# Washington County Schools:

Tennessee's First Electric School Bus



## ACKNOWLEDGMENTS

## **Thank You**

This case study was developed using data and insights provided by Washington County Schools, BrightRidge and other community partners supportive of school bus electrification.

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5 Tennessee Department of Education, 2021 District-Level Profile.

1 United States Census Bureau, 2020 American Community Survey (ACS) 5-Year Estimates. 2 University of Tennessee – Knoxville's Tennessee State Data Center, 2020-2070 Projections. 3 University of Tennessee - Knoxville's Tennessee State Data Center, 2020-2070 Projections. 4 Tennessee Department of Economic and Community Development (ECD), County Profile Tool.

# Background

The Infrastructure Investment and Jobs Act (IIJA) allocated \$5 billion toward the U.S. Environmental Protection Agency (EPA) Clean School Bus Program for Fiscal Years 2022-2026, to fund the replacement of existing school buses with zero-emission and clean school buses. In response to this funding opportunity, this case study examines Tennessee's first electric school bus, located in Washington County, and shares lessons learned to assist other districts interested in purchasing their own electric school buses.

Washington County is located in northeast Tennessee, bordered by the Tri-Cities of Bristol, Kingsport and Johnson City, and near both the Appalachian National Scenic Trail and the Cherokee National Forest. It is home to 128,874 residents<sup>1</sup>, many of whom live in the county seat of Jonesborough, or nearby Johnson City. Washington County is the 12th most populated county in

Tennessee<sup>2</sup> and is more heavily and densely populated than many of its surrounding counties. It has experienced an 8% growth in population from 2010-2020, which is projected to continue in the future<sup>3</sup>. The majority of its workers are employed in the government, health care and social assistance, retail trade, accommodation and food services or manufacturing industries<sup>4</sup>.

Washington County Schools is comprised of 16 schools, serving 8,249 students<sup>5</sup> from pre-kindergarten through high school. As of August 2022, Washington County Schools operates a fleet of 120 school buses -1 electric, 32 gasoline, 11 propane and 76 diesel. The district operates up to 93 routes on any given day, with an average route length of 60 miles. In the 2021-2022 school year, Washington County Schools consumed 172,257 gallons of diesel, 21,000 gallons of gasoline and 29,700 gallons of propane.



FUEL CONSUMPTION (2021-2022 school year)

## Bì

172,257 Gallons of diesel



29,700 **Gallons of propane** 



ÍG

32

Gasoline

buses

### WASHINGTON COUNTY SCHOOLS BUS FLEET MIX







## ÍG 21,000 Gallons of gasoline









# **Overview of Funding** and Delivery

In fall 2018, Washington County Schools applied for a grant under the Tennessee Department of Environment and Conservation's (TDEC) School Bus Replacement Grant Program, funded by the Volkswagen Diesel Settlement Environmental Mitigation Trust. Washington County's application was the only all-electric school bus that was awarded in that grant program and is the first purchased in Tennessee. Funding from TDEC did not cover the full purchase cost of the electric bus; additional funding was provided by the school district's local power company, BrightRidge, and the region's power generating authority, the Tennessee Valley Authority (TVA). Both BrightRidge and TVA saw Washington County Schools' electric school bus acquisition as a research opportunity.

In March 2020, Washington County Schools ordered a 2020 Lion Class C electric school

bus to replace a 2004 diesel school bus. Despite COVID-19 pandemic-induced disruptions in the manufacturing process and supply chain, Washington County Schools received the new bus in May 2021. Alongside community and funding partners, Washington County Schools debuted the district's new electric school bus in June 2021 and began serving students in the fall for the 2021-2022 school year.

Upon delivery, electric school bus inspection regulations were under development for the State of Tennessee. By working closely with the Tennessee Department of Safety and Homeland Security's Pupil Transportation Division, Washington County Schools' electric school bus spurred the modification of existing school bus inspection regulations that will streamline the inspections of future electric school buses in the state.



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# Project Implementation

## Electric School Bus Operations

Washington County Schools' electric school bus currently serves two different campuses: the Grandview Elementary School campus and the Jonesborough Elementary and Middle School campus. Navigating winding roads along mountainous and hilly terrain, it serves 120 total students each day over two consecutive routes (totaling approximately 60 miles per day). The two school campuses are approximately seven miles apart, which is helpful for coordinating bus pickup and drop-off schedules between them.

### MORNING ROUTE SCHEDULE

### 6:30 A.M

The bus leaves the school district's garage and picks up students attending Jonesborough Elementary School and Middle School.

### 7:30 A.M

Students are dropped off at the Jonesborough Elementary School and Middle School campus. The bus then proceeds to pick up students attending Grandview Elementary School.

### 8:15 A.M

The bus drops off students at Grandview Elementary School and returns to the garage.

This pickup and drop-off schedule is mirrored for the afternoon routes. Once students are returned home, the bus arrives at the garage and is plugged in to recharge its batteries overnight.



## **Partnerships**

The partnerships that formed early in the electric school bus acquisition process were essential to this project's success. Dr. Bill Flanary, the director of schools, and Dr. Jarrod Adams, the chief operations officer, were interested in a fully electric school bus (as opposed to a hybrid electric or other alternative fuel school bus) because they wanted to embrace a zero-emissions technology that would improve the health and environment of their students while providing long-term financial savings. Dr. Flanary and Dr. Adams conducted extensive research into electric school buses and determined that going electric would become increasingly prevalent over the next few years. They wanted to be as proactive and forward-thinking as possible for their district.

After conducting research, Dr. Flanary and Dr. Adams obtained approval from the

Washington County School Board to move forward with applying for a School Bus Replacement Grant. The electric school bus proposal was then reviewed and approved by two county commission committees the Health, Education and Wellness Committee and the Budget Committee. Additionally, the full county commission reviewed and then approved the proposal for the electric school bus. Once approval was secured, Washington County Schools contacted BrightRidge and TVA to evaluate potential charging locations.

Washington County Schools has also partnered with the East Tennessee Clean Fuels Coalition to support ongoing fleet conversion efforts. By tapping into their alternative fuel and grant writing expertise, the district continues to benefit from this local partnership.





Washington County's electric school bus travels this route twice per day – once in the morning, and once in the afternoon - on a single charge from the previous night.

The electric bus easily navigates winding roads along mountainous and hilly terrain, in addition to flat, rural terrain.



\* This map is for visual purposes only and does not represent the route's precise direction or distance.

## **ROUTE SPECIFICATIONS**



There are

miles between the campuses, making it easy to coordinate bus schedules

60 schools

### WASHINGTON COUNTY WEATHER<sup>6</sup> (2021–2022 school year)

## 24.9°F was the school year's coldest

recorded temperature (January 2022)

86.9°F was the school year's hottest recorded temperature

(August 2021)



Approximtately

miles per day is traveled in order to accommodate the routes for both



This route serves



total students each morning over two consecutive routes

54.7°F

was the school year's average recorded temperature



No weather-related operational disruptions were experienced for the electric school bus.

6 NOAA National Centers for Environmental information, Climate at a Glance: County Mapping.

## **Charging Infrastructure**

Working with BrightRidge and TVA, the school district determined that a Level 2 charging station would adequately meet the needs of the electric school bus, given the range and requirements of the vehicle, the nature of the routes it would serve and the time available overnight to charge. This decision resulted in notable infrastructure cost savings, as Washington County Schools purchased a Level 2 Clipper Creek 15 kW charger with a double pole 80-amp breaker. By opting for a Level 2 charger, rather than a Direct Current Fast Charger (DCFC), the school district reduced both charging station unit and installation costs.

Additionally, minimal site upgrades were required for Washington County Schools. Because the school bus is housed at their garage, the school district worked with BrightRidge and TVA to ensure the site was equipped to successfully support the selected bus and charging station. A utility engineer evaluated the site by conducting a load calculation, which informed the type of charging station that was purchased, as well as its placement.

Washington County Schools' bus takes approximately six-and-a-half hours to reach a full charge by utilizing their 240-Volt Level 2 charger. They coupled the charging station with the EVolution Charging Station Energy Monitoring System, which is a technology tool that tracks the energy consumption trends of the electric school bus.





## **DETERMINING FACTORS FOR THE CHARGING SITE**



evo

## **POWER AVAILABILITY**

The bus garage's existing electrical panel had capacity to meet the requirements of their selected Level 2 charging station.

The bus garage was already on a small commercial rate (GSA-1, single phase, <50 kW), which has no demand charges.



The school district worked closely with its utility partners to select the optimal location for the charging infrastructure. After surveying several locations across numerous school campuses, the district's bus garage

## **OPERATIONAL FIT**

Many of the school district's buses were already parked at the bus garage overnight.

## ELECTRICAL RATE





By initiating discussions upfront, the utility representatives were able to proactively survey the site and assess power availability. The analysis revealed that the bus garage could accommodate one electric bus charger without the need for electrical upgrades. However, if Washington County Schools acquires more electric buses, a utility service upgrade will be needed, and they will likely move to a large commercial rate (GSA-2, >50 kW).

Washington County Schools also worked with BrightRidge to identify the ideal charging timeframe for the electric school bus. In the afternoon, the bus leaves the garage and returns to the Jonesborough Elementary and Middle School campus, picking up the first group of students around 2:55 p.m. Like the morning route, it then proceeds to serve the students from Grandview Elementary School and typically returns to the garage around 4:45 p.m., when it is plugged into its charging station. By using a timer on the chargers, the bus does not begin to charge until 10:00 p.m. each night. Scheduling a later charging start time is easier on the utility grid by charging during off-peak hours. The six-and-a-half hour overnight charging window means the bus will have enough range for the 6:30 a.m. departure time the next morning.

Depending on the electric rate structure, schools may be able to benefit from additional cost savings by charging overnight or during other off-peak times.



# **Findings and Benefits**

Switching transportation fuel sources from diesel to electric may come with a learning curve as electric vehicles are a new technology to most. However, Washington County Schools found that the performance benefits of the bus were quickly recognized by drivers, staff, parents and students. Noise reduction is noticeable since the electric school bus has virtually no engine noise. However, the electric school bus has an external speaker which plays an audible

sound anytime the bus is operating below a specified speed limit, to notify pedestrians and provide comfort to students. Bus drivers have also found that the electric school bus is much more responsive, allowing it to accelerate much guicker than their existing diesel school buses, especially uphill. This performance improvement can enhance vehicle responsiveness and, therefore, vehicle safety.





"I love telling the story of when we picked the bus driver to drive [our new electric] bus. He was adamant at the time, [saying] 'I don't want to drive the electric bus, I don't think it'll be good, I like my diesel.' But we talked him into going for a test drive [in the new electric bus], and now he loves it. He wouldn't trade that bus for anything."

**DR. JARROD ADAMS** Washington County Schools

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# **Project Costs**

The 2020 Lion Class C electric school bus, seating 72 students plus the driver, was purchased by Washington County Schools for \$389,105. This is much higher than the \$83,000 set aside by the school district to purchase a diesel bus in 2020; therefore, purchasing the electric school bus would not have been possible without grant funding and financial support from TDEC, TVA and BrightRidge.

The Level 2 Clipper Creek 15 kW charger was \$3,654, plus shipping costs, and the optional EVolution Charging Station Energy Monitoring System was an additional \$689. As previously mentioned, the upgrade costs for charger installation were minimal. The existing electrical capacity and equipment at the school district's bus garage allowed the school district's electricians to install the charging station and monitoring system themselves, further minimizing installation costs. The cost of the charging station and associated monitoring system was easily recouped within the first year of the vehicle's operation, given the operations and maintenance savings discussed in the following section.

To adequately support the weight of the new bus, Washington County Schools laid a new concrete pad at the garage and installed bollards to protect the charging station. The total cost of these site upgrades was approximately \$1,000, and the upgrades were completed by the school district's existing maintenance staff.

By contacting their local power company early in the process, the school district ensured that their site was ready, and that their bus and charging station were compatible with their needs and resources.

### **VEHICLE COSTS<sup>7</sup>**

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## **\$389,105** Per electric bus

(2)

\$83,000 Per diesel bus

7 These vehicle costs are based on the cost of a 2020 electric school bus model and the school bus set-aside in the 2020 school district budget.

### FUNDING SOURCES

**\$219,250** Provided by TDEC

\$100k Provided by TVA

## **\$30k** Provided by BrightRidge

## FUEL COST SAVINGS<sup>®</sup>

\*

## **\$5,000** saved per bus, per year,

by swapping diesel fuel for electric energy.

8 This calculation is based on Washington County Schools paying 13.1 cents per kWh, which is equivalent to \$1.31 per gallon of diesel. This calculation also assumes a cost of \$3.50 per gallon of diesel, which reflects the typical costs during the 2021-2022 school year.



Purchasing the electric school bus would not have been possible without grant funding and financial support from TDEC, TVA and BrightRidge.

# **Financial Savings**

Washington County Schools also realized significant operations and maintenance cost savings after transitioning to an electric school bus. First, the cost of electricity required to charge an electric school bus is around 70% cheaper than diesel fuel.

BrightRidge helped calculate that Washington County Schools pays

approximately 13.1 cents per kWh to charge their bus, which is equivalent to paying \$1.31 per gallon of diesel. Based on the anticipated diesel fuel costs for Washington County Schools for the 2021-2022 school year, which is about \$3.50 per gallon, this school district has the potential to save nearly \$5,000 per bus, per year, by swapping diesel fuel for electric energy.

\$

**Electricity is** 70% cheaper than

diesel fuel.<sup>8</sup>



cents per kWh

That's equal to paying only \$1.31 per gallon of diesel. \$5,000

saved per bus, per year, by switching to electric.<sup>8</sup>

That's \$90,000 over the life of a typical bus! Second, an electric school bus has substantially fewer mechanical parts than a diesel school bus, which results in fewer maintenance issues. There is no need for oil changes, diesel particulate filter (DPF) maintenance or other routine maintenance required for traditional fossil-fueled vehicles. Typically, Washington County Schools only needs to monitor tires, brakes, windshield wipers and any warning lights, just as would be done with any school bus. For potential maintenance issues on the electric drivetrain specifically, Lion Electric not only trained local mechanics on addressing such concerns upon delivery of the bus, but also remotely monitors the maintenance status of the bus, as well. Should any issues arise, local staff can easily contact Lion Electric to jointly troubleshoot the issue.

### **MECHANICAL BENEFITS**

**Electric buses** have fewer maintenance issues due to the presence of fewer mechanical parts.

or DPF

The Washington County Schools electric school bus project totaled approximately \$395,000 in all (including vehicle, charging station, energy monitoring system and concrete pad). In addition to TDEC's School Bus Replacement Grant awarding \$219,250, TVA provided \$100,000 and BrightRidge contributed \$30,000. Due to the financial contributions of partners, the final cost of the electric school bus and its associated infrastructure, borne by the school district, was less than the cost of a diesel school bus. Upon deployment of the electric school bus, Washington County Schools continues to reap financial benefits due to reduced operations and maintenance costs.

No need for oil changes maintenance.



The manufacturer remotely monitors the maintenance status of each bus.

## Lessons Learned

This process opened Dr. Adams' eyes to a network of organizations and individuals that was willing to work with Washington County Schools throughout the entire vehicle and charging infrastructure procurement process.

Reflecting on this process and lessons learned along the way, Dr. Adams

encourages schools interested in using electric school buses to begin the process by doing their own research. Additionally, Dr. Adams suggests bringing others along to foster local support of their electric school bus project, as he did by educating district stakeholders about the benefits and operational characteristics of electric school buses.



By engaging many different organizations early on, Washington County Schools was able to benefit from the knowledge of varied subject matter experts and financial resources to make this transition to clean fuels a reality.



# **Next Steps**

If school districts are interested in exploring the possibility of bringing electric school buses to their school, there are a few steps that can be taken now to set these districts up for success. After all, buying a new electric school bus is more than just a transportation purchase. Additional buy-in is necessary for this transition from gas or diesel buses to electric buses. Such buy-in will be needed from school boards, county commissions, school administrative and maintenance staff and bus drivers.

### **HELPFUL TIP**

Identify and reach out to organizational partners early. This will help inform project development from the beginning and ensure implementation is successful and streamlined.

## Identify and Contact Partners

While specific partners will vary for each school, at a minimum, you should always coordinate with your:

> School district Including administration and board

Local power company

- Vehicle and charging infrastructure manufacturers and distributors
- Local government agencies
- Clean Cities Coalition

Other organizations
providing project funding

## **Pursue Funding Sources**

M EnergyRight

A BrightRidge

www.brightridge.com

Federal funding may be a potential solution for school districts that have an interest in electric school buses but are unable to cover the additional upfront costs for the new bus on their own. When pursuing federal funding, there are two steps that can be taken to make sure schools are ready to hit the ground running when project solicitations open.

### **STEP 1**

## Ensure an active administrative account

Ensure the school district has an active, organizational administrative account that corresponds to the funding source of interest, particularly for federal funding. Typically, this is the portal by which applicants apply for any competitive funding. If the school district does not have an account, or accounts need to be updated or reactivated, this is an essential first step.



### **STEP 2**

## Identify eligible buses for replacement

Identify existing school buses that would be replaced by new electric school buses. Existing buses eligible for replacement will vary, based on the funding source. Specific details will be determined by agencies administering the funding, so verify that any actions align with the requirements and expectations of the potential funding.

# Conclusion

While operations and maintenance cost savings have been realized early on, the upfront funding required to purchase the electric school bus posed a significant barrier. The availability of grant funding and partnerships with other organizations minimized the impact of this barrier, allowing Washington County Schools to purchase

the bus with minimal upfront investment from the school district. Washington County Schools hopes that sharing their experience with purchasing and using an electric school bus helps give other school districts more information when considering if an electric school bus is the right option for them.



Washington County Schools' first electric school bus has been a successful pilot project for the school district, encouraging them to acquire additional electric school buses in the future.

## Resources

EPA's Clean School Bus Program will provide \$5 billion over the next five years for clean school bus adoption, including for electric buses. Visit the Program website at www.epa.gov/cleanschoolbus.

To learn more about electric school buses and access implementation tools, resources and events, check out the World Resources Institute's Electric School Bus Initiative at www.electricschoolbusinitiative.org.

The U.S. Department of Energy and U.S. Department of Transportation have joined forces to create the Joint Office of Energy and Transportation, which is a primary resource for federal electric vehicle and charging infrastructure programming. For more information, visit: www.driveelectric.gov.

To find a Clean Cities or Clean Fuels Coalition or to learn about alternative fuels, visit the U.S. Department of Energy's Alternative Fuels Data Center at www.afdc.energy.gov.

For those located in Tennessee and looking for hands-on technical assistance for electric school bus adoption, check out the Tennessee Bus Electrification, Education and Planning (TN BEEP) initiative at www.tnbeep.org.

