MAINE CLEAN SCHOOL BUS PROGRAM

FREQUENTLY ASKED QUESTIONS

IMPLEMENTATION

What type of charging station will be needed for an electric school bus?
Charging infrastructure can consist of a range of potential equipment upgrades that include charging stations, new wiring or rewiring, and electric paneling upgrades necessary to handle additional electric load to serve any new electric school buses (ESB) in your school's fleet. Depending on the number of ESBs your school district acquires will determine the number of charging mounts necessary to supply energy to the buses. Consulting with your local utility about electric vehicle supply equipment (EVSE) planning is an important first step for electric school bus procurement.
Each ESB in your initial deployment will likely benefit from a dedicated charging station, and the type and power of charging stations you plan to install may have a big impact on the electrical infrastructure your facility will require to support them.

There are 3 main types of chargers that can be used to power an ESB which include:

1) High-powered Level 2 charging station
2) Medium-powered Level 3 Direct Current (DC) charging station
3) High-powered Level 3 Direct Current (DC) charging station

Many factors like bus battery size and preferred charging strategy, cost, infrastructure needs/availability, and ESB model compatibility will likely influence your final decision on selecting a charging station type(s) for your project. It will be most helpful to consider the power demand of each type, and how many charging stations you might deploy to understand how your eventual charging station selection (and overall charging strategy) will impact your facility electrical infrastructure needs.

What type of training will drivers need to adjust to an electric school bus?
Training for driver and maintenance staff is provide by vehicle vendors when they deliver ESBs to the fleet. Many manufacturers supply basic training free of charge. School transportation managers can stipulate robust staff training from the ESB vendor of their choice during their procurement process.

Is the passenger capacity on electric school buses the same as diesel buses?
Yes, electric school buses frames are built to hold the same number of passengers within each bus class and can be outfitted with special equipment such as wheelchair lifts and tie downs.

What costs are associate with installing charger stations?
High-power Level 2 chargers typically cost between $2,000 and $5,000 for the equipment, and $1,000 to over $10,000 for installation (depending on the complexity/difficulty). Medium-powered DC fast chargers are more expensive with costs around $10,000-$18,000 for more basic equipment to more than $40,000 for larger, more powerful stations, and $50,000 or greater for high-powered DC fast charging stations. They may also require a three-phase power supply, so installation costs are

typically higher as well – ranging from $4,000 to $15,000 on the lower end to over $50,000 for larger and more complex projects.

The cost of installing one or more charging stations can vary widely depending on site characteristics, quantity, and type of charging equipment. That said, there are two primary considerations that drive the cost of installation:

1). The distance from the power source to the charging station: Costs associated with connecting a charging station to the power source can account for 40% or more of the installation cost. If possible, minimize your installation costs by installing the station as close as possible to an existing power source that has sufficient capacity to avoid service upgrades. Longer distances between the charging station location and power source increase costs by requiring more electric circuit components and conduit-runs, as well as trenching or linear drilling costs for underground conduit.

2). Whether the charging station is mounted to an existing wall or installed as a free-standing unit. Wall mounted charging stations are generally less expensive because they do not require a free-standing pedestal (or a concrete pad) or trenching to connect them to a power source. Whether wall-mount units can work for a school bus depends on the location and position of bus parking relative to the building. Note that high-powered DC fast charging stations typically require freestanding installation due to their size.

What is a better choice a diesel cabin heater or an electric cabin heater?
Choosing between an electric or diesel cabin heater is dependent on multiple factors including fuel cost, operational needs, battery capacity, and electricity costs. The main advantage of a diesel fired auxiliary heater is that it saves range because energy from the battery is not being used to heat the cabin. The primary disadvantage is that it uses diesel fuel which is subject to dramatic price variations and causes air pollution when burnt. Electric heat uses energy from the battery pack to heat the cabin but can be used to preheat the bus while still plugged in allowing for the battery to only be used to maintain the heat rather than bring a cold bus up to a comfortable temperature. Cost savings for both are tied to energy costs for fuel and electricity. In general, electric tends to be slightly more expensive to operate however some buses are equipped with both electric and diesel heat so the most cost-effective method can be chosen based on market conditions.

ENVIRONMENT

What are the health benefits associated with ESBs?
Electric school buses have zero tailpipe emissions and improve the air quality inside and outside the bus. This is important for children, who spend between 20 minutes to several hours a day on school buses: air pollution levels inside older diesel buses can exceed surrounding areas by 5 – 10 times. It is also important for school bus drivers, who benefit from cleaner, healthier, and quieter working conditions when driving ESBs.

What are the workplace benefits of ESBs?

ESBs provide numerous direct and indirect benefits to their surrounding work environment. With zero tailpipe emissions, an ESB can dramatically improve the air quality in and around the work environment. In addition, ESBs are significantly quieter than diesel buses reducing noise pollution. ESBs also have the potential to supply used energy. ESB batteries can feed electricity back into nearby buildings and the electric grid through a process known as Vehicle-to-Grid (V2G) or Vehicle to-Building (V2B) - potentially increasing community resilience to power outages and providing financial value to schools and local utilities.

What are the emissions reductions associated with replacing a diesel bus with an ESB?
ESBs have zero tailpipe emissions eliminating the direct pollution of greenhouse gases (GHGs) and criteria air pollutants (CAPs). Depending on the vehicle lifecycle of a school's current diesel bus will determine the total reduction in GHGs and CAPs. Reductions in nitrogen oxides (NOx) for a school bus replacement range from around 93% to 99% and reductions of ultra-fine particulate matter (PM2.5) range from roughly 16% to 98%.

What are the emissions impacts from the source of electricity for ESBs in Maine?
Electric vehicles, powered by a battery instead of an internal combustion engine (ICE), do not produce tailpipe emissions. To determine the total emissions of an EV, it is important to consider the source of electricity generation. Maine's Renewable Portfolio Standard (RPS) requires a minimum of 48% of electricity supplied in the state in 2022 to be sourced from renewable generators. The state's Renewable Portfolio Standard (RPS) will continue decarbonizing the electricity grid, requiring 80% renewable consumption by 2030 and a goal of 100% renewable consumption by 2050. Due to the lower carbon intensity of electricity generation in Maine, driving an EV today will have a lower emissions impact than a vehicle with an ICE. A light-duty gasoline vehicle in Maine produces over 11,000 pounds of CO2 equivalent on an annual basis. A light-duty EV in Maine is estimated to produce only 852 pounds of CO2 equivalent, or 92% less overall emissions than a gasoline vehicle. Similar results are seen with ESBs when compared to diesel buses. With such a low carbon intensity for electricity production, EVs in Maine are estimated to produce 77% lower GHG emissions than the national average for EVs. These calculations account for emissions on a well-to-wheel basis, which includes impacts related to fuel production, processing, distribution, and use.

Some ESBs have diesel heaters for the cabin, does that mean they pollute like a diesel bus?
Some ESBs include a fuel fired cabin heater rather than using energy from the battery pack to warm the cabin. This conserves the amount of energy available for motion during winter months. A 2022 evaluation of the first electric school bus in Maine found that the amount of fuel consumed by the cabin heater was significantly less than the amount of fuel used by a comparable diesel bus. Less fuel usage equates to carbon savings.
Other emissions parameters are harder to calculate due to less emissions regulation in the accessory market as well as the assumption that emissions from these devices would factor into total emissions when installed on a fossil fuel vehicle. California does provide some emissions guidance for these devices when installed on fossil fuel vehicles

and has a list of approved models that meet their more stringent emissions standards. Currently there is no test procedures for these devices when installed in a zero-emissions drivetrain application. Further work will need to be done to quantify the emissions impact however it is likely that since the heater is only used part of the year, the total emissions levels would be less than the comparable fossil fuel bus.

What will happen to the batteries on the bus once it is retired? Can they be used for other purposes or recycled?

Given that most electric school buses have an identical body to a conventional diesel, we expect that the leading cause of electric bus retirement will be body, not drivetrain, related. This likely means that the capacity of the battery pack will be sufficient for reuse in other applications. While capacity loss is expected over the life of the bus and will vary based on usage and operating conditions, one bus manufacturer reported that their oldest bus has only seen 1% loss of capacity over 7 years.

The more mature consumer electric vehicle market can provide us with insight into reuse and recycling. Many early plug-in vehicles have now reached their end of life however their batteries are continuing to provide service in grid or building energy storage. One company called B2U Storage Solutions has been operating a 17 MWh solar energy storage facility using 1000 used electric car batteries. By repurposing these used batteries, they were able to build this storage facility at two thirds the cost of using new batteries. Automakers such as Nissan and General Motors are also exploring this option.

Recycling is the best option for batteries that have reached their end of life. Recycling will allow for the recovery of valuable materials that can be used to make new batteries. While there is some recycling infrastructure already in place for lithium-ion batteries, much of it is geared toward smaller consumer electronic sized batteries. These are harder to recycle due to there being a wide variety of sizes and form factors available. With the shift toward a battery-powered economy, companies such as Li-Cycle, Northvolt, and Redwood Materials are starting to develop more efficient processes to recycle batteries from cars. Some of these companies are even looking to produce their own battery cells from the materials they recycle, and many are already accepting batteries for disposal.

What are the environmental impacts of mining for minerals to make batteries versus extracting and refining oil?

Maine's Clean Transportation Roadmap provides a clear explanation of this issue for light duty vehicles. We expect similar results with school buses and other commercial vehicles. "*Production of an EV can be thought of as the production of the necessary raw materials, the manufacturing of component parts, and the vehicle assembly process. EV production can be more emissions-intensive than an ICE vehicle due primarily to the lithium, cobalt, and copper requirements for battery manufacturing. Though EV production can be higher-emitting, total well-to-wheel emissions, or emissions over the entire lifecycle of the vehicle, are lower for EVs than ICE vehicles. The overall lower emissions impact of EVs can be attributed to much lower impact from operational use and maintenance over the lifetime of the vehicle. In addition, as the* *source of electricity becomes increasingly powered by renewable energy generation, the environmental impact of EV operation decreases over time. Acknowledging the environmental impact of EV production, the EV supply chain is innovating to ensure well-to-wheel EV emissions continue to decline. Improvements in manufacturing are underway to ensure that the impacts from the battery production and the end of life, including the collection, recycling, energy recovery and disposal of the vehicle and batteries, are less emissions intensive. For example, EV battery manufacturers are pursuing new technologies, such as sodium-ion and solid-state batteries, to improve energy density, reduce cost, and rely less on limited critical materials. As the EV market continues to grow, the market for these innovations also matures."*

OPERATIONAL

What is the distance that can be covered by an electric school bus?
The range for a typical Type C ESB is 100-155 miles. Some manufacturers offer longer range options. Type A ESBs typically offer 75 to 100 miles of range.

Will the battery work in the winter?
Yes, twenty- four states including cold weather places such as Vermont, Minnesota, Michigan, North Dakota, and Alaska have deployed electric school buses. During cold winter months, nominal range can decrease by 30% to as much as 50% on the very coldest (sub-zero) days, as the batteries draw energy to maintain optimal operating temperature and heat the cabin. Many electric buses can be equipped with optional fuel-fired auxiliary heaters to mitigate most of this range decrease.

How long is the charging time for an electric bus?
A typical charging time for a Type C ESB with a 150kWh battery pack will be able to charge in 6-8 hours overnight using a high-powered Level 2 charging station.

Can a bus be charged in the rain or snow?
Yes, ESBs are designed to withstand harsh weather conditions including rain and snow. A level 2 charging port can flush water and drain to protect equipment. The cord itself is made to repel water and contains a watertight seal which protects wiring from water damage.

Can ESBs be stored outdoors?
Yes, both ESBs and charging stations can be stored and operated outdoors.

How much does it cost for the maintenance of an ESB?
Maintenance costs associated with ESBs are significantly lower due to ESBs having fewer moving parts, so there are fewer repairs and reduced maintenance requirements. As a result, ESBs are expected to provide maintenance savings of up to 40%.

Will an ESB raise the cost of our electricity bill?
Yes, since an ESB requires power from the electric grid to charge, your electricity bill will increase. However, the cost per mile for operating an electric bus is less so you could save up to 75% compared to a diesel bus.

What are the risks surrounding fire and ESBs?

EV Firesafe, a safety group funded by the Australian government, has found only 18 verifiable electric bus fires (EBF) globally from 2010 to mid-2022 out of a global fleet of over 110,000 vehicles. These vehicles were mostly transit buses and as of October 2022, there have been no electric school bus fires reported in the US. In contrast, a 2016 study by the US Department of Transportation found that roughly one fossil fuel school bus caught on fire every day (there were only 9 ESBs deployed nationally at the time of this study). Electric school buses must meet or exceed the same safety standards as conventional school buses.