WORLD RESOURCES INSTITUTE

A DATASET OF ELECTRIC SCHOOL BUS ADOPTION IN THE UNITED STATES

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ABSTRACT

Transitioning to electric school buses (ESBs) from traditional diesel-powered school buses can reduce students' exposure to air pollution and decrease greenhouse gas emissions. School districts and private fleet operators around the United States are adopting electric school buses with increasing speed, but so far ESB adoption has not been tracked in a centralized, public way. WRI aims to create accessible data and analyses that can help school district staff, advocates, policymakers, and other stakeholders make evidence-based decisions and support the transition to ESBs. This technical note describes the methods used to create a first-of-its-kind dataset that tracks ESB adoption across the United States.

The dataset is organized by school district and tracks the number of "committed" ESBs in each district. An ESB is considered "committed" starting when a school district or fleet operator has been awarded funding to purchase it, or has made formal agreement to purchase it from a manufacturer or dealer. We would not consider an ESB "committed" if a school district or other fleet operator only stated that they plan to acquire ESBs. The dataset also includes other details related to "committed" electric school buses, such as the manufacturer and funding source(s). It also includes school district characteristics such as poverty, racial composition, and locale (urban, suburban, town, or rural), to enable wider analysis of the adoption of ESBs, including whether the transition to ESBs is happening equitably. ESB-related data were collected from a variety of publicly available sources, including news articles, school websites, industry publications, and social media posts. Other demographic and economic data come from reputable, public datasets,

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Technical notes document the research or analytical methodology underpinning a publication, interactive application, or tool.

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including the Environmental Protection Agency, U.S. Census, and National Center for Education Statistics. This dataset will be updated quarterly over the life of WRI's Electric School Bus Initiative to include newly committed ESBs and additional indicators.

MOTIVATION

In recent years, the number of electric school buses across the country has been growing rapidly, but ESB adoption is not being reported in a centralized, publicly accessible way. This dataset fills that gap and includes additional data that enable researchers, policymakers, and advocates to conduct their own analysis of ESB adoption based on school district characteristics such as average income, poverty level, racial composition, region, and locale (urban, suburban, town, or rural). This dataset is the first step toward building a central hub for information on ESBs that will be complemented by innovative data combinations (e.g., scorecards, metrics, indices) and other information (e.g., case studies, community organizing tools, social connections) to help target users push to electrify school buses. This can inform policy evaluation, future policy design, research, and advocacy. We hope that the stakeholders who engage with this dataset will help us locate additional or improved information about ESB deployment that can be included in updates to the dataset.

INDICATOR AND SOURCE SELECTION CRITERIA

Indicator Selection Criteria

The following criteria guided our selection of indicators to include. These criteria were applied especially when developing the indicators in Category 4, "Socioeconomic and demographic characteristics," but they also informed decisions about indicators in all other categories, since not all information about the characteristics of ESBs, characteristics of school bus fleets, school district administrative structures, and so on, are equally useful for the dataset's target audience and intended purpose.

1. **Prevalent**: Indicators should be widely used in other work on related topics to enable comparison with other research, alignment with ESB funding criteria, and alignment with wider consensus on the most appropriate indicators to use on these topics. For example, in Category 4, we include indicators that

have been regularly used to assess school districts' eligibility for federal funding for ESBs or other programs, such as percentage of children in poverty, which is used to assess eligibility for free and reduced school lunch and American Rescue Plan ESB funding.

2. **Curated**: Keeping in mind that we cannot predict all the ways stakeholders will want to use these data, this dataset should balance providing all the information relevant to our expected use cases (see Section 4, "Use Cases") with not including so many indicators that it overwhelms nontechnical users or puts the burden on users to research and select indicators. For example, in Category 4, demographics should balance providing an adequately holistic understanding of socioeconomic and environmental health disparities and inequalities resulting from racism, wealth, geography, and other factors, but they do not need to include more than a few prevalent poverty-related indicators.

3. **Relevant to ESBs**: For health risk indicators, we selected indicators related to health issues that result from air pollutant exposure, since these are conditions that ESBs could improve. According to this criterion, we did not include factors such as water pollution, lead exposure, or proximity to Superfund sites. For indicators related to school bus fleets and school district administrative and geographic information, we included those that seemed most relevant to the adoption of ESBs, such as bus ownership structure and locale.

Source Selection Criteria

The following criteria guided our selection of the sources used to build this dataset. A full list of data sources can be found in Table A1.

1. **Reputable**: Data should come from government sources or other reputable and widely used sources such as academic journals, well-regarded industry publications, or peer-reviewed sources from think tanks or nonprofits. Some data (mainly related to ESB commitments) are only available from less verifiable sources like news articles or school district press releases. In those cases, we cross-checked information across multiple sources wherever possible and deferred to the most reputable or detailed source.

2. **Appropriate scale**: Data should either be already available at the school district level or available at a finer-grained resolution than the school district (i.e.,

census block group) so that it can be accurately scaled up to the school district level.

3. **Recent**: Data should be the most recent available, be regularly updated, and have been updated in the past three to five years.

DATA DESCRIPTION AND METHODS

This section describes the contents of the dataset. It groups the data into eight categories and, for each, provides information such as how they were collected and/or analyzed, how they can be interpreted, and why they were included (in relation to the above indicator selection criteria).

Sheet 1. Main Dataset on ESB Adoption

Category 1: School district characteristics

This category includes the base table of this dataset, which comes from the district directory of the National Center for Education Statistics (NCES) for the 2020–21 school year. This directory lists the nation's local education agencies (LEAs, which this technical note refers to as "school districts" for ease of understanding), by name and unique identification number (LEA ID). The U.S. Department of Education defines a local education agency as "a public board of education or other public authority legally constituted within a State for either administrative control or direction of, or to perform a service function for, public elementary schools or secondary schools in a city, county, township, school district, or other political subdivision of a State, or for a combination of school districts or counties that is recognized in a State as an administrative agency for its public elementary schools or secondary schools" (NCES n.d.d).

The approximately 19,500 LEAs in the United States make up the rows of this dataset. There are eight types of LEAs, including several types of public education-related entities beyond what is typically referred to as a "school district," such as a state-operated agency or a service agency (see Table 1). This ESB adoption dataset includes all LEA types because there may eventually be ESBs owned by any of these LEA types. The dataset also includes any other entities (without LEA IDs) that have obtained electric school buses (i.e., private schools and private fleet operators). However, most LEAs are either "regular public school districts that are not a component of a supervisory union" or "regular public school districts that are a component of a supervisory union," and most of the data related to

school bus fleet characteristics, electric school bus fleet characteristics, and demographics (Categories 2–5 below) are associated with these two types of LEAs. These two LEA types are what are most often referred to as "school districts," including in reference to there being roughly 13,500 school districts in the United States.

This category also contains data referring to geographic and administrative characteristics of the school district, including its address, location in various regional groupings, locale (urban, suburban, town, or rural), latitude and longitude coordinates, and others.

DATA SOURCE, COLLECTION METHOD, AND/OR ANALYSIS METHOD

School districts included in this dataset come from the 2020–21 Local Education Agency Universe Survey Data preliminary directory file from the National Center for Education Statistics (NCES LEA Directory). All data in this category were available at the school district level, so no scaling or aggregation was necessary. See Table A1 for details.

This category, specifically the list of LEA IDs, served as the foundation for this dataset in that all other datasets were combined with the NCES LEA Directory using an XLOOKUP function in Excel that matched on LEA IDs. This was more effective than trying to match data to school districts based on name, since some school districts in different states have the same name, or are written differently in different contexts (e.g., Mt. Pleasant School District vs. Mount Pleasant School District).

Category 2: School bus fleet characteristics

These data refer the school district's overall school bus fleet characteristics, including the number of buses, mileage, and ownership model. With a few exceptions, these data are only available for the 100 largest U.S. school bus fleets, and are updated annually. This is only a small fraction of the country's school districts but represents about one-fifth of all U.S. school buses (91,400 out of approximately 480,000 school buses) (ASBC n.d.).

DATA SOURCE, COLLECTION METHOD, AND/OR ANALYSIS METHOD

This category includes several calculated variables. The calculations, sources, and notes for these variables are explained in Table 2. *School Bus Fleet* (2019) provides data on the number of route buses and the annual route mileage (sum of all buses) for the 100 largest school bus fleets. We divided the annual route mileage by the number of route buses to estimate the average annual route mileage per bus. We divided the average annual route mileage

Table 1 | **LEA Types and Definitions**

TYPE CODE	TYPE NAME	DEFINITION
1	Regular local school district	Locally governed agency responsible for providing free public elementary or secondary education; includes independent school districts and those that are a dependent segment of a local government, such as a city or county.
2	Component district	Regular local school district that shares its superintendent and administrative services with other school districts participating in the supervisory union.
3	Supervisory union	An education agency that performs administrative services for more than one school district, providing a common superintendent for participating districts.
4	Regional education service agency	Agency providing specialized education services to a variety of local education agencies, or a county superintendent serving the same purposes.
5	State-operated agency	Agency that is charged, at least in part, with providing elementary and/or secondary instruction or support services. Includes the state education agency if this agency operates schools. Examples include elementary/secondary schools operated by the state for the deaf or blind, as well as programs operated by state correctional facilities.
6	Federal-operated agency	A federal agency that is charged, at least in part, with providing elementary or secondary instruction or support services.
7	Charter agency	All schools associated with the agency are charter schools.
8	Other education agency	Agency providing elementary or secondary instruction or support services that does not fall within the definitions of agency types 1–7.

Source: Adapted from NCES (n.d.d).

per bus by 180 school days (the standard for the United States, based on NCES n.d.e) to estimate the average daily route mileage per bus. This indicator was included because ESBs may be best suited for certain types of routes, such as shorter routes during the winter in colder climates where a share of the battery charge will be used to heat the bus. In some school districts, the variable "Average daily route mileage per bus" reflects the total mileage of several different routes a single school bus may drive every day; we do not know which school districts this applies to. This is common in districts that have staggered school start and end times, enabling them to use each bus on multiple routes each day, an increasingly common practice given the shortages of school bus drivers that deepened in 2021 (Lieberman 2021). This variable should not be interpreted as the mileage that a typical student would travel each day. All data in this category were available at the school district level, so no scaling or aggregation was necessary.

Category 3: Electric school bus fleet characteristics

These data include whether a school district has any "committed" electric school buses; if it does, the data include other information about those buses, such as manufacturer, funding source, and government agencies and utilities involved. These data were collected by WRI and have not previously been published in a compiled format. This dataset does not include information on alternative-fuel buses other than electric buses, such as compressed natural gas (CNG) or propane buses.

WHICH ELECTRIC SCHOOL BUSES ARE INCLUDED IN THIS DATASET?

The electric school bus "adoption" process consists of many phases, including visioning, technical preparations, awarding of government funding to purchase an ESB, placing an order, taking delivery of the bus, and using the bus to transport students, among others (see Figure 1). Before any of these steps are taken, some school districts may announce their intention to acquire ESBs, while other districts set long-term targets for full fleet electrification. We therefore had to determine when in this process to include an ESB in this dataset. This dataset tracks "committed" ESBs.

- **Definition:** An ESB is considered "committed" when a school district or fleet operator has been awarded funding to purchase it, or has made formal agreement to purchase it from a manufacturer or dealer. We would not consider an ESB "committed" if a school district or other fleet operator only expressed interest

Table 2 | Sources and calculations for calculated variables in Category 2, "School bus fleet characteristics"

VARIABLE ID	VARIABLE	CALCULATION	UNIT	SOURCE	NOTES
2b	Total number of buses		Number	*School Bus Fleet* (2019)	Data available only for the 100 largest school bus fleets.
2c	Number of route buses		Number	*School Bus Fleet* (2019)	Data available only for the 100 largest school bus fleets.
2d	Annual route mileage		Miles	*School Bus Fleet* (2019)	Data available only for the 100 largest school bus fleets.
2e	Average annual route mileage per bus	2e = 2d / 2c	Miles	WRI analysis, based on *School Bus Fleet* (2019)	Data available only for the 100 largest school bus fleets.
2f	Average daily route mileage per bus	2f = 2e / 180	Miles	WRI analysis, based on *School Bus Fleet* (2019) and assuming 180 school days per year (NCES n.d.e)	Data available only for the 100 largest school bus fleets. This may reflect the total mileage of several different routes a school bus may take each day and should not be interpreted as the mileage one student would travel on a typical school day.
2g	Students transported daily		Number	*School Bus Fleet* (2019)	Data available only for the 100 largest school bus fleets.

Note: See Table A1 for further detail.

Source: Authors.

in ESBs or stated that they plan to acquire ESBs, without having been awarded funding or having reached a formal agreement with a third party.

- **Examples**: Examples of information that would lead to a designation of "committed" include a public announcement that a school district has been awarded funding from a federal school bus rebate program like the one created by the Diesel Emissions Reduction Act (DERA), or a news article stating that a school district has placed an order for ESBs from a manufacturer. An unsuccessful or pending funding application for ESBs, or a 2035 full-fleet electrification target that is not substantiated by funding or formal agreements, would not be considered "committed" (though it may be included in Category 5, "Expressions of interest in ESBs").

- **Rationale**: We chose this starting point for considering an ESB "committed" for two main reasons: good data availability and to avoid overcounting. Relatively good data are available about when an ESB reaches this phase because there are official announcements when school districts and private fleet operators are awarded public funds for ESBs, and nearly all ESBs tracked to date are supported by public funds. We
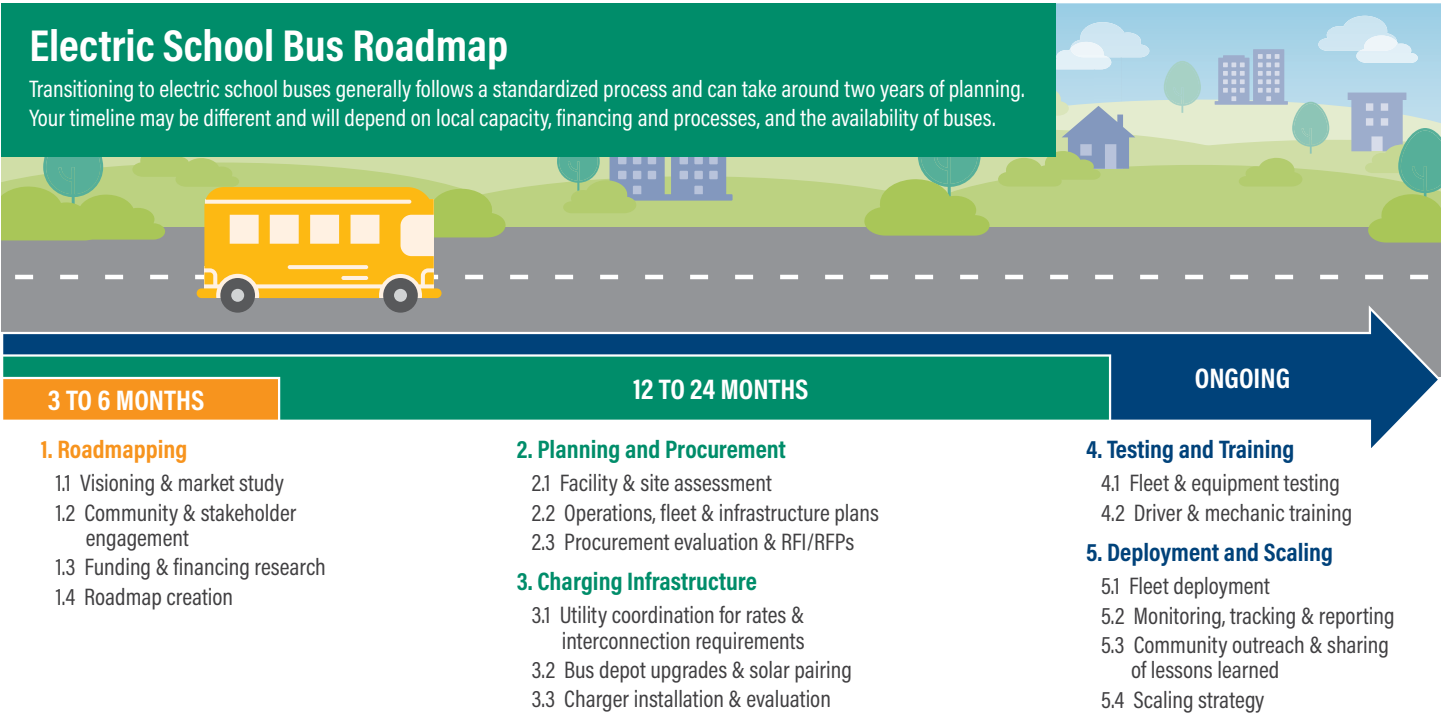
also chose this starting point because our research and school district engagement suggest that when an ESB reaches this phase of the adoption process, there is a step-change increase in the likelihood that it will continue advancing through the adoption process and be put into operation in due course. Therefore, this starting point helps avoid overcounting, giving a more accurate estimate of the ESB adoption. We reported just "committed" ESBs because of constraints in data availability that prevent accurate tracking of ESBs through later the phases of adoption. We are exploring additional data sources so that updates to the dataset can report when ESBs reach later phases in the adoption process. However, we can be fairly certain that a large majority of ESBs in this dataset are not yet in operation, because many of them were funded in the past 18 months, and it usually takes two or more years for a bus to go from funding into operation.

DATA SOURCE, COLLECTION METHOD, AND/OR ANALYSIS METHOD

As there is no known public, centrally available dataset on ESB adoption, we used Google with the search term "electric school bus" (quotes included) to find sources that reported electric school buses that had been committed, including news articles, school websites, social

Figure 1 | Electric School Bus Roadmap

Electric School Bus Roadmap

Transitioning to electric school buses generally follows a standardized process and can take around two years of planning. Your timeline may be different and will depend on local capacity, financing and processes, and the availability of buses.

3 TO 6 MONTHS	12 TO 24 MONTHS	ONGOING
1. Roadmapping 1.1 Visioning & market study 1.2 Community & stakeholder engagement 1.3 Funding & financing research 1.4 Roadmap creation	**2. Planning and Procurement** 2.1 Facility & site assessment 2.2 Operations, fleet & infrastructure plans 2.3 Procurement evaluation & RFI/RFPs **3. Charging Infrastructure** 3.1 Utility coordination for rates & interconnection requirements 3.2 Bus depot upgrades & solar pairing 3.3 Charger installation & evaluation	**4. Testing and Training** 4.1 Fleet & equipment testing 4.2 Driver & mechanic training **5. Deployment and Scaling** 5.1 Fleet deployment 5.2 Monitoring, tracking & reporting 5.3 Community outreach & sharing of lessons learned 5.4 Scaling strategy

Source: Shaver and Wang (forthcoming).

media posts, government funding announcements, and datasets from government or nonprofit entities. We also learned some information from correspondence with our partners, which we confirmed with published sources wherever possible. The sources for ESB adoption are listed at the end of the row of each fleet operator, as indicated in Category 6 of Table A1. Once we completed a comprehensive initial collection of ESB adoption data, new ESBs were identified using Google news alerts with "electric school bus" to receive notifications of news related to ESB adoptions. We also tracked the disbursement of funds from major ESB funding opportunities, such as the Volkswagen Diesel Emissions Environmental Mitigation Trust (n.d.) and the EPA's Diesel Emissions Reduction Act rebates and grants (EPA n.d.a).

Category 4: Socioeconomic and demographic characteristics

These data describe the social, economic, and demographic characteristics of the school district. As described in "Indicator Selection Criteria" (Section 2), we tried to include data that would provide an adequately holistic understanding of socioeconomic and environmental health condition disparities among school districts, in alignment with wider thinking on the topic and what is relevant to ESBs, while not including so many indicators that they burden nontechnical users with researching and selecting indicators. This section includes data on each school district's number of enrolled students, median household income, percentage of households below the federal poverty level, the distribution of the population among race and ethnic categories, the number of school students with a disability, and whether the school district was qualified for ESB funding from the American Rescue Plan.

DATA SOURCE, COLLECTION METHOD, AND/OR ANALYSIS METHOD

Most of these data were sourced from the National Center for Education Statistics (NCES), a federal entity responsible for collecting and analyzing data related to education in the United States. NCES draws on U.S. Census data to publish these demographic, social, and economic data at the school district level.

Category 5: Expressions of interest in ESBs

This category includes data that could help identify school districts that have expressed interest in electric school buses or environmental sustainability, or school districts in cities or towns that have expressed interest in electric public vehicles. These include whether, to our knowledge, the school district previously applied for funding for ESBs but was not awarded that funding, whether the city where the school district is located is a member of the Climate Mayors Electric Vehicle Purchasing Collaborative, and whether the school district has made a sustainability commitment, which can refer to several types of commitments, such as membership in the Green Schools National Network or Schools for Climate Action, as detailed in Table A1. Additional indicators will be added as more information is found.

DATA SOURCE, COLLECTION METHOD, AND/OR ANALYSIS METHOD

Once an indicator was selected, the data were collected from the website of the relevant program or commitment and manually entered into the corresponding cells. Some of these indicators were already at the school district level, such as the Green Schools National Network, in which case no scaling or aggregation was necessary. Some indicators were at the city level, such as the Climate Mayors Electric Vehicle Purchasing Collaborative, in which case we associated the commitment with the school district(s) in that city.

Category 6: Sources and updates

This category includes links to sources for Category 3, "Electric school bus fleet characteristics." All other data sources are listed in Table A1. This category also includes data on when the data in Category 3 were most recently updated.

Sheet 2. Utilities

This category includes information on the electric power utilities operating in each school district. The "Utility name" variables include the names of all utility companies that operate within the boundaries of the school district. Variables covering the possible utility ownership structures include "Cooperative ownership," "Municipal ownership," "Investor ownership," and the like. These variables indicate whether any utility of the specified ownership model operates anywhere in the school district. For example, a "Yes" under "Cooperative ownership" indicates that one or more cooperative electric power utilities operate in that school district. The "RTO/ISO variable"

indicates which regional transmission organization or independent system operator serves that school district. Additional research is underway to determine which utilities serve the schools and bus depots in each school district, since some school districts have multiple electric power utilities, meaning that different utilities could serve school buildings and bus depots.

Data source, collection method, and/or analysis method

Spatial data on utility company boundaries in 2020 was sourced from Homeland Infrastructure Foundation-Level Data (HIFLD 2020). GIS analysis was conducted using these shapefiles and shapefiles of school districts from NCES (2020c) to determine which utility service areas intersect with which school districts. The resulting dataset was exported from ArcGIS as a spreadsheet and merged into this dataset using an XLOOKUP Excel function based on LEA IDs.

Sheet 3. Counties

The category lists all the counties that intersect with each school district. Some school districts are entirely contained within one county, but almost 4,000 LEAs contain two or more counties. These data are important because certain funding opportunities, datasets, or decision-making powers relevant to ESBs are at the county level and not the school district level. Where school districts contain more than one county, the order of the counties listed with each school district is not meaningful (i.e., the county with the most area in the school district is not necessarily listed first).

Data source, collection method, and/or analysis method

These data come from the School District Geographic Relationship Files published by NCES, which list the counties associated with each school district (NCES 2020b).

USE CASES

A main value-add of this dataset is its compilation and organization of data on ESBs (Category 3) in a useful, cohesive structure that enables comparison between school districts and with other datasets (such as U.S. Census or other demographic data). Many users may want to filter the data to identify only school districts with ESBs, and then filter or sort based on other characteristics. This could answer questions such as "How are ESBs distrib-

uted across school districts of different income levels or racial compositions?" or "How are ESBs distributed across different regions of the country, states, or urban and rural areas?" Users may also want to look for trends in the data in Category 3, such as "What funding sources have been used most frequently to fund ESBs, or to fund ESBs in disadvantaged school districts?"

This dataset includes all school districts, not only school districts with ESBs, to enable comparisons between school districts with ESBs and the wider universe of school districts, such as "Do school districts with ESBs have a higher percentage of people of color than the average school district?"

Examples of Use Cases

■ A staff member or student in a school district is trying to find information about how their school district compares to others with regard to sustainability and equity outcomes. They would use this information to assess the feasibility of transition to ESBs based on their similarity to other school districts with ESBs or to advocate for cleaner bus fleets if similar schools have been able to make the change.

■ A journalist is looking for the most up-to-date data on ESB adoption in the United States and wants to run analyses that compare ESB adoption against other indicators, such as air pollution exposure of children. The journalist would use the data to write a piece on the case for ESBs from a health perspective.

■ A congressional staffer wants to know how the district or state of their member of Congress compares to others when it comes to ESB adoption. That staffer would use the data to advocate for full appropriations of zero-emissions school bus funding allocated in federal legislation, such as the 2021 infrastructure bill and/or the Reconciliation bill.

■ ESB advocates working at the local, state, or federal government level want to know characteristics of their school bus fleet and how many are ESBs. They would use the data to create a snapshot of the current status in order to bolster efforts to write ESB-friendly policy.

We see very limited potential for misuse of these data or use of the data for efforts not aligned with the goals of WRI's Electric School Bus Initiative. It may be possible to use these data to advocate against the use of public funding to support ESB adoption, if ESB adoption is not deemed to be widespread, equitable, or cost-effective enough to justify the investment. It may also be possible for an advocate or school district or state official to use these data to argue against the adoption of ESBs in their jurisdiction (i.e., to argue for other alternative-fuel buses like propane or CNG) if they deem there to be insufficient nationwide piloting or use of ESBs. We anticipate that these risks will decrease as the number of ESBs committed and in operation increases in the early 2020s.

LIMITATIONS
Limitations in Data Availability (Data Gaps)

A current major data gap regards school bus fleet characteristics at the school district level, including number of buses, age of buses, ownership model, and number or share of students transported. This dataset only includes data for the 100 largest school bus fleets (from *School Bus Fleet* magazine) and a few select other districts. We are looking into additional sources for these data, including from state vehicle registration data or ESB grant applications. There are also gaps in socioeconomic data relating to nonregular LEA types like charter schools and tribal schools, and in the socioeconomic characteristics of school districts served by ESBs that are owned by a private fleet operator, in cases where we do not know where those ESBs operate.

Uncertainty and Potential Bias

Data on the number and location of electric school buses in the United States were aggregated from hundreds of news articles, funding announcements, press releases, and other disparate online sources. This method of data collection is a source of uncertainty in this dataset. We are unable to quantify the amount of uncertainty; this section explains where and how error may have been introduced, how that impacts the use of the findings, how we are working to counteract that source of uncertainty, and how users might counteract that uncertainty in their use of the data.

■ **Outdated information:** The real-world situation may have changed since the source was published (as is the case with any static dataset). To counteract this uncertainty, users can search for additional or more recent sources about ESBs in particular districts of interest. We intend to update the dataset quarterly to limit the accumulation of out-of-date information across the entire dataset.

- **Omitted information:** Given the disparate and numerous sources used to collect these data, the dataset may inadvertently omit ESBs (or details about ESBs) for which data are publicly available. We hope that the publication of this dataset will lead users to provide WRI with missing information that can be included in updates.

- **Unknown location of buses owned by private fleet operators:** Several private fleet operators have committed to ESBs. Some of these operators serve school districts around the country, and in some cases, there is not information about where the ESBs will operate. In such cases, the ESBs are listed as owned by the fleet operator, but no associated geographic or demographic information is provided. This means the school buses are included in the total number of ESBs and number of entities with ESBs (and in some cases in the count of ESBs by funding source), but they would not be represented in analyses of the distribution of ESBs by region, income, and so forth. To counteract this uncertainty, the Electric School Bus Initiative is working to build partnerships with fleet operators so that, among other things, we can access more accurate information on the school districts that these ESBs serve. As we learn about the location of these ESBs, updates to this dataset will list those ESBs with the school district they serve, and the fleet operator will be noted in the school district's "Fleet operator" column.

- **Double-counting of school buses owned by private fleet operators:** In other cases, we may have information that the ESBs owned by a private fleet operator will serve a given school district. However, some school districts have a hybrid model of school bus ownership where they own some buses and contract with a private operator for others. Given the fragmented nature of information available, this could potentially lead to double-counting. For example, a news article from the local newspaper covering a school district may indicate that the district is "getting" a certain number of ESBs, while funding allocation announcements (for example, from the EPA's DERA program) may state that the fleet operator will be purchasing those same buses. This could potentially lead to the same bus(es) being listed under both the school district and the fleet operator. To counteract this uncertainty, the Electric School Bus Initiative is working to build partnerships with fleet operators so that, among other things, we can access

more accurate information on the school districts that these ESBs serve. As we learn about the location of these ESBs, updates to this dataset will list those ESBs with the school districts they serve, and the fleet operator will be noted in the school district's "Fleet operator" column.

Consistency among Data Sources

This dataset draws from multiple data sources that differ in their method, time of publication, and other characteristics. Combining these to produce new insights presents a potential quality risk. We used the criteria described in "Indicator Selection Criteria" (Section 2) to ensure that all the data are as consistent, accurate, and fit for purpose as possible. We also describe the limitations of this dataset above, and include information in Table A1 that informs users of the specific characteristics and caveats of each included dataset.

Comprehensiveness of Indicators

The social, economic, environmental, and demographic data included in this dataset are ones that we determined to be relevant and robust, but they are by no means comprehensive. A nuanced understanding of the disadvantages or environmental injustices a community has experienced would require a wider array of information on topics such as exposure to various pollutants, health outcomes, access to services, employment, the policy and historical context, and many others. It would also benefit from a look at spatial scales larger and smaller than the school district level. However, we hope that the data provided here can help identify areas for further research. Updates to this dataset may include additional social, economic, environmental, and demographic indicators.

APPENDIX A. DATA DESCRIPTION AND SOURCES

Descriptions of Major Sources

- **The National Center for Education Statistics (NCES)** is an entity of the U.S. Department of Education responsible for "collecting and analyzing data related to education in the U.S. and other nations." Many of the data are updated yearly and presented in Excel or comma-separated value files at the school, district, and state levels, based on U.S. Census data. We collected data from NCES largely at the district level and use its district identifier number, known as a local education agency (LEA) ID, to ensure accurate data merging and tracking.

- *School Bus Fleet* is a pupil transportation trade publication that releases various surveys and statistics. Most of our data come from the magazine's survey of the top 100 school district fleets of 2019.

- **Homeland Infrastructure Foundation-Level Data (HIFLD)** is a public-domain website containing a variety of nationwide geospatial data. We used this source to determine utility boundaries so we could see how they overlap with school district boundaries using GIS analysis.

Table A1 | **Data Description and Sources**

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
SHEET 1: MAIN DATA								
1. School district characteristics								
1a	LEA ID	Local education agency identification number	Identifier			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	Also referred to as "NCES School District ID." This field displays the unique 7-digit school identification number for each school district. The first 2 digits identify the state and the last 5 identify the district ID. Note that private school LEA IDs do not follow this format.
1b	LEA or entity name	Local education agency or entity name	Text			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1b	State name		Text				https://nces.ed.gov/ccd/files.asp	
1d	Street address 1		Text			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1e	Street address 2		Text			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1f	City		Text			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1g	State		Text			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1h	Zip code		Code			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1i	Website		URL			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1j	Has LEA ID?		Categorical	Yes, Private fleet operator, Nonprofit fleet operator		NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1k	LEA type (number)		Categorical	1 to 9		NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	We assigned "N/A" to entities that do not have an LEA ID, such as private fleet operators.

Table A1 | **Data Description and Sources (Cont.)**

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
1l	LEA type (name)		Categorical	▪ Regular public school district that is not a component of a supervisory union ▪ Regular public school district that is a component of a supervisory union ▪ Supervisory union administrative center ▪ Service agency ▪ State agency ▪ Federal agency ▪ Independent charter district ▪ Other education agency ▪ Specialized public school district ▪ N/A		NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	We assigned the category "Non-LEA" to entities that do not have an LEA ID, such as private fleet operators.
1m	Supervisory union LEA ID (if applicable)		Identifier			NCES (n.d.a)	https://nces.ed.gov/ccd/files.asp	
1n	Locale (category full number)		Categorical	11, 12, 13, 21, 22, 23, 31, 32, 33, 41, 42, 43		NCES (2020a)	https://nces.ed.gov/programs/digest/d20/tables/dt20_214.40.asp	For a more detailed description of the locale classifications and criteria, see NCES (n.d.c).
1o	Locale category (number)		Categorical	1 to 4		NCES (2020a)	https://nces.ed.gov/programs/digest/d20/tables/dt20_214.40.asp	For a more detailed description of the locale classifications and criteria, see NCES (n.d.c).
1p	Locale category (name)		Categorical	Rural, Town, Suburban, Urban		NCES (2020a)	https://nces.ed.gov/programs/digest/d20/tables/dt20_214.40.asp	For a more detailed description of the locale classifications and criteria, see NCES (n.d.c).
1q	Census region		Categorical	Midwest, Northeast, South, West, None		U.S. Census (2010)	https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf	
1r	Census division		Categorical	▪ East North Central ▪ East South Central ▪ Middle Atlantic ▪ Mountain ▪ New England ▪ Pacific ▪ South Atlantic ▪ West North Central ▪ West South Central ▪ None		U.S. Census (2010)	https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf	
1s	EPA region	Environmental Protection Agency region	Categorical	1 to 10		EPA (n.d.b)	https://www.epa.gov/aboutepa/regional-and-geographic-offices	
1t	Latitude		Number	Coordinate	Degrees	WRI analysis based on NCES (2020c)	https://nces.ed.gov/programs/edge/Geographic/DistrictBoundaries	Coordinates of the centroid of the school district
1u	Longitude		Number	Coordinate	Degrees	WRI analysis based on NCES (2020c)	https://nces.ed.gov/programs/edge/Geographic/DistrictBoundaries	Coordinates of the centroid of the school district

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
2. School bus fleet characteristics								
2a	Ranking of school bus fleet size		Number	1 to 101		School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2b	Total number of buses		Number		Buses	School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2c	Number of route buses		Number		Route buses	School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2d	Annual route mileage		Number		Miles	School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2e	Average annual route mileage per bus		Number		Miles	WRI analysis, based on School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets. See technical note for methodology.
2f	Average daily route mileage per bus		Number		Miles	WRI analysis, based on School Bus Fleet (2019) and assuming 180 school days per year	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets. This may reflect the total mileage of several different routes a school bus may take every day, such as in districts that have staggered school start and end times, enabling them to use each bus on multiple routes each day, an increasingly common practice given the shortages of school bus drivers that deepened in 2021. This variable should not be interpreted as the mileage that one student would travel on a typical school day. See technical note for methodology.
2g	Students transported daily		Number		Students	School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2h	Ownership structure		Categorical	District, State, Contractor, Hybrid		School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2i	Fleet operator (if applicable)		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	
2j	Fleet operator 2 (if applicable)		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	
2k	Starting hourly pay for drivers		Number		USD	School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
2l	Labor shortage		Categorical	Mild, Moderate, Severe, Desperate, N/A		School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.

Table A1 | **Data Description and Sources (Cont.)**

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
2m	Unionized?		Categorical	Yes, No, N/A		School Bus Fleet (2019)	https://www.schoolbusfleet.com/research/download?id=10117399	Data available only for the 100 largest school bus fleets.
3. Electric school bus fleet characteristics								
3a	Has ESBs?		Categorical	Yes, No		Original WRI data collection	Various, see "Sources" columns for each school district.	
3b	Number of ESBs committed		Number		ESBs	Original WRI data collection	Various, see "Sources" columns for each school district.	"Committed" includes buses that have been announced, procured, delivered, or are in operation. The majority of these buses are not in operation. See technical note for details on the criteria for including specific ESBs in this dataset.
3c	Bus manufacturer		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has electric school buses from more than one manufacturer.
3d	Bus model		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has more than one model of electric school bus.
3e	Bus type		Categorical	Type A, Type B, Type C, Type D		Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has more than one type of electric school bus.
3f	Dealer		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has used more than one dealer of electric school buses.
3g	Funding source		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has more than one funding source for its electric school buses.
3h	Agency administering funds		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has used funding from more than one agency for its electric school buses.
3i	Government agency involved (nonfunding)		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has worked with more than one government agency to acquire electric school buses.
3j	Utility/energy company involved		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has worked with more than one utility or energy company.
3k	Charging company involved		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has worked with more than one charging company.
3l	Other groups involved		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	There are multiple columns for this variable to capture when a school district has worked with more than one other group, such as a local advocacy organization.

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
3m	Other notes		Text			Original WRI data collection	Various, see "Sources" columns for each school district.	
4. Socioeconomic and demographic characteristics								
4a	Number of students in district	Student count at the LEA level, as of October 2020	Number		Students	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2019	"Includes students attending a school in the LEA, students placed in private schools by the LEA and funded by the LEA, and children participating in a prekindergarten program administered directly by the LEA, or by its grantees or subcontractors. Does not include students given vouchers to attend private schools or students placed by their parents in private schools whose tuition is paid for by their parents but who receive special education services from their home district. For details, see U.S. Department of Education (2019)."
4b	Median household income	Median household income and benefits, total population (2015–19)	Number		USD (2019 inflation-adjusted dollars)	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2019	
4c	Percentage of population below the poverty level	Percentage of families and people whose income in the past 12 months is below the poverty level, total population (2015–19)	Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2019	
4d	Percentage one race: White		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2019	
4e	Percentage race alone or multiracial: White		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2020	
4f	% one race: Black or African American		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2021	
4g	Percentage race alone or multiracial: Black		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2022	
4h	Percentage one race: American Indian and Alaska Native		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2023	

Table A1 | **Data Description and Sources (Cont.)**

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
4i	Percentage race alone or multiracial: American Indian and Alaska Native		Number		Percentage	NCES (n.d.b)	https://nces. ed.gov/programs/ edge/TableViewer/ acsProfile/2024	
4j	Percentage one race: Asian		Number		Percentage	NCES (n.d.b)	https://nces. ed.gov/programs/ edge/TableViewer/ acsProfile/2025	
4k	Percentage race alone or multiracial: Asian		Number		Percentage	NCES (n.d.b)	https://nces. ed.gov/programs/ edge/TableViewer/ acsProfile/2026	
4l	Percentage one race: Native Hawaiian and Other Pacific Islander		Number		Percentage	NCES (n.d.b)	https://nces. ed.gov/programs/ edge/TableViewer/ acsProfile/2027	
4m	Percentage race alone or multiracial: Native Hawaiian and Other Pacific Islander		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/ programs/edge/ TableViewer/acsPro- file/2019	
4n	Percentage one race: some other race		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/ programs/edge/ TableViewer/acsPro- file/2019	
4o	Percentage race alone or multiracial: Some other race		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/ programs/edge/ TableViewer/acsPro- file/2019	
4p	Percentage two or more races		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/ programs/edge/ TableViewer/acsPro- file/2019	
4q	Percentage Hispanic or Latino (of any race)		Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/ programs/edge/ TableViewer/acsPro- file/2019	Ethnicity (Hispanic or Latino) is collected separately from race in the U.S. Census. This means that, in the context of the race and ethnicity percentages included here, a Hispanic or Latinx person can be any race(s), and several of the race categories listed here may include Hispanic or Latinx people. Hispanic or Latinx are often considered or identify as people of color. Therefore, adding together the percentages of races other than White is NOT an appropriate way to estimate the percentage of people of color in a given school district.

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
4r	Percentage of school children with a disability	Disability status of the civilian noninstitutional-ized population, relevant chil-dren, enrolled public, with a disability, under 18 years, 2015–19	Number		Percentage	NCES (n.d.b)	https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2019	
4s	Qualified for American Rescue Plan funding?		Categorical	Yes, No, N/A		EPA (2021b); U.S. Census (2020)	https://www.epa.gov/system/files/documents/2021-09/fy21-arp-elect-school-bus-rebate-elig-list.pdf, https://www.census.gov/data/datasets/2019/demo/saipe/2019-school-districts.html	
5. Expressions of interest in ESBs								
5a	Applied for ESB funding but not awarded		Text	Funding opportunity applied to		EPA (2021a); NJDEP (2018, 2020)	https://www.epa.gov/sites/default/files/2021-01/documents/2020-rebate-wait-list-2021-01.pdf, https://www.state.nj.us/dep/vw/phase1proposals.html, https://www.state.nj.us/dep/vw/phase2propos-als.html	This is not a comprehensive list. We were only able to collect data for 2020 DERA applicants and applicants to VW Settlement Funds in New Jersey in 2018 and 2020. This data is included for informational purposes but should not be used to analyze characteristics or trends of ESB funding applicants.
5b	Member of Climate Mayors Electric Vehicle Purchasing Collaborative?		Categorical	Yes, No, N/A		Climate Mayors (2018)	https://driveevfleets.org/what-is-the-collab-orative/	
5c	School district sustainability commitment?		Text	Commitment type as listed		Schools for Climate Action (n.d.); Green Schools Na-tional Network (n.d.); A Climate to Thrive (n.d.); Esteves (2021)	https://schoolsforcli-mateaction.weebly.com/, https://www.aclimateto-thrive.org/, https://www.theatlantavoice.com/articles/why-electric-school-buses-are-a-win-for-georgians/, https://greenschoolsnational-network.org/about/	
6. Sources and updates								
6a	Date of most recent update		Date					This field is updated when a new electric school bus is added to the total for that school district.
6b	Source		URL					This field includes a link to a source of ESB data for that school district. Multiple sources may be listed for each school district.

Table A1 | **Data Description and Sources (Cont.)**

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
SHEET 2: UTILITIES								
7. Utility data								
7a	Utility name		Text			HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.92	There are multiple columns for this variable to capture when a school district has more than one utility operating within its boundaries.
7b	Cooperative ownership		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.93	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7c	Federal owner-ship		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.94	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7d	Investor ownership		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.95	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7e	Municipal ownership		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.96	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7f	Municipal marketing authority		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.97	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7g	Political subdivision		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.98	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7h	State owner-ship		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplat-form.opendata.arcgis.com/datasets/electric-retail-service-territories/explore?location=10.412340%2C163.801333%2C1.99	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.

VARIABLE ID	VARIABLE	FULL NAME	DATA TYPE	DATA DESCRIPTION	UNIT	SOURCE	LINK	NOTES
7i	Wholesale		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplatform.opendata.arcgis. com/datasets/electricretail-service-territories/ explore?location=10.4 12340%2C163.801333 %2C1.100	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7j	Not available		Categorical	Yes, No		HFILD (2020)	https://hifld-geoplatform.opendata.arcgis. com/datasets/electricretail-service-territories/ explore?location=10.4 12340%2C163.801333 %2C1.101	This variable indicates whether any utility of the specified ownership model operates anywhere in the school district.
7k	RTO/ISO	Regional transmission organization / independent system operator	Text			HFILD (2020)	https://hifld-geoplatform.opendata.arcgis. com/datasets/electricretail-service-territories/ explore?location=10.4 12340%2C163.801333 %2C1.102	
SHEET 3: COUNTIES								
8. County data								
8a	Number of counties in school distrct		Number			NCES (2020b)	https://nces.ed.gov/ programs/edge/ Geographic/RelationshipFiles	
8b	County name		Text			NCES (2020b)	https://nces.ed.gov/ programs/edge/ Geographic/RelationshipFiles	There are multiple columns for this variable to capture when a school district has multiple counties within its borders.
8c	County FIPS code	County-level Federal Information Processing System code	Code			NCES (2020b)	https://nces.ed.gov/ programs/edge/ Geographic/RelationshipFiles	This field displays the 5-digit county-level FIPS code. The first 2 digits of the code represent the state. There are multiple columns for this variable to capture when a school district has multiple counties within its borders.

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COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

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