Joint Office of Energy and Transportation

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TECHNICAL ASSISTANCE HELP SHEET

Hot Weather Impacts on Electric School Buses

School bus fleets considering electric school buses can start here to learn how hot weather impacts these vehicles, and to find suggestions for optimizing bus performance when temperatures rise.

Electric school buses are proven to operate effectively in hot weather; however, extreme hot temperatures could adversely impact their range and efficiency. School bus fleets can effectively manage these impacts by considering effective safeguards during operations planning.

Hot Weather Impacts

Air temperatures ranging from 55°F–60°F are ideal for optimizing electric bus performance. Electric school buses have proven to operate fairly well in warmer climates, but it is important to understand how extreme heat can potentially affect their operation. Hot temperatures (80°F and higher) can reduce vehicle efficiency and performance and require additional energy for cabin and battery cooling. Electric school bus performance can also be reduced due to slower charge and discharge speeds because of heat.

Air-conditioning the cabin takes additional energy from the battery because higher ambient temperatures will require more energy to cool the cabin. Electric school buses are equipped with a battery thermal management system (BTMS) that conditions the batteries to operate at optimal temperature in all conditions. The BTMS draws energy from the batteries both during operation and while idling or charging. When the battery temperature exceeds optimal temperature, typically around 90°F, the BTMS works to cool the batteries. The battery coolant system adds about 3%–6% of energy draw on the battery in hot weather. The BTMS cooling system does not reduce range substantially, but the effect may be noticeable to those familiar with the vehicle's typical operating capabilities.

To minimize hot weather impacts and optimize performance, the Joint Office of Energy and Transportation (Joint Office) recommends the approaches outlined below.

Hot Weather Considerations

Train your drivers.
Compared to extreme cold temperatures, electric school buses operate relatively well in hot conditions. Train drivers on proper operating procedures to get the most efficiency out of the bus. Drivetrain thermal management and air-conditioner usage are the biggest drains on the battery, so drivers should be cognizant of excessive air-conditioner usage and learn about the best ways to operate the vehicle by working with the bus manufacturer. Idling in extreme heat wastes energy through the cabin cooling system. To avoid unnecessary energy usage, drivers should not have the bus sitting engaged but unplugged for extended periods of time. It is critical to work with the bus manufacturer or distributor to ensure that the drivers have the best training possible to maximize the vehicle's capabilities.

Schedule charging with peak temperatures in mind.
Temperatures are typically highest at midday. This is also the time when the utility costs are typically at their highest. Additionally, rapid charging creates heat within the battery pack. Operators in hot climates should schedule bus charging during off-peak temperatures, such as overnight or early morning, to avoid excessively heating the battery through rapid charging. Charging during off-peak times will also ensure that the charging time does not have negative impacts on time-of-use or demand charges.

Consider ordering buses with white roofs.
School districts in hot weather climates that have intense sun should consider procuring buses with white or light-colored roofs, if state school bus regulations allow. Darker roofs absorb heat, which can ultimately make the cabin hotter, requiring the operator to run the air conditioning excessively. This pulls more energy out of the battery and reduces vehicle range. Work with the bus manufacturer and discuss with local fleets operating electric school buses to see if there are additional options that can be considered to ensure the cabin stays cool while minimizing the use of air conditioning.

Shade charging stations.
In extreme hot temperatures, protect charging equipment and buses from the sun. When planning for electric school buses, plan to provide shade to charging stations and bus parking areas. Shade will prevent additional heat gain within the buses while parked and provide a cooler operational environment for the charging stations. Locating the charging station in an area with natural shading from surrounding foliage may also help. Lower temperatures means less energy will be spent on cooling while the bus is charging.

Consider heat absorption when planning for charging stations.
Colors that can reflect incident light or radiation should be considered when planning for charging stations. Consider painting the area (parking lot and charging station area) using green and blue paints that reflect more light and radiation than conventional asphalt. Using colors that reflect more light and radiation will allow those areas to absorb less heat, providing a cooler space for the electric school buses and charging equipment.

Consider excessive hot weather when performing route analysis.
Consider driving the electric school bus on various routes during its first season operating in hot weather, starting with the shortest, least demanding route. This will allow for a fleet to monitor range and determine which route offers the most cost savings.

Joint Office of Energy and Transportation

About the Joint Office of Energy and Transportation
The Joint Office provides technical assistance on planning and implementation of a national network of electric vehicle chargers and zero-emission fueling infrastructure, as well as zero-emission transit and school buses. For more technical assistance resources, please review **https://driveelectric.gov/school-districts**. If you would like detailed help or assistance, please contact the Clean School Bus Technical Assistance team at **DriveElectric.gov/contact**.

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