

Zero-Emission Bus Update

April 2022

Metro is committed to transitioning to a zero-emission bus fleet. By 2030, every new Metrobus purchase will be a zero-emission vehicle, and the entire 1,600-vehicle Metrobus fleet will be zero-emission by 2045. Metrobus already delivers strong emission reduction benefits, and transitioning to zero-emission vehicles allows us to further reduce greenhouse gas emissions and improve local air quality.

Converting to zero-emission technology requires significant coordination and investment by both Metro and the region. This document highlights the benefits zero-emission buses will bring to the region, identifies the broader framework and partnerships required to support a zero-emission bus fleet, and reviews accomplishments and next steps.

Board-Adopted Zero-Emission Bus Goals

Purchase only lower-emission and electric buses in next procurement

Transition to 100% zero-emission bus purchases by 2030

Have a 100% zero-emission bus fleet by 2045

Zero-Emission Bus Benefits

Metro is already the greenest travel option for metropolitan Washington residents and visitors. Traveling by Metrobus, for example, results in 25 percent less greenhouse gas emissions per mile compared to a single-occupancy vehicle. This is possible because, beyond the inherent environmental advantage of transit, which significantly reduces the number of single-occupancy vehicle trips, Metrobus has already been adopting cleaner technology—80 percent of our current fleet is either compressed natural gas (CNG) or diesel-electric hybrid technology.

Metro's commitment to transitioning to a zero-emission Metrobus fleet presents an important opportunity to build on the health and environmental benefits transit brings to

the region while improving the experience of Metrobus customers. Zero-emission buses reduce greenhouse gas emissions, improve local air quality, and provide a quieter, smoother ride for passengers. In addition, zero-emission buses can reduce operating and maintenance costs.

A zero-emission bus is one with no tailpipe emissions. There are currently two types of zero-emission transit bus technologies on the market: battery-electric and hydrogen fuel cell. While our goals are technology-neutral, in the near-term we are focusing on battery-electric buses, the more tested and cost-effective zero-emission bus technology on the market today.

Planning for the Transition to Zero-Emission Buses

Because transitioning to a zero-emission bus fleet requires more than buying buses, Metro has initiated a Transition Planning process designed to identify all the supporting activities needed to transform our fleet in a manner that ensures continued safe, reliable service. Key Metro activities include:

Provision of bus service

Model operational needs and assess zero-emission bus ability to meet those needs

Route modeling is the first step in determining how to introduce zero-emission technologies by identifying which bus routes are appropriate for initial electric bus deployment with the current range, charging requirements, and state of technology. Bus technology is evolving, and the performance characteristics of electric buses do not yet match those of conventionally-fueled buses (see Figure 1). Our modeling will consider different performance scenarios and will regularly assess the state of technology that will meet Metro's needs most effectively.

Buses

Buy, test, operate, and maintain zero-emission buses






Based on evolving bus technology and the results of our initial deployments of electric buses, Metro will develop specifications to procure buses that meet Metro's needs – and regularly revisit those to reflect performance improvements as they come to market.

Facility infrastructure

Design and build infrastructure at our facilities to support the charging or fueling of zero-emission buses

Facilities design and construction requires long lead times and significant capital investment, and that work will ultimately affect bus delivery schedules. Therefore, it is important to assess facilities early in the process and begin the improvements required to accommodate a zero-emission fleet.

Figure 1. Performance Characteristics of Electric Buses Not Yet On Par with Conventional Buses*

	Present	Target
Miles/Hours of Service 	Limited demonstration data suggests approx. 15,000–20,000 miles/year	Approx. 30,000 miles/year (On par with conventional vehicles)
Availability 	Demonstrated availability averages approx. 75%	85% of days (On par with conventional vehicles)
Reliability 	Limited demonstration data suggests approx. 2,500–5,000 miles between failures	Approx. 7,800 miles between failures (On par with conventional vehicles, Metro target)
Travel Range 	Varies by operating conditions approx. 150 miles	Approx. 250+ miles (On par with conventional vehicles, Metro target)
Useful Life 	Useful life assumption of 12 years	15 years (On par with conventional vehicles, Metro target)

*Present figures represent electric bus performance in demonstrations to date; target figures reflect current Metrobus fleet performance.

Charging equipment

Buy, test, operate, and maintain charging equipment for electric buses

Like the buses, charging equipment technology is also rapidly developing. Beyond the initial specifications developed for our Test and Evaluation program, Metro will regularly assess the evolving state of technology to ensure the charging equipment we procure and deploy is matched to our fleet and operational requirements.

Fleet planning

Maintain a long-term strategic plan for fleet conversion

Metro has identified a long-term strategy for transitioning our bus fleet to zero-emissions and will continue to refine and adjust that strategy to align with our facility readiness, funding availability, equity, and advances in technology.

Workforce development and training

Develop the workforce to ensure it is trained and ready to operate and maintain the new buses and charging equipment

Our employees are vital to the success of this program. Metro has begun to plan the training requirements to ensure that our operators and maintenance employees have the necessary skills and training to support the new technologies as they are deployed.

Safety

Continue to prioritize safety in all aspects of Metrobus operations

As we deploy new technology, we will closely monitor and evaluate its performance and assess our safety practices to continue providing a safe bus system.

While there are some actions Metro can undertake on its own, there are steps toward a zero-emission fleet conversion that require regional cooperation and shared commitment. Major stakeholders include bus transit providers, utilities, utility commissions, regulators, and funding partners. Metro is committed to working with our partners to address the challenges associated with deploying a zero-emission bus fleet and provide an even more sustainable transportation future. Shared responsibilities include:

Funding

The conversion to a zero-emission fleet requires significant upfront capital investment

The cost of an electric bus today, for example, is approximately 30–45 percent higher than a CNG or diesel bus. We also expect the cost of facility infrastructure improvements to be in the order of hundreds of millions of dollars over the course of the transition. Metro's Zero-Emission Bus Transition Plan will provide more detailed cost estimates and identify options to consider as we advance.

The Bipartisan Infrastructure Law provides increased funding for transit through both formula funding and competitive

grant programs that will help to modernize transit vehicle fleets and support the conversion to cleaner vehicles. Metro will continue to pursue relevant grant funding opportunities as they become available to support the conversion of our fleet and facilities. Metro will also consider innovative financing options, such as public-private partnerships and targeted jurisdictional investment to support the region's transition to a zero-emission fleet.

Utility grid infrastructure investments

Zero-emission technology requires utility infrastructure different than that which traditional fueling requires

Preliminary analysis shows that a typical Metro garage of 150 electric buses will require the utility to deliver an estimated 9 megawatts of power to the garage—equivalent to the amount of power needed for 6,000 homes (see Figure 2). These large power needs may require the local utilities to upgrade their distribution systems to increase the power they can provide to the sites; these upgrades can be expensive and require long lead times.

Metro will continue to work with local utilities and other regional partners to identify the needs, costs, and funding sources available to support the utility infrastructure needed

for a zero-emission fleet. The region must prioritize needed utility investments and identify funding to pay for them. This could include coordination among the utility, Metro, and other regional partners to upgrade and fund utility infrastructure for electric bus charging, especially if the upgrade serves multiple properties installing EV infrastructure.

As we convert to electricity as a fuel, we must also consider resiliency to ensure critical bus services continue without interruption (e.g., in the case of an extended power outage). Metro will work with the utilities to assess the risk of outages and potential resiliency solutions.

Utility rates and incentives

Electric buses use significant amounts of energy to operate, so electricity rates are important drivers of operating costs

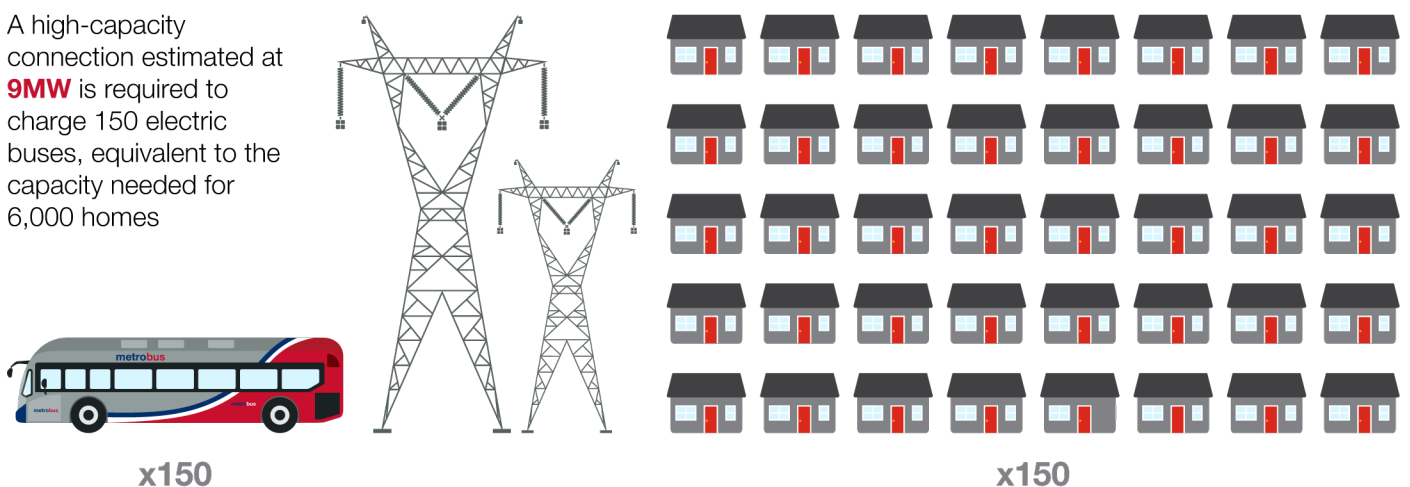
There is currently no standard electric utility rate for bus fleet charging in our region. To facilitate a regional switch to cleaner fleets, it is essential that an electric rate structure be developed so that electricity is an economically viable bus fuel.

Metro staff are regularly working with local electric utilities, Dominion and Pepco, on Metro's energy needs. Consequently, Pepco recently submitted a Climate Solutions

5-Year Action Plan to its regulatory authority, the DC Public Service Commission, detailing plans to work with Metro to develop a rate and technology solutions to optimize grid and fleet operations, and launch a Transit Bus Charging program to offset some costs of installing electric transit bus charging infrastructure. These are important first steps toward a long-term solution that will benefit Metro as well as other regional transit providers.

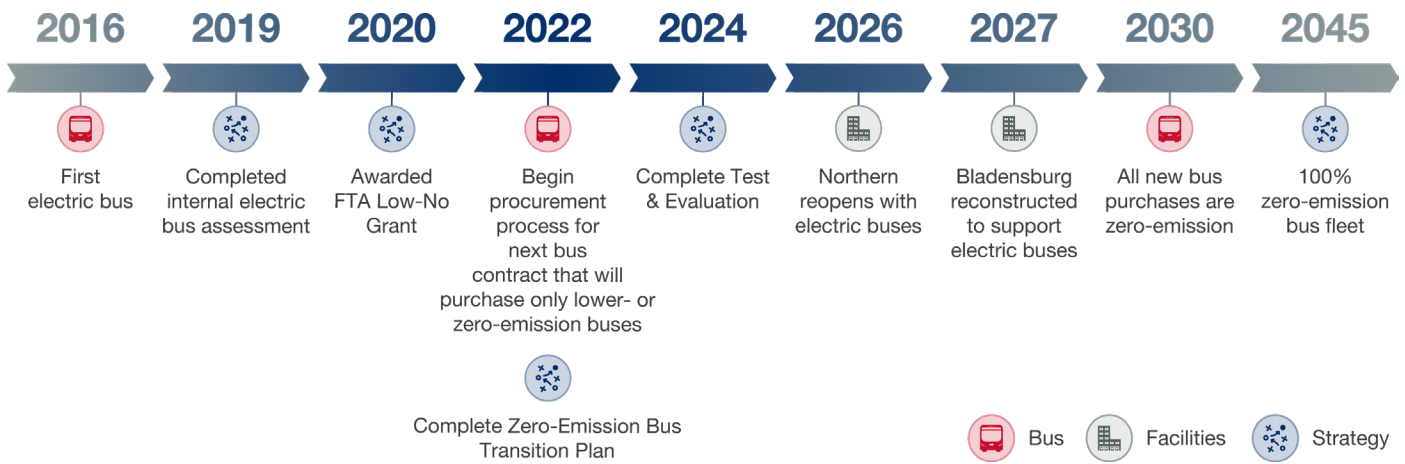
Figure 2. Electric Buses Have a Large Power Demand

A high-capacity connection estimated at **9MW** is required to charge 150 electric buses, equivalent to the capacity needed for 6,000 homes





Key Accomplishments and Next Steps

Figure 3. Timeline of Key Zero-Emission Bus Activities



Key Accomplishments

Over the past several years, Metro has created a foundation for transforming the bus fleet. The Authority has:

-  Conducted an initial, internal **Opportunities Analysis** to assess battery-electric bus technology, service, infrastructure requirements, and costs to inform and make recommendations for a battery-electric bus test and evaluation.
-  **Established Board-adopted goals** to transition the Metrobus fleet to zero-emission.
-  Revised the **Metrobus Fleet Management Plan** to incorporate Metro’s Board-adopted goals of 100% zero-emission bus purchases by 2030, and a 100% zero-emission bus fleet by 2045.
-  Launched a **Battery-Electric Bus Test and Evaluation** in which Metro is procuring 12 electric buses and associated charging equipment to operate from Shepherd Parkway Bus Division. The goal of this Test and Evaluation is to assess the interoperability of buses and chargers, and provide data and experience in Metrobus operating conditions that will help inform full roll out of this technology.
-  **Obtained a \$4.2 million grant** from the FTA Low or No Emission Program to support the purchase of two battery-electric buses and associated chargers that are part of the Battery-Electric Bus Test and Evaluation.
-  Initiated work on a **Zero-Emission Bus Transition Plan**, a holistic roadmap for organizational transition and investment in our fleet, facilities, internal workforce, and operations. The roadmap builds in important equity and resilience considerations. The phased plan will provide cost estimates for fleet and facility improvements, and help Metro determine the order and timing of facility conversions and other capital investments needed.
-  Incorporated **electric bus design into bus garages** currently undergoing redevelopment to take advantage of ongoing design and construction activities.
-  Established ongoing **engagement with regional utilities** to identify and plan for electric service capacity and infrastructure investment required for electrification.
-  Engaged other **regional transit agencies and stakeholders** to identify opportunities for coordination and collaboration.

Next Steps

In 2022, Metro will take key steps to continue our ambitious transition to a zero-emission bus fleet:

- ⌚ Execute the Battery-Electric Bus Test and Evaluation.
 - Design and construct the infrastructure needed at Shepherd Parkway to support electric bus charging equipment.
- ⌚ Develop Zero-Emission Bus Transition Plan.
- ⌚ Begin design for battery-electric bus infrastructure at Northern Bus Garage.
- ⌚ Continue engaging local utilities to identify, define, and plan for electric service capacity and infrastructure investment.
- ⌚ Continue coordinating with regional and national transit agencies to share lessons learned on zero-emission bus deployment.

