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How Do Electric School Buses Perform in Cold Weather?

Evaluating Performance Across the Country

On one frigid February morning in 2023, it was so cold that South Burlington School District in Vermont canceled classes. On the same day, Sean McKenzie, the district's transportation coordinator, was scheduled to host representatives from another Vermont school district keen to learn more about South Burlington's experience with electric school buses.

McKenzie fields many questions from school districts that want to know how South Burlington's electric buses perform on their morning and afternoon routes of approximately 25 to 30 miles each. On that chilly February morning, McKenzie drove his visitors around in one of the buses amid temperatures that dropped to negative 15 degrees Fahrenheit. "It performed just as well as it would in the summertime," said McKenzie. "It was like the bus didn't even know it was cold."

Hosting the group interested in learning more about electric school buses on what happened to be an exceptionally cold day proved instructive to McKenzie's visitors. One of the main concerns school districts have when adopting electric buses is the impact of cold weather on their batteries. Worries about performance in extreme weather were one of the main concerns that transportation supervisor Kenni Jean Schrader heard expressed when she first investigated the purchase of electric buses for Michigan's Three Rivers Community Schools in 2016.

"There were a lot of naysayers who said it's never going to work in Michigan, not in our weather," said Schrader. But since the winter of 2020, two electric buses have been providing her district's students with reliable transportation on routes ranging between 60 and 90 miles.

Growing Demand for Electric Buses

Electric school buses have been gaining popularity across the U.S. in recent years, thanks to their environmental and student-health benefits. Replacing the nation's nearly 500,000 diesel-powered school buses with EVs would avoid an estimated 8 million tons of greenhouse gas emissions each year. A transition to EVs would also vastly reduce exposure to diesel exhaust, which can be harmful to student health and negatively impact school performance.

The World Resources Institute tracks orders, purchases, and deliveries of school-transport EVs as part of its Electric School Bus Initiative. As of September 2024, there were over 4,500 electric school buses on the road across 51 U.S. states and territories. That number more than doubles to 12,000 buses when also accounting for EVs that have been awarded, ordered, or delivered.

Federal funding that either covers or reduces the higher upfront cost of electric school buses is a big reason for their growth. The 2021 Bipartisan Infrastructure Law allocated $5 billion through 2026 to the Environmental Protection Agency's Clean School Bus Program. As of September 2024, over $2.8 billion has been awarded to 1,283 school districts, which will replace 8,725 diesel-powered school buses with electric school buses and clean school buses.

No Buses Like Cold Weather

Questions about the potential impacts of cold weather on electric bus batteries are not unreasonable. Cold weather does impact EV battery performance. When temperatures fall, more energy from the battery is needed to maintain a comfortable cabin temperature. Because that energy is being used to produce heat instead of powering propulsion, the ranges of electric school buses tend to fall as temperatures drop.

The National Renewable Energy Laboratory (NREL) studied the impact of cold temperatures on electric bus performance by monitoring buses operated by the Duluth Transit Authority in Minnesota. NREL found that the range of buses decreased by 33 percent when the air temperature dropped to between 25 and 30 degrees Fahrenheit.

But conventional diesel buses are not immune from cold-weather performance issues. Diesel fuel starts to gel at about 10 degrees Fahrenheit and requires additives to help prevent coagulation. In cold regions, many diesel school buses rely on heating blocks to keep the engine warm enough overnight to be able to start in the morning. Even with precautions, some school districts face occasional late starts or missed days of school because of cold-weather diesel bus performance problems. “Our EV buses have outperformed the ICE [internal combustion engine] buses in cold weather,” said Schrader.

Benefits of Running EV Buses in Cold Weather

- Electric school buses warm the cabin far quicker than their diesel counterparts, which lessens the extended warmup and idling required before a diesel bus is comfortable enough to begin its route. Many electric bus models also have heated driver seats.

- Battery-powered buses are heavier than diesel buses. Their weight is more centered between their axles and the weight does not shift as fuel is burned, which allows for a more stable and consistent drive on snow and ice-covered roads.

- In Vermont, McKenzie has the district's drivers warm their buses on cold mornings while still plugged into the charger. This allows the grid to power the necessary heating before drivers start their morning routes, and it also warms up the battery, which improves range.

Embracing the Change

In South Burlington, drivers plug their buses back in after finishing their morning routes. The school district uses 60-kilowatt DC fast chargers, which means that the buses can fully recharge in three to four hours. “A morning route is usually done around 9:00 or 9:30, and the buses don’t go back out again until around 2:00 in the afternoon,” said McKenzie. “You’ve got about three to four hours to be able to charge it back up, and we’ve never had an issue where we didn’t have enough charge in the bus to use it in the afternoon.”

McKenzie says the school district representatives he toured around on that bitterly cold morning in February 2023 were a little apprehensive about purchasing electric buses. Ultimately, though, their concerns about cold-weather performance melted away, and the school district they work for now has electric buses in its fleet.

Learn more about electric school bus performance in cold weather and tips to run your fleet here.