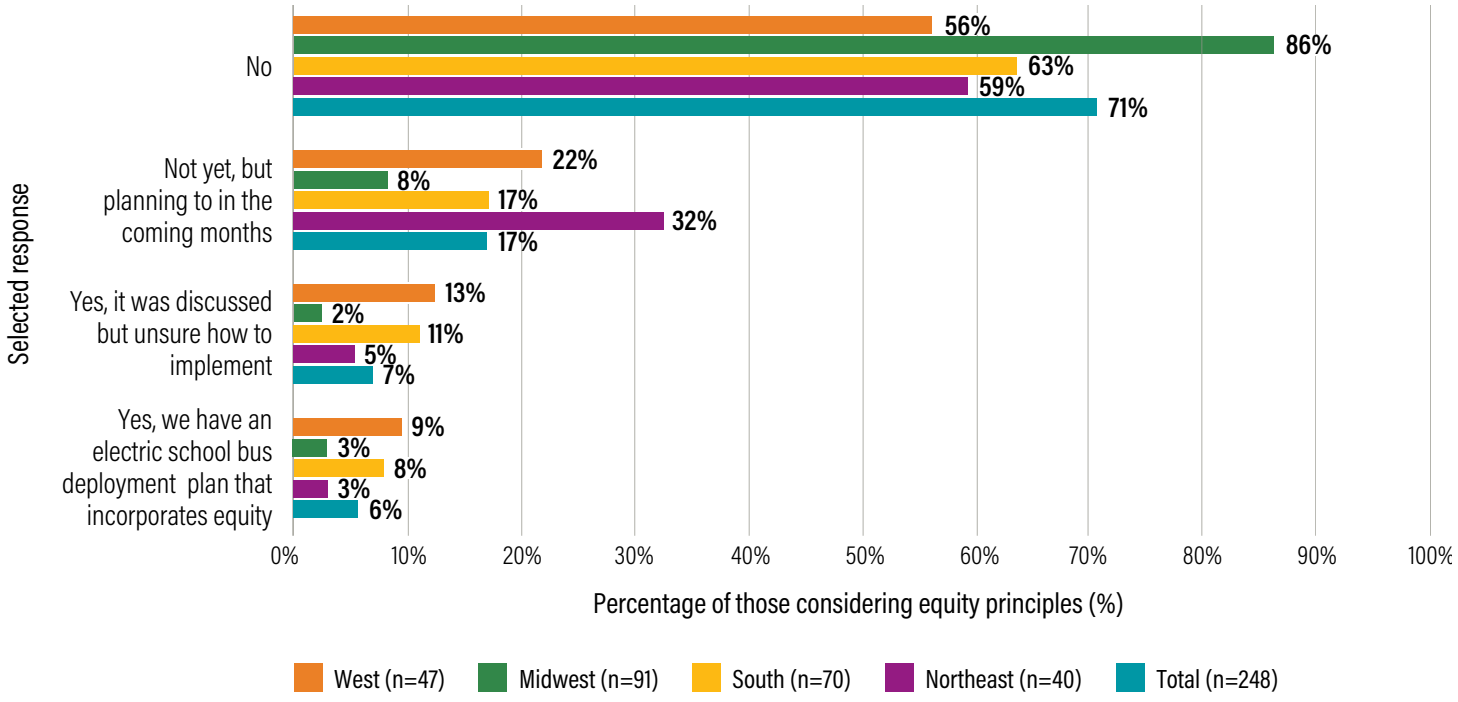
Note: POD = priority district.
Source: Authors.

Figure A-20 | **Incorporation of equity principles by locale**



Source: Authors.

Figure A-21 | **Incorporation of equity principles by geography**



Source: Authors.

Appendix B. 2023 survey questions

Introduction

1. What is the name of your school district, and in what city and state is it located?
2. What is your LEAID (Local Education Agency Identification Number). If you don't have one, or don't know, please mention that in the blank.
3. What is your title? (Please select only one)
   - Superintendent/Administrator
   - Executive/Other Manager
   - Transportation Director/Fleet Manager
   - Maintenance Manager/Supervisor
   - Operations Manager/Supervisor
   - School Board/ or other public official
   - Driver Trainer
   - Purchasing/ Grants/Budgets
   - Safety Manager/Supervisor
   - Bus Driver/Mechanic
   - Sustainability Director
   - Other (please specify)
4. What kind of schools do your buses primarily serve? (Please select only one)
   - Public: primary or secondary
   - Private: primary or secondary
   - College or university
   - Other (please specify)
5. How many school buses of each type do you have in your fleet? (In your responses, please round to whole numbers only. Please do not include percentage signs, ranges, decimals, less than or greater than signs.)
   - Number of Type A (small, typically seating fewer than 36 passengers).
   - Number of Type C (seating between 40 and 83 students with the door behind the front wheels).
   - Number of Type D (largest, seating up to 90 students, with the door in front of the front wheels).
6. What fuel types do you use in your school bus fleet? (Please check all that apply)
   - Diesel
   - Gasoline
   - CNG
   - Propane
   - Electric
   - Other (please specify)
7. What is the operational model for your bus fleet? (Please check only one)
   - The district owns and operates all the buses
   - A private contractor owns and operates all the buses
   - Buses are leased and operated by the district
   - A combination of ownership and responsibilities shared between district and private contractor
   - Other (please specify)
8. Have concerns about air quality on school buses or near schools been raised by anyone in your community such as family members, parents, students, colleagues or other residents in the district? (Please select only one)
   - Yes
   - No
   - Don't know/Not sure
9. Have you heard of the federal Clean School Bus Program run by the U.S. EPA? (Please select only one)
   - Yes
   - No
   - Don't know/Not sure
10. Did you know that the Clean School Bus Program provides funds to cover a large share of upfront costs related to electric school buses and charging infrastructure? (Please select only one)
    - Yes
    - No
    - Don't know/Not sure

11. Would your district be interested in this program? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Don't know/Not sure

12. Have you heard of the tax credit for Qualified Commercial Clean Vehicles (section 45W) in the 2022 Inflation Reduction Act? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Possibly
    - ▫ Don't know/Not sure

13. Would your district be interested in taking advantage of the tax credit for Qualified Commercial Clean Vehicles (section 45W) in the 2022 Inflation Reduction Act? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Don't know/Not sure

14. Are you aware of local community development financial institutions or Green Banks? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Possibly
    - ▫ Don't know/Not sure

15. Did you know that Green Banks and other community development financial institutions can provide low-cost financing to support electric school bus procurement? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Possibly
    - ▫ Don't know/Not sure

16. Before taking this survey, were you aware that there are opportunities for you to receive financial support to purchase an electric school bus? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Don't know/Not sure

17. Have you worked with the WRI Electric School Bus Initiative in any way? This could include viewing materials on the website (prior to this survey), attending events, or receiving technical assistance? (Please select only one)
    - ▫ Yes
    - ▫ No
    - ▫ Possibly
    - ▫ Don't know/Not sure

18. Which of the following barriers have hindered your ability to pursue electric school buses in your district, if any? (Please check all that apply)
    - ▫ Cannot currently afford electric school buses
    - ▫ Cannot access new funding or financing
    - ▫ Hesitation due to our long bus routes
    - ▫ Hesitation due to our climate
    - ▫ Aligning stakeholders inside the school system (e.g., transportation department, maintenance, school board, superintendents, other departments)
    - ▫ Staffing constraints
    - ▫ Getting community buy-in
    - ▫ Building out infrastructure and working with utilities
    - ▫ Working with manufacturers or school bus dealers
    - ▫ Understanding the technology
    - ▫ Maintaining the bus
    - ▫ Operating the bus
    - ▫ We are currently planning for electric school buses
    - ▫ There is no interest in electric school buses
    - ▫ Other

19. Of the barriers which have hindered acquiring electric school buses, please rank them from the most important to least important. Rank the most important factor first.
    - ▫ Cannot currently afford electric school buses
    - ▫ Cannot access new funding or financing
    - ▫ Hesitation due to our long bus routes
    - ▫ Hesitation due to our climate
    - ▫ Aligning stakeholders inside the school system (e.g., transportation department, maintenance, school board, superintendents, other departments)

- Staffing constraints
- Getting community buy-in
- Building out infrastructure and working with utilities
- Working with manufacturers or school bus dealers
- Understanding the technology
- Maintaining the bus
- Operating the bus
- We are currently planning for electric school buses
- There is no interest in electric school buses
- Other

20. If you are exploring electric school buses as an option, have you discussed incorporating equity principles (i.e., principles that guarantee fair treatment, access, opportunity, and advancement for all) into your efforts to electrify school buses? For example, engaging communities during the planning process or prioritizing electric bus routes through neighborhoods experiencing higher levels of pollution due to historic discrimination. (Please select only one)
    - Yes, we have an electric school bus deployment plan that incorporates equity
    - Yes, it was discussed but unsure how to implement
    - Not yet, but planning to in the coming months
    - No

21. Please explain the situation with implementing equity principles in your district in one to three sentences.

22. Would you be willing to participate in a post-survey focus group on school bus electrification conducted by WRI to inform WRI's direct technical assistance and guidance for school districts? The focus group will be virtual, you will receive $100 for your time, and the session will last 90 minutes. Your responses will be kept confidential and used only to draw general conclusions without connecting them to your identity or your school district.
    - Yes
    - No
    - Maybe
    - Don't know

Appendix C. 2023 focus group questions

Consent form reminder

If you filled it out and it did not ask you for your name, please fill it out again. One of the links missed that question and we need the name and consent on the same document. Apologies for the inconvenience and thank you for taking the time to fill it out!

Focus group questions

Introduction

- Ask everyone to state their name and their job.

Interest in school bus electrification

Note: Try to keep this section on the shorter side (one minute per participant, max two).

1. What, if anything, appeals to you about school bus electrification?
    a. Note: If they talk about air quality or climate impacts, ask if they prioritize both. If not, ask why one might be more of a priority than the other.
2. If you are still considering other fuel types, what makes them appealing?
    a. Follow-up: Is there anything that would convince you ESBs might be a better option?

Barriers to school bus electrification

Note: Try to keep this section on the shorter side (one minute per participant, max two).

1. Some of the most common barriers in our survey include building out infrastructure, hesitation due to long routes, affordability, and maintenance. Have you experienced any of these barriers? If so, what has made them so challenging to deal with?
    a. Follow-up: Is there anything that could help you overcome these barriers?

Internal and external stakeholders

1. Which departments would be involved in a project to electrify the school bus fleet?
    a. Follow-up: How common is collaboration among these departments? What mechanisms does your district usually use for collaboration (e.g., emails, regular meetings, sporadic phone calls)?

2. Are there any external stakeholders (e.g., students, parents, mechanics, community members) with whom you currently discuss transportation issues or whom you would consider involving in future projects?

Contractors

1. For those of you who use contractors, what factors did you consider when making the decision (e.g., cost, efficiency, land use, local policies)?
    a. Follow-ups: How long is your contract term? How do state or local policies, such as the way school transportation is funded, affect your decision to contract?
2. For those of you who do not use contractors, why did you decide not to use a contractor?
3. If you were to consider electrification, would that shift your stance on contracting?

Equity

1. Are there any inequities in your current school bus operations? For instance, which groups of students are most likely to ride the bus? Do students with disabilities have special bus routes? Which neighborhoods house your bus depots?
2. If there are any inequities, how do you think electrification might impact them?

Funding and financing

1. What factors affect your annual transportation budget?
2. What type of cost information is typically collected, or analysis typically conducted, as part of school bus (or contractor) procurement decisions?
    a. Follow-up: Is there any information or analysis that your district does not have or is not able to conduct that would be useful for internal decision-makers?
3. In a typical school bus procurement (not necessarily for an electric bus), does your district use, or consider using, any forms of financing (e.g., vehicle leasing, loans, issuance of bonds)?
    a. If so, how have you, or would you, choose your financial provider?

Route planning

1. IF TIME: How do you do your route planning?

Appendix D. Table comparing 2022 and 2023 responses

Tables D-1 and D-2 summarize the questions and findings from the 2022 and 2023 surveys and focus group discussions. The questions for both changed from one year to the next, so most questions are not a one-to-one comparison. The most similar questions were paired together. If there was not a similar question, the corresponding row was left blank.

Table D-1 | **Survey questions and answers in 2022 and 2023**

2022 SURVEY QUESTIONS	2022 ANSWERS[a]	2023 SURVEY QUESTIONS	2023 ANSWERS
On a scale of 1 to 5, how familiar are you with electric school bus technology?	62 percent of districts were extremely, moderately, or somewhat familiar with ESB technology.	Have you heard of the federal Clean School Bus Program run by the EPA?	88 percent of districts were aware of the CSBP.
		Have you heard of the tax credit for qualified commercial clean vehicles (section 45W) in the 2022 Inflation Reduction Act?	32 percent of districts were aware of the tax credit.
How would you describe your school district's interest in electric school buses?	71 percent of respondents had some interest in ESBs.	Would your district be interested in the CSBP?	42 percent of respondents reported interest in pursuing the CSBP.
		Would your district be interested in taking advantage of the tax credit for qualified commercial clean vehicles (section 45W) in the 2022 Inflation Reduction Act?	22 percent of districts reported interest in 45W.
What barriers have you faced or do you anticipate facing in accessing electric school buses?	Non-priority districts selected an average of 4.7 barriers, and priority districts selected an average of 3 barriers. The most frequently reported barriers had to do with infrastructure and cost, followed by maintenance and operations and working with manufacturers.	Which of the following barriers have hindered your ability to pursue electric school buses in your district, if any?	The top 2023 barriers were "building out infrastructure and working with utilities" at 53 percent, "hesitation due to our long bus routes" at 47 percent, "cannot currently afford electric school buses" at 41 percent, and "maintaining the bus" at 36 percent. On average, respondents selected 3.3 barriers in 2023.
Have concerns about air quality been raised by anyone in your community, such as family members, parents, students, colleagues, or other residents in the district?	More than half of respondents (55 percent) said that concerns had not been raised, and 18 percent answered that they did not know.	Have concerns about air quality on school buses or near schools been raised by anyone in your community such as family members, parents, students, colleagues, or other residents in the district?	73 percent said no concerns had been raised, 10 percent said they were not sure, and 17 percent of respondents said that air-quality concerns had been raised.
What do you see as the main benefits of electrification for your district? Please select up to 3 benefits and answer even if you are not considering purchasing ESBs right now.	The top 3 perceived benefits were improved health outcomes for children and bus drivers, reduced operating expenses, and cleaner air, especially in high-pollution areas, with more than 50 percent of respondents selecting each of those benefits.	N/A	
Have you incorporated equity principles into your efforts to electrify school buses?	15 percent of respondents said "yes," 18 percent responded "no," and 67 percent that they did not know. Those who answered yes cited actions like operating vehicles in low-income neighborhoods and putting their first ESBs on routes at historically underserved schools.	If you are exploring electric school buses as an option, have you discussed incorporating equity principles (i.e., principles that guarantee fair treatment, access, opportunity, and advancement for all) into your efforts to electrify school buses? For example, this could mean engaging communities during the planning process or prioritizing electric bus routes through neighborhoods experiencing higher levels of pollution due to historic discrimination.	More than 60 percent of respondents said that they had not and did not plan to incorporate equity into their electrification processes.

Sources: Authors.

Table D-2 | **Focus group questions and answers in 2022 and 2023**

2022 FOCUS GROUP QUESTIONS	2022 ANSWERS[a]	2023 FOCUS GROUP QUESTIONS	2023 ANSWERS
Please describe your school district's interest in electric school buses. What do you see as the main benefits of school bus electrification?	Focus group mentioned cleaner air and a better user experience as reasons they were interested in ESBs. They also saw the opportunity to serve as role models or their exposure to ESBs as motivating factors.	What, if anything, appeals to you about school bus electrification?	Focus group members were motivated by serving as role models, the availability of grants, and the opportunity to pilot new technologies. They also noted that they were able to be early adopters due to support from local leaders and partners.
How many of you are considering purchasing school buses with other fuel types instead of or in addition to ESBs?	When it comes to comparing technologies, 2022 participants mentioned propane and CNG infrastructure as a pro.	If you are still considering other fuel types, what makes them appealing?	The perception that propane and CNG would be an easier transition when it came to infrastructure remained. Participants also expressed concerns about the grid's capacity to accommodate new EVs in addition to other demands.
What do you see as the main barriers of school bus electrification?	Focus group participants mentioned cost, school bus contractors, range perception, limited land for infrastructure, and infrastructure and supply chain issues.	Some of the most common barriers in our survey include building out infrastructure, hesitation due to long routes, affordability, and maintenance. Have you experienced these barriers? If so, what has made them so challenging to deal with?	Participants also mentioned cost, installing infrastructure, technician training, school bus contractors, driver shortages, range, land, and supply chain issues. Participants also expressed concerns about the grid's capacity to accommodate new EVs, building out infrastructure for buses parked at drivers' homes, getting warranties when outside of big cities, concerns about being a guinea pig on dirt roads, lost investment due to renting property, and a concern that utilities would need to keep burning fossil fuels to generate new energy for the grid.
By a show of hands, how many of you have incorporated equity principles into your efforts to electrify school buses? Any specific concerns regarding underserved or under-resourced communities or populations?	One of the four participants had incorporated equity. The respondent who stated their district had thought about equity said their districts focused on prioritizing low-income and underserved neighborhoods for route planning and aimed to provide all schools with equal access to services.	Are there any inequities in your current school bus operations? For instance, which groups of students are most likely to ride on the bus? Do students with disabilities have special bus routes? Which neighborhoods house your bus depots?	Districts in the South talked about special considerations for students experiencing homelessness. The Midwest group discussed language barriers when sharing information with parents, providing services for students with disabilities, and special routes for students who remain in school until they are 21 to attend vocational programs. In the Northeast, respondents talked about using a rotational system for bus replacements where they replace the oldest bus first and the newest bus last thus tackling equity from a bus driver's perspective as opposed to a student's perspective, and giving the drivers with the dirtiest buses the first crack at a new bus.

Note: [a] All answers in this column come from the first version of the needs assessment (Brown and Jackson 2023). CNG = compressed natural gas; EV = electric vehicle.
Sources: Authors.

Endnotes

1. PM2.5 refers to particulate matter of 2.5 micrometers or less in diameter.
2. Propane-burning school buses are responsible for more greenhouse gas emissions than electric school buses on any electric grid in the nation currently—and in some cases, propane school buses are responsible for four times the greenhouse gas emissions.

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Acknowledgments

This publication was made possible thanks to the support of the Bezos Earth Fund, which provides funding for the Electric School Bus Initiative. The authors wish to thank the many people who offered their time and expertise to review and provide comments on the many iterations of this paper. Internal reviewers who provided comments on the first internal draft include Brittany Barrett, Sue Gander, Michelle Levinson, Katherine Roboff, Amy Todd, and Carla Walker. The authors are equally grateful to those who reviewed this published document. Internal reviewers who provided helpful guidance include Brittany Barrett, Sue Gander, Amy Todd, Carlos Muñoz Pina, and Carla Walker. Hana Creger and Keba Baldwin provided valuable insights as external reviewers. We also thank Carla Walker and Sue Gander for their leadership throughout the process, Kathleen Schlach for her generous support in editing, and Renee Pineda for her coordination.

Disclaimer

This project by Equitable Cities, LLC, was funded by World Resources Institute in support of the Electric School Bus Initiative. The views and findings expressed in this independent report and analysis are those of the authors, affiliated with Equitable Cities, LLC, and WRI, and are not meant to imply endorsement or reflect the views and policies of WRI, without formal review and approval.

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About the Electric School Bus Initiative

In collaboration with partners and communities, the Electric School Bus Initiative aims to build unstoppable momentum toward an equitable transition of the US school bus fleet to electric, bringing health, climate, and economic benefits to children and families across the country and normalizing electric mobility for an entire generation. We are working with key stakeholders at all levels and across areas, including school districts, private fleet operators, electric utilities, public and private lenders, manufacturing organizations, policymakers, program administrators, and community members and groups.

About Equitable Cities

Equitable Cities is a US.-based urban planning, public policy, and research firm working at the intersection of transportation, health, and equity. Equitable Cities recenters the narrative of who moves, how people move, and where people move by conducting street-level research and collaborating with community partners and clients worldwide.

About WRI

World Resources Institute works to improve people's lives, protect and restore nature and stabilize the climate. As an independent research organization, we leverage our data, expertise and global reach to influence policy and catalyze change across systems like food, land and water; energy; and cities. Our 2,000+ staff work on the ground in more than a dozen focus countries and with partners in over 50 nations.