

THE DISTRICT OF COLUMBIA  
**TRANSPORTATION  
ELECTRIFICATION  
ROADMAP**



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## **DEAR WASHINGTONIANS,**

In 2019 the Department of Energy and Environment (DOEE) was tasked with developing a broad-ranging Transportation Electrification Roadmap, a guide to help the District and the public transportation sector pursue the electrification of their light, medium, and heavy-duty vehicles to help achieve the goal of Washington, DC becoming a carbon-neutral city by 2050. Reaching carbon neutrality will help the lives of our residents and surrounding communities, improve the air quality equitably, and usher in a cleaner future for those who call Washington, DC home.

With nearly 700,000 residents and 300,000 registered vehicles operating here, addressing the multiple barriers that restrain many who are interested in switching their vehicles to electric, and the many more who are unable to do so for a myriad of reasons, is critical. And we listened—we were determined throughout the process to engage with as many stakeholders as possible, and have highlighted the importance of continued discussion as this roadmap is adopted.

To be clear, this roadmap addresses only one section of our larger transportation infrastructure. Our transportation sector has many other needs and goals that are described in detail in other plans, such as moveDC and Sustainable DC 2.0, where mass transit, biking, and walking are identified as key elements of reducing our carbon and air pollution footprints. DOEE relied heavily on the work and experiences of its sister agencies to develop this roadmap.

The electric vehicle landscape continues to change, and this roadmap will require the diligence of the District government and stakeholders to adapt to those changes. We look forward to building upon this roadmap with stakeholder groups and welcome as many additional voices as possible to improve it so that all Washingtonians can live healthier, safer, stronger, and more equitable and resilient lives.



**Muriel Bowser**  
**Mayor, District of Columbia**

# DEFINITIONS

## Battery-Electric Vehicles (BEV)

BEVs use a battery to store the electric energy that powers the motor. The battery is charged by plugging the vehicle into charging equipment.

## Car Share

Car share is a service that gives members access to an automobile for short-term use – usually by the minute, hour, or day (e.g. Zipcar, Car2go).

## Carbon neutral

A state in which the net amount of carbon dioxide or other carbon compounds emitted into the atmosphere is reduced to zero because it is balanced by actions to reduce or offset these emissions.

## Direct Current Fast Charging (DCFC)

DCFC equipment (typically 208/480V AC three-phase input and less than 125 amps) enables rapid charging at a rate of at least 40 kW, with newer chargers rated up to 350 kW. Most commonly, DCFC can provide about 125 miles in 20-30 minutes.

## Electric Vehicle Supply Equipment (EVSE)

EVSE refers to all of the equipment associated with transferring electric energy to a battery or other energy storage device in an electric vehicle. This includes hardware, including connectors, fixtures, devices, and other components. This is commonly called a charging station.

## Electric Vehicles (EV)

EVs are vehicles powered, at least in part, by electricity. Unless otherwise noted, EV refers to all plug-in vehicles in this report, including PHEVs and BEVs.

## Greenhouse Gas Emissions (GHG)

Gases that trap heat in the atmosphere and contribute to the greenhouse effect, including carbon dioxide, methane, nitrous oxide, and fluorinated gases.

## Level 2 Charging

AC Level 2 EV charging offers charging through 240V (typical in residential applications) or 208V (typical in commercial applications) single-phase electrical service (like a dryer plug) at 12-80 amps (typically 32 amps). Level 2 EV chargers provide about 10-20 miles of range per hour of charging.

## Plug-in Hybrid Electric Vehicles (PHEV)

PHEVs are vehicles with both an internal combustion engine and an electric motor that can be powered either by gas or electricity through a rechargeable battery. PHEVs may be zero-emission vehicles if they're operated entirely as BEVs, but are not true ZEVs because the hybrid mode includes the use of an internal combustion engine.

## Ride-Hailing

A way for people to request rides to and from the location of their choice, typically using a smartphone app.

## Single-Occupancy Vehicle (SOV)

A motor vehicle containing only the driver.

## Transportation Network Companies (TNCs)

Programs, like ride-hailing apps, that provide prearranged and on-demand transportation services for compensation by connecting drivers of personal vehicles with passengers through mobile applications.

## Zero-Emission Vehicles (ZEV)

ZEVs are defined as those that emit zero pollutants (GHG or otherwise) during their operation, including emissions that result from fuel production.

# ACRONYMS

<b>ACCC</b>	American Cities Climate Challenge	<b>DDOT</b>	District Department of Transportation
<b>ADOPT</b>	Automotive Deployment Options Projection Tool	<b>DMOI</b>	Office of the Deputy Mayor for Operations and Infrastructure
<b>AFDC</b>	Alternative Fuels Data Center	<b>DC DMV</b>	District of Columbia Department of Motor Vehicles
<b>AFV</b>	Alternative Fuel Vehicle	<b>DOE</b>	United States Department of Energy
<b>ANC</b>	Advisory Neighborhood Commissions	<b>DOEE</b>	Department of Energy and Environment
<b>BEB</b>	Battery Electric Buses	<b>EPA</b>	United States Environmental Protection Agency
<b>BEV</b>	Battery Electric Vehicle	<b>EV</b>	Electric Vehicle
<b>BID</b>	Business Improvement Districts	<b>EVSE</b>	Electric Vehicle Supply Equipment
<b>CEDC Act</b>	Clean Energy Omnibus Amendment Act of 2018	<b>GHG</b>	Greenhouse Gas
<b>CEDC Plan</b>	Clean Energy DC Plan	<b>GVWR</b>	Gross Vehicle Weight Rating
<b>CO2</b>	Carbon Dioxide	<b>HOV</b>	High-Occupancy Vehicle
<b>DCFC</b>	Direct Current Fast Charger	<b>ICE</b>	Internal Combustion Engine
<b>DCPS</b>	DC Public Schools	<b>ILEV</b>	Inherently Low Emission Vehicles
<b>DCRA</b>	Department of Consumer and Regulatory Affairs	<b>kWh</b>	Kilowatt-Hour



<b>LDV</b>	Light-Duty Vehicle	<b>R-PIV</b>	Residential Service – Plug-in Vehicle Charging
<b>MOU</b>	Memorandum of Understanding	<b>SOV</b>	Single-Occupancy Vehicle
<b>MUD</b>	Multi-Unit Dwelling	<b>TBD</b>	To Be Determined
<b>NO<sub>x</sub></b>	Nitrogen Oxides	<b>TCI</b>	Transportation and Climate Initiative
<b>NREL</b>	National Renewable Energy Laboratory	<b>TCO</b>	Total Cost of Ownership
<b>OCFO</b>	Office of the Chief Financial Officer	<b>TEP</b>	Transportation Electrification Program
<b>OSSE</b>	Office of the State Superintendent of Education	<b>TNA</b>	Transportation Needs Assessment
<b>Pepco</b>	Potomac Electric Power Company	<b>TNC</b>	Transportation Network Company
<b>PEV</b>	Plug-in Electric Vehicle	<b>TOU</b>	Time of Use
<b>PHEV</b>	Plug-in Hybrid Electric Vehicle	<b>USDN</b>	Urban Sustainability Directors Network
<b>PIV-GREEN</b>	Plug-in Vehicle – Green Rider	<b>VMT</b>	Vehicle Miles Traveled
<b>PM<sub>2.5</sub></b>	Fine Particulate Matter	<b>VOC</b>	Volatile Organic Compounds
<b>PSC</b>	Public Service Commission	<b>ZEV</b>	Zero-Emission Vehicle
<b>REIA</b>	Racial Equity Impact Assessment		

# EXECUTIVE SUMMARY

The Transportation Electrification Roadmap (Roadmap) for the District of Columbia (District) is both a guiding document and plan of action to transition our local transportation sector to zero-emission vehicles by 2045. The Roadmap is designed to support the District's important goal of becoming carbon neutral by 2050.





Emissions from diesel- and gasoline-powered vehicles contribute approximately 22% of the District’s annual citywide greenhouse gas emissions (GHG) produced. The Roadmap focuses on the specific transportation goals of Title V of the Clean Energy DC Omnibus Amendment Act of 2018 that will reduce these greenhouse gas emissions from vehicles.

The Transportation Electrification Roadmap will:

- Identify and pursue short-term strategies for the District to achieve at least 25% zero-emission vehicle registrations by calendar year 2030.
- Inform and guide the District’s medium-term strategy for converting its public buses, high-capacity private passenger/light-duty vehicles, and commercial fleets to electric vehicles by 2045.
- Outline clear pathways to achieve 100% replacement of DC’s school buses with electric buses at the end of their useful life.

The Roadmap is one part of the District’s larger effort to meet climate goals and energy targets and not a comprehensive transportation plan. The Roadmap supports prioritizing the District’s efforts to mode shift away from single-occupant, non-battery electric vehicles first, then focus on electrifying buses and fleets. By taking the actions recommended in this Roadmap, the District will be able to reduce greenhouse gas emissions, helping to achieve the District’s GHG reduction target.

## ENGAGEMENT AND FEEDBACK PROCESS

The Roadmap was developed by working with District agency stakeholders, industry stakeholders integral to advancing transportation electrification, and the public. We were aware from the outset of the need to design and execute equitable engagement processes to provide all community members a voice in the development of the Roadmap.

To support this, the Department of Energy and Environment (DOEE) completed the Equitable EV Programs Engagement Workbook. The Workbook is designed to establish a solid framework to embed equity considerations into engagement activities. But, during development of this document, not all stakeholders may have been reached. COVID-19 restrictions limited engagement activities to exclusively virtual events. Each of eight sessions was designed to introduce the goals of the Roadmap, provide an update on a particular aspect of analysis being done to inform recommendations, and ensure the opportunity to provide feedback to shape the development of the Roadmap to best meet the needs of the District.

Additional feedback was gathered through survey responses, individual comments, and additional meetings.

## KEY AREAS OF CONSIDERATION

The Roadmap identifies several key areas of consideration for fostering an environment that will encourage rapid EV adoption. To meet the goals of the Roadmap, actions in all areas will need to be implemented.

## Electric Vehicle Charging Needs

To meet the goal of having 25% of the registered vehicles in the District as EVs by 2030, the number of EV chargers will need to increase. This includes residential, public, and workplace Level 2, and DCFC charging. DCFCs are extremely important for fleets such as taxis, ride-hailing fleets, and other high-mileage fleets to transition to electric.

EV charging expansion is recommended to be prioritized in three key geographic areas:

- High-traffic and commuting locations.
- Environmental Justice and Opportunity Areas.
- “Gap fill” areas, to improve the proximity of EV charging across the city, minimizing the distance to the nearest EV charging station for residents and travelers.

## Education and Outreach

Building awareness and educating District residents, businesses, organizations, and local officials is a critical component of accelerating local EV adoption rates and lowering the District’s GHG emission levels. The proposed Consumer EV Adoption Campaign will engage local and EV industry stakeholders in



strategic processes and actions that will stimulate EV adoption. The campaign would focus on several priorities including public and private fleet electrification, establishing different charging locations across the city, engaging dealerships and car sellers, ride and drive events, and fostering diversity, equity, and inclusion.

### EV-Related Policies

Electric vehicles and associated infrastructure have had higher upfront costs than comparable conventional gas vehicles. To drive early adoption to more mass adoption, a complementary suite of supportive EV and charging infrastructure policies are needed to make a critical difference in driving EV adoption and achieving the District's long-term emission reduction goals. Municipalities that have comprehensive supportive EV policies have the greatest EV adoption.<sup>1</sup> The policies recommended in this Roadmap are designed to maximize EV adoption and emission reductions in the District's transportation sector, and include policy implementation across all transportation modes.

### EV-Related Incentives

While detailing the programs currently underway by Pepco, our local electric utility, this document looks at EV electric demand loads and analyzes options for the creation of beneficial EV electricity rates to inform the EV electric billing rate development process in the District to help maximize predictability and savings from EV charging. Next steps for the DC Public Service Commission are cataloged as well.

### Bus Fleet Transition

In the goals put forth for the Roadmap, the District would transition District Government bus fleets, public buses, and school buses to zero-emission vehicles. In September 2021, the Washington Metropolitan Area Transit Authority (WMATA) announced its transition to



a zero-emission bus fleet by 2045.<sup>2</sup> The electrification of these transportation options is especially critical as it also contributes directly to the District's goals to reduce air pollution and GHG emissions.

The electrification of the bus fleet becomes ever more important with the District's mode shift goals. Avoiding tail-pipe emissions can have a significant impact on several underlying health conditions that are negatively impacted by air pollution. It also advances important equity goals, as Black and/or lower-income residents of the District tend to be disproportionately exposed to air pollution and have higher rates of chronic illnesses exacerbated by air pollution.

Already in the process of transitioning its fleet, the District Department of Transportation (DDOT) began the [Circulator Electric Bus Pilot](#) in April of 2018. This two-year pilot assessed and demonstrated the benefits of operating battery electric buses over operating a traditional diesel-powered fleet. Based on the results, DDOT has committed to transitioning its entire fleet to electric buses. At the same time, DDOT is currently developing its DC Circulator Sustainability Plan, which includes a comprehensive fleet transition

<sup>1</sup> The International Council on Clean Transportation. Evaluating electric vehicle market growth across U.S. cities. September 2021. <https://theicct.org/publications/ev-us-market-growth-cities-sept21>.

<sup>2</sup> WMATA. Zero-Emission Buses. Accessed September 18, 2021. <https://www.wmata.com/initiatives/plans/zero-emission-buses.cfm>

plan. To further increase the emissions reductions from an electric fleet, work has already begun to develop a solar photovoltaic array on a new bus-charging facility, with support from both a Low No Grant from the Federal Transit Administration awarded in 2021 and funding from DOEE. It is recommended that DDOT continue the planning and transition it has already begun, continuing to take advantage of federal funding opportunities and opportunities to partner with other District agencies.

A key part of the Roadmap is a pilot project involving the District's school bus fleet that will allow Office of the State Superintendent of Education (OSSE) fleet management staff to learn how to optimize the operations and maintenance of electric school buses while being able to meet the operational needs of the DC Public Schools (DCPS).

### **Federal Government Fleet and Incentive Coordination**

The District is in a unique position as the nation's capital. With the federal government's large footprint within the District, there is a large opportunity to streamline transportation electrification efforts and deliver significant economies of scale through coordinated infrastructure planning and bulk EV fleet purchases with our federal partners. Taking such steps is part of the recommendations in this Roadmap.

In February of 2022, the Federal Government released their guidance for the National Electric Vehicle Infrastructure Program (NEVI), which provides local and state governments with financial assistance to pursue transportation electrification goals. This is an example of one of many types of financial funding that previously were not available. The Roadmap strongly recommends the District Government to continue to pursue these incentives.

### **Adaptive and Dynamic Roadmap**

The transportation electrification market, technology, and opportunities are all emergent and rapidly evolving. Therefore, an approach that is static or too

prescriptive will be unable to provide the flexibility needed to take advantage of new information, new technologies, and synergies that may arise in the future. The recommendations in the Roadmap are meant to provide short-term and long-term actions that, along with input from the community and other stakeholders, provide guidance for achieving the District's transportation goals both now and into the future.

The Roadmap will be assessed in 2025 and every two years thereafter, to determine if the effort to achieve its goals is on track, what funding sources are available for its initiatives, and whether there are more effective or cost-efficient actions the District can take. Revisiting the Roadmap is also important because the EV market is young and evolving rapidly. Reevaluating the market periodically, with federal funding opportunities, will provide the best route towards analyzing the cost of implementing the Roadmap. In addition, since the Roadmap is goal-oriented, but does not include an estimated implementation budget, the recommendations will need to be prioritized and analyzed on an ongoing basis, taking into account the cost of implementation.

### **Starting Implementation**

Prior to the completion of the Roadmap, the Deputy Mayor for Operations and Infrastructure (DMOI) established a Transportation Electrification Working Group. The list of relevant agencies is available in Appendix D. Since the Working Group has recently been established, roles and responsibilities related to the Roadmap's recommendations are still being developed. The Working Group will be a key mechanism for the District Government to coordinate its Roadmap implementation strategy.

This Roadmap puts the District on a path to achieving its transportation electrification goals. Meeting ambitious energy reduction targets and greenhouse gas emissions reductions will allow the District to meet climate commitments and help maintain and improve the quality of life for District residents.



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## COMPLETE LIST OF RECOMMENDATIONS

### EQUITY

EQ.1

Analyze all transportation electrification plans, policies, and programs to prioritize and contribute to a green and equitable economy across all Wards.

### COMMUNITY ENGAGEMENT

CE.1

Within six months of the Roadmap's public release, continue community engagement convenings that make it easier for more people, particularly communities and people least represented, to gather input and feedback as Roadmap actions are implemented.

CE.2

Foster and support engagement through at least six public events through Advisory Neighborhood Commission (ANC) engagement targeted to low/middle-income and working-class communities in Wards 5, 7, and 8 to continue to include their voices to identify actions needed to support a fair and equitable transition to electric vehicles.

CE.3

Facilitate four EV-related training opportunities with labor unions, trade organizations, and other groups representing transit workers, electricians, or automotive service technicians to build a workforce that can support EVs and also deliver good-paying jobs for District residents by 2025.

CE.4

Host six educational opportunities by 2025 to encourage ANCs, large DC-area employers, commercial entities, Business Improvement Districts (BIDs), property developers, and other site hosts to install EV chargers to support the needs of their residents, customers, employees, and stakeholders.

CE.5

Within six months of the Roadmap's public release, create an interagency task force to guide and support District agencies implementing actions to achieve transportation electrification.

### ELECTRIC VEHICLE MARKET AND CHARGING NEEDS

EV.1

Within one year of the Roadmap's public release, using the charging gap analysis, identify 200 locations to install EV charging infrastructure to prioritize EV adoption, through incentives and priority funding, in areas historically overburdened by poor air quality.

EV.2

Build out public Level 2 charging by increasing chargers at a 2% ratio of District-registered EVs by 2025 with an emphasis on installations in Wards 5, 7, and 8.



**EV.3** Build out workplace Level 2 charging by increasing chargers to 2% of the estimated commuters driving into the District by 2025.

**EV.4** Expand public EV charging by deploying chargers at 50 District-owned properties, such as libraries, parks, and recreation centers, by 2025 with an emphasis on installations in Wards 5, 7, and 8.

**EV.5** Pursue or develop grant opportunities to fund pilot projects that support vehicle electrification and the future of existing gas stations.

**EV.6** Partner with National Park Service and other federal agencies to install or prompt the installation of EV charging stations in parking lots by recreation sites, such as Fort DuPont Park and Rock Creek Park, and at the National Arboretum, by 2025.

## EDUCATION AND OUTREACH

**EO.1** Offer public and private fleet managers suitable educational materials and sufficient resources by 2024 to support the transition to 100% electrified fleets by 2045.

**EO.2** Engage both community organizations and diverse public-interest groups through public meetings focused on the planning and implementation processes of the campaign to ensure that benefits are shared broadly, especially to low-income communities and/or communities of color, by 2024.

**EO.3** DOEE to create incentives for multi-unit dwelling (MUD) property owners to install EV chargers at MUDs so residents who do not have the opportunity to install their own charging equipment can charge their vehicles from home.

**EO.4** Connect with 100 local business leaders and employees to promote the benefits of EVs for them and the importance of accessible, low-cost workplace charging by 2024.

**EO.5** Educate 100 commercial property owners about the benefits that EV charging can provide tenants, their employees, and their customers by 2024.

**EO.6** Provide consumer adoption campaign materials to car dealerships within the DMV that educate and inform prospective EV buyers by 2024.

**EO.7** DOEE to host in a publicly accessible location EV and EVSE resources educating the public about EVs, their infrastructure, and available incentives within six months of public release of the Roadmap.

## EV RELATED POLICIES

- POL.1** Develop incentives for expanding public and residential EV charging infrastructure through the EV make-ready building code and code changes for existing buildings by DOEE.
- POL.2** Expand curbside charging access by offering a curbside charging program managed by DDOT by 2024.
- POL.3** Develop multi-unit dwelling EV infrastructure grants to increase residential charging infrastructure for tenants by 2025.
- POL.4** Expedite and streamline permitting of charging stations to reduce hurdles and shorten timeline for EV charger installations through DCRA by 2024.
- POL.5** Adopt Right-to-Charge legislation enabling MUD tenants and condominium-owners the right to install EV chargers, by 2025
- POL.6** Explore additional opportunities for low-cost charging options through partnership opportunities to expand residential EV charging, by 2024.
- POL.7** Develop EV purchasing incentives for new & used vehicles to increase EV adoption for taxicab fleets and low-income drivers.
- POL.8** Develop low-income EV leasing incentives to increase EV adoption in a market segment not currently reached.

## MUNICIPALITY ENGAGEMENT

- ME.1** DOEE to meet quarterly with Pepco to discuss infrastructure plans and prioritized locations.
- ME.2** Propose optimal electric rate design, including shifting EV charging to off-peak hours, for both light-duty vehicles and buses in coordination with Pepco, the Public Service Commission, and other stakeholders by 2025.
- ME.3** Analyze costs/benefits of the District's fleet vehicles with the DRVE Tool and other tools within six months of the Roadmap's public release.

## BUS FLEET TRANSITION

- BFT.1** Adopt and follow the DC Circulator Sustainability Plan that identifies the timeline and pathway to full electrification of the DC Circulator fleet by 2045.
- BFT.2** Pilot a 24-month program, comprising five to 10 type A battery electric buses and five to 10 electric passenger vans, in the OSSE fleet to gain operating and maintenance experience with electric buses, vehicles, and infrastructure.
- BFT.3** OSSE will continue to work with OCFO and complete by the end of 2022 a vehicle budget to purchase electric school buses to meet goals in the medium- and heavy-duty vehicle MOU.
- BFT.4** Train first responders in proper techniques to respond to incidents involving electric vehicles, particularly to address the differences in vehicle design that can present different hazards in a crash situation compared to vehicles with an internal combustion engine.
- BFT.5** Develop public messaging by 2024 around the public health and air quality benefits that electric buses offer the communities where they operate.
- BFT.6** DOEE and DDOT will collaborate with the Washington Metropolitan Area Transit Authority (WMATA) to identify opportunities to share infrastructure and optimize the complete transition to, and operation of, electric transit buses, thereby reducing greenhouse gas emissions and improving air quality.

## FEDERAL GOVERNMENT FLEET COORDINATION

- FGC.1** Identify opportunities, by 2023, for shared infrastructure with the Federal Energy Management Program, which helps the federal fleet community implement EVs and charging infrastructure.
- FGC.2** Coordinate, by 2023, bulk vehicle purchases and charging infrastructure with large District agency fleets and federal fleets acquiring light-, medium-, and heavy-duty electric vehicles.



# INTRODUCTION

In 2017, Mayor Muriel Bowser committed the District of Columbia (District) to the creation of a vision of what the District could and must become to face the realities of climate change, while centering principles of environmental justice in our work. Building upon the momentum of the [Sustainable DC 2.0 Plan](#) and [moveDC](#), the District set its focus on climate adaption in [Climate Ready DC](#), and on mitigation in [Clean Energy DC plan \(CEDC plan\)](#). With these plans and the District Government’s passage of the [Clean Energy Omnibus Amendment Act of 2018 \(CEDC Act\)](#), the District is ready to move from envisioning a sustainable and equitable future to building it.

The Transportation Electrification Roadmap (Roadmap) will guide the transition from traditional vehicles to electric vehicles. Designed to complement the activities of moveDC, enhance the outcomes of Climate Ready DC, and serve as implementation guidance for CEDC plan, the Roadmap:

- Establishes the District’s electrification vision,
- Articulates measurable actions,
- Illustrates how to achieve the goals, and
- Addresses roles for the District Government, the private sector, and the community.

Underlying these efforts are residents’ and businesses’ health and well-being; their ability to thrive and raise strong families; their ability to grow both personally and economically and, on a fundamental level, their ability to simply breathe without harming their health.

Tailpipe emissions have been linked to impaired lung development and increased likelihood of respiratory illness, heart disease, and premature death.<sup>3</sup> While nitrogen oxides (NO<sub>x</sub>), fine particulate matter (PM<sub>2.5</sub>), ozone, and other toxins are detrimental to overall public

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3 Department of Energy & Environment. Ambient Air Quality Trends Report 1996-2019. Accessed January 10, 2021. [https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service\\_content/attachments/2020%20Ambient%20Air%20Quality%20Trends%20Report.pdf](https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/2020%20Ambient%20Air%20Quality%20Trends%20Report.pdf)

health and are among some of the leading causes of death in the United States, transportation-related health risks disproportionately burden lower-income communities and communities of color. Transportation planning around the transition to zero-emissions vehicles, therefore, can address not only public health and sustainability but also longstanding issues related to environmental justice and equity, provided there is a sustained commitment to including and uplifting underrepresented communities.

Despite a focus on local efforts, the activities addressed in the Roadmap will have global impacts. Climate change knows no boundaries and, as with air pollution, the worst impacts of a warming climate will be experienced by those already at greater risk and with fewer resources to adapt. The transportation sector is one of the leading contributors to climate change, and, as a highly visible member of the global community, the District of Columbia provides leadership. Transforming the District's transportation sector from one based on fossil fuels to one powered by clean, renewable-generated electricity sources will lessen long-term climate change effects and demonstrate to the world that resilience and equity are not only local issues but rather global issues whose solutions have global partners and effects.

These actions will be an engine of growth and dynamism for the District. In July 2020, the District signed onto a collaborative multi-state effort to advance cleaner transportation options, joining 15 states to advance and accelerate the market for electric medium- and heavy-duty vehicles. The goal of the Medium- and Heavy-Duty ZEV Memorandum of Understanding (MOU) is to ensure that 100% of all new truck and bus sales are ZEVs by 2050, with an interim target of 30% by 2030.

All of the Roadmap's strategies are designed to complement existing activities and build upon the

District's current momentum to reduce greenhouse gas emissions and air pollutants from the transportation sector. Activities are further informed by initiatives that include the engagement of the Department of Energy and Environment (DOEE) – including the Bloomberg Philanthropies American Cities Climate Challenge (ACCC), a Circulator sustainability study, a carbon neutrality strategy, and a grid electrification that will serve as the District's Strategic Electrification Roadmap.

### AIR POLLUTANTS

Introduction of pollutants, or other unsafe materials, or organic molecules, into Earth's atmosphere. Air pollutants in the District mainly result from vehicle exhaust and air pollution transported from other areas.

Incorporated into the Roadmap are high-priority subjects emphasized in the District's existing plans. These are:

1. mode share changes,
2. increasing EV adoption,
3. electrifying the bus fleet, and
4. preparing for future transportation trends while committing to ensure that programs and policies are equitable, address diverse circumstances, and foster inclusion.

This Roadmap, in consultation with community and industry stakeholders, provides the District an in-depth examination of where the EV market is heading. It provides specific recommendations to foster the District's market development by expanding charging infrastructure and implementing policies that provide EV access to all residents.

# CURRENT LANDSCAPE OF THE DISTRICT

The District has put forth a suite of bold plans to transform itself into the healthiest, greenest, most livable city for all its residents. Approaching sustainability from various angles, the plans detail strategies and actions for progress to meet the District's ambitious justice, climate, and clean energy goals. The Transportation Electrification Roadmap is the next advancement in the complex undertaking of transforming the transportation sector now and into the future.



## Greenhouse Gas Emissions

Greenhouse gases generated from human activities have been a significant driver for climate change since the mid-20<sup>th</sup> century.<sup>4</sup> An excess of carbon in our atmosphere traps heat, leading to rising sea levels, changes in seasonal patterns, and an increase in the likelihood of extreme weather events, as the District has certainly witnessed over the last decade.

In the near term, the District will continue to see the local impacts of climate change in higher average temperatures, more frequent heat waves with up to two to three times as many dangerously hot days, more favorable conditions for high-ozone (poor air quality) days, and more frequent and intense heavy rain events, as well as higher tides resulting from rising sea levels across the Eastern seaboard, according to the Climate Ready DC report.

The connection to the transportation sector is undeniable. Emissions resulting from the burning of gasoline and diesel fuels in vehicles are consistently one of the leading contributors to climate change across the world. In 2019, transportation fuels

accounted for 22% of the District's citywide greenhouse gas emissions.<sup>5</sup>

By transitioning away from conventional vehicles and electrifying our transportation modes, fewer greenhouse gas emissions will be emitted, leading to a reduction in the severity of climate change's future impacts. As we move towards carbon neutrality across all sectors, an electrified transportation sector will be an integral component of our future mobility.

At the same time, electrifying the transportation sector improves the District's outcomes in the near term. Electrification reduces ground-level pollution and the compounding health impacts amid warmer temperatures.

## Air Quality

Air quality in the District has improved significantly in the last two decades, meeting the National Ambient Air Quality Standards for all criteria pollutants except for ground-level ozone. Air quality issues in the District are primarily due to emissions from vehicles and air pollution transported from other states.

4 U.S. Environmental Protection Agency. Climate Change Indicators: Greenhouse gases. Accessed September 26, 2021. <https://www.epa.gov/climate-indicators/greenhouse-gases>

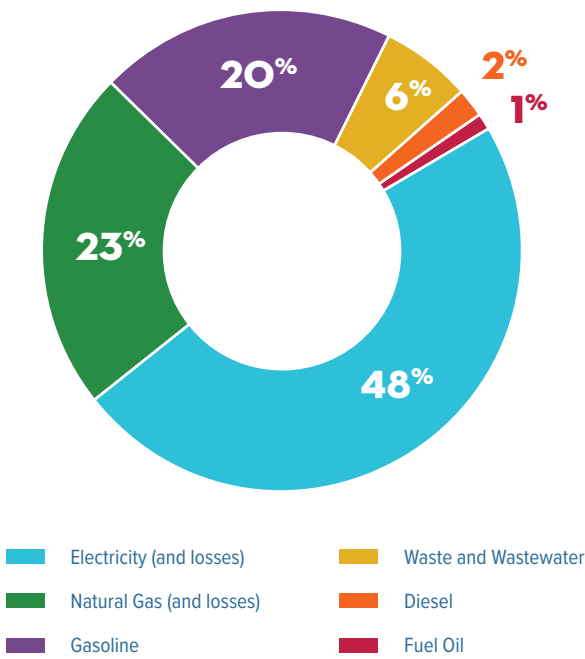
5 Department of Energy & Environment. Greenhouse Gas Inventories. Accessed October 28, 2021. <https://doee.dc.gov/service/greenhouse-gas-inventories>

FIG. 1



The District has completed six guiding plans regarding reducing carbon emissions and transportation: DDOT released its long-range transportation plan, MoveDC, for the District of Columbia in 2014 and 2022; DOEE released critical climate plans, Climate Ready DC in 2016, Clean Energy DC in 2018, and Sustainable DC 2.0 in 2019; DC Council passed and the Mayor signed the Clean Energy DC Omnibus Amendment Act of 2018 into law in 2019.

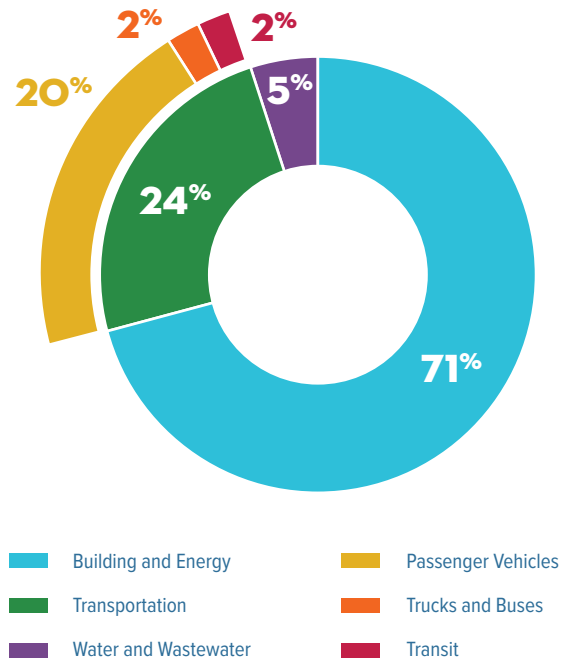
**GHG Emissions by Source (2019)**



**FIG. 2**

The District’s greenhouse gas emissions are broken down by fuel source.

**GHG Emissions by Sector (2019)**



**FIG. 3**

The District’s greenhouse gas emissions are broken down by sector. Transportation accounts for 24% of these emissions.

**Climate Change and Air Quality**

Climate change is contributing to worsening air quality in the form of extreme heat, drought, and catastrophic wildfires. Of particular importance in DC, increasing temperatures are leading to more favorable conditions for the formation of ground-level ozone pollution, and smoke from more frequent and intense wildfires contributes to particle pollution that can travel hundreds of miles. Due to climate change, the number of high-ozone days (days above 75 parts per billion) is expected to increase by 6-9 days annually in the District by 2050.<sup>6</sup> These risks and exposures

are not equally shared across our society, and many communities face greater exposures and are more vulnerable to the impacts of poor air quality and climate change.

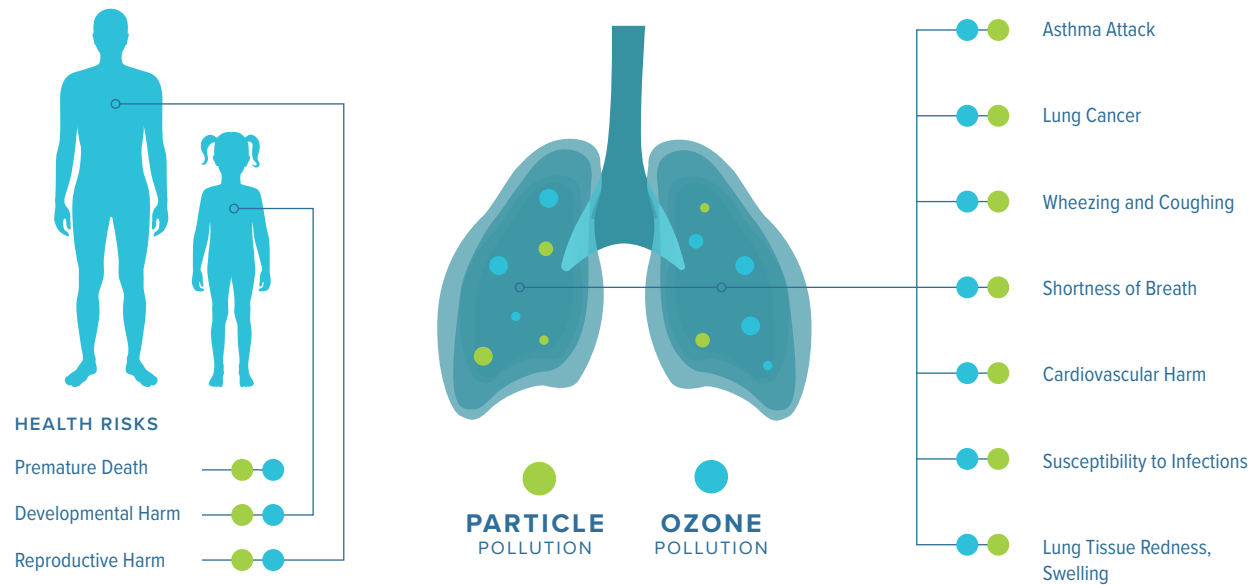
**Health Impacts of Air Quality**

Exposure to ozone and particle pollution contributes to a wide range of negative health effects and is especially dangerous to children, seniors, people living with asthma and other health conditions, people with lower incomes, and communities of color (Figure 4). Transportation represents over half of the total ozone- and particle-forming NO<sub>x</sub> emissions in the United States. Transportation sources also contribute to particle pollution and local diesel exhaust impacts that threaten lung health. Major trucking corridors, warehouse distribution centers, and other diesel hot spots close to major population sectors inflict serious

6 Shen L., Mickley L. J., and Gilleland E. “Impact of increasing heat waves on U.S. ozone episodes in the 2050s: Results from a multimodel analysis using extreme value theory.” *Geophysical Research Letters*. 2016. Accessed: <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2016GL068432>



## Air Pollution Remains a Major Danger to the Health of Children and Adults



**FIG. 4**

Air pollutants harmful health effects

harms to human health and often highlight disparities in the impacts of transportation pollution burdens. In the District, diesel vehicles are modeled to be the second-largest source of ozone pollution in 2023, behind nonroad equipment.<sup>7</sup>

In the District, transportation as a whole makes up 11% of PM<sub>2.5</sub> and 48% of NO<sub>x</sub> inventory, based on 2017 National Emissions Inventory data. The same modeling of 2023 ozone formation finds that transportation contributes up to 20% ozone levels on peak days.

Black residents in the District experienced three times as many deaths per capita from cardiovascular disease from 2016-2018 as their White counterparts.<sup>8</sup>

In the District, children who live in predominantly Black communities have asthma-related emergency department visit rates significantly higher - in some cases, nearly 20 times higher - than their counterparts in majority White communities (Figure 5).<sup>9</sup> Using the U.S. Environmental Protection Agency’s (EPA) BenMap tool, DOEE evaluated the reduced mortality that would have occurred in 2017 through 2019 had our region experienced ozone levels attaining a 65 parts per

### GREENHOUSE GASES (GHG)

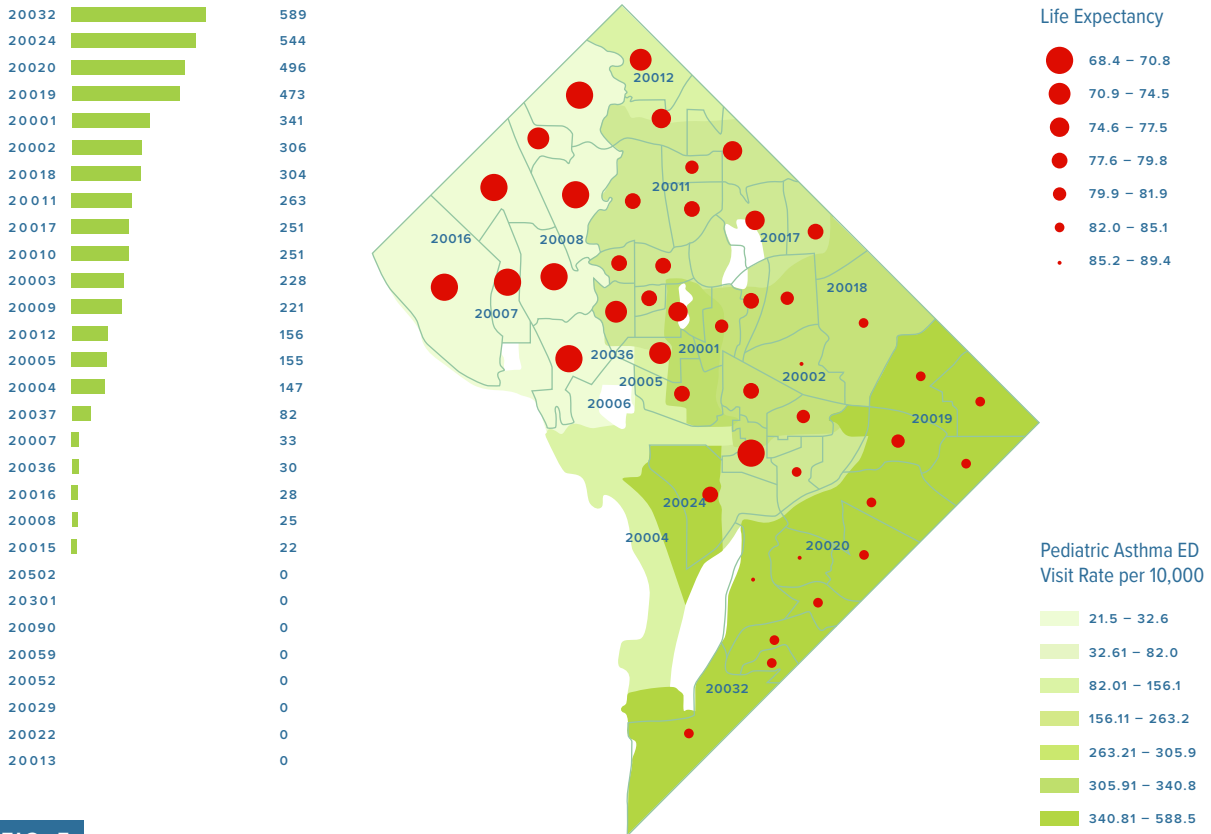
Gases that trap heat in the atmosphere and contribute to the greenhouse effect, including carbon dioxide, methane, ozone, and fluorocarbons.

7 Ozone Transport Commission. “Technical Support Document for the 2011 Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union Modeling Platform – Second Revision.” September 2018.

8 Center for Disease Control. Interactive Atlas of Heart Disease and Stroke. Accessed August 26, 2020. <https://nccd.cdc.gov/DHDSAtlas/Default.aspx?state=DC>.

9 Health Equity Report for the District of Columbia 2018.

### Rate Per 10,000 Pediatric (Age 2-17) Asthma Emergency Room Visits



**FIG. 5**

**Data Source** Hospital Discharge Data 2014 – 2016, DC Hospital Association  
**Data Analysis** Center for Policy, Planning and Evaluation, DC Department of Health

billion ozone National Ambient Air Quality Standard. Had that been the case, there would have been fewer deaths due to short-term ozone exposure—deaths which came at an economic cost of \$95 million to the District.

**ZEVs and Air Quality**

Vehicle emissions can be divided into two general categories: air pollutants, which contribute to smog, haze, and health problems; and greenhouse gases (GHGs), such as carbon dioxide and methane. Conventional vehicles with an internal combustion engine (ICE) produce direct emissions through the tailpipe, as well as through evaporation from the vehicle’s fuel system and during the fueling process. Conversely, ZEVs produce zero direct or upstream emissions. Direct emissions are important due to the

location and time that pollution occurs concerning air quality. Direct emissions are more likely to occur near where people live, work, and play, and can often be centralized near activity hubs creating “hot spots” of poor air quality, contributing to environmental inequities in the District. Second, direct emissions from cars tend to cluster during peak travel times, contributing to high-ozone days.

Under the requirements of the CEDC Act, we expect to see emission reductions of 0.0652 tons of NO<sub>x</sub>, 0.0012 tons of PM<sub>2.5</sub>, and 0.0159 tons of volatile organic compounds (VOC) by switching school buses to electric. We expect 1.99 tons of NO<sub>x</sub>, 0.034 tons of PM<sub>2.5</sub>, and 0.236 tons of VOCs to be reduced from the Circulator transit bus fleet.

According to the American Lung Association’s “Road to Clean Air” report, the widespread transition to zero-emission transportation technologies could produce emission reductions in 2050 that could add up to \$72 billion in avoided health harms nationwide, saving approximately 6,300 lives and avoiding more than 93,000 asthma attacks and 416,000 lost work days annually due to significant reductions in transportation-related pollution.<sup>10</sup> In the District, annually 10 avoided deaths would be expected by 2050, with 142 avoided asthma attacks, and 829 avoided lost work days and a cost savings of over \$110,000,000 annually due to PM<sub>2.5</sub> reduction alone (not including ozone). While this report relies on a rapid adoption of personal EVs and is, therefore, an overestimate of the current transportation plan, it illustrates what is possible under rapid EV adoption. As such, this report does not supersede the District’s moveDC Plan, nor should it be used to determine grid infrastructure needs. The District

can expect a benefit of a portion of these reductions through the current plan to electrify fleets outlined in the CEDC Act.

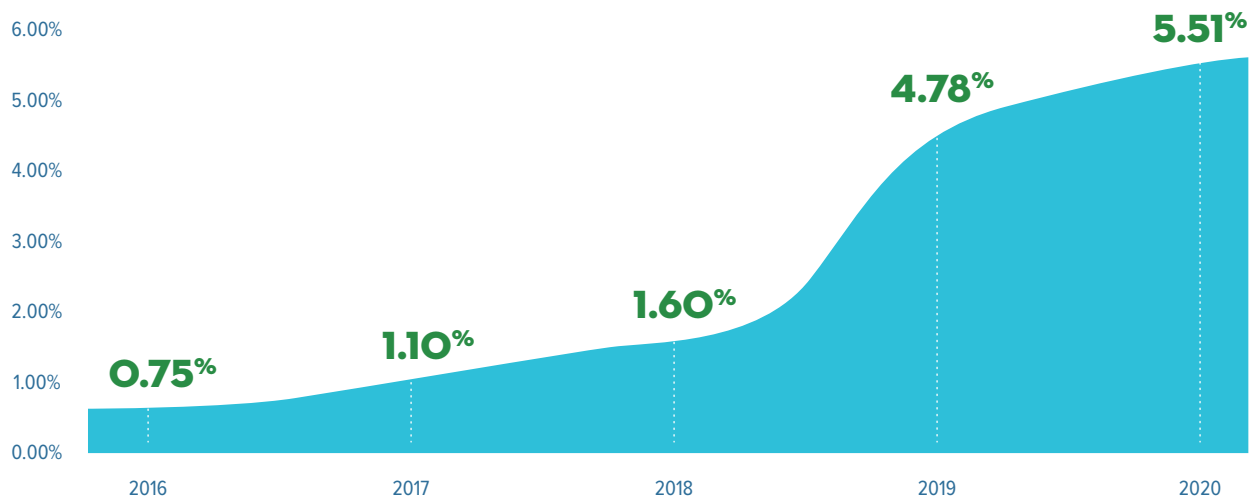
### Historical and Current EV Sales in District of Columbia

EV ownership in the District has historically been relatively low, partly due to a lower overall vehicle registration rate relative to the surrounding region. IHS Markit and District Department of Motor Vehicles (DMV) data from 2020 indicates that there are approximately 3,500 DC-registered EVs on the road, with a broader 11,000 EVs on the road in the greater DC metro region. As EV ownership has grown over this time, so too has its share of new vehicle purchases (Figure 6).

Nationally, 5% of new vehicle purchases are electric or plug-in hybrid electric vehicles (PHEV). EV and PHEV adoption in the District has grown every year since 2016, and in 2021 was trending above the national average with 6% of new vehicles being EVs or PHEVs. Of these new purchases, Tesla, Chevrolet, and Ford

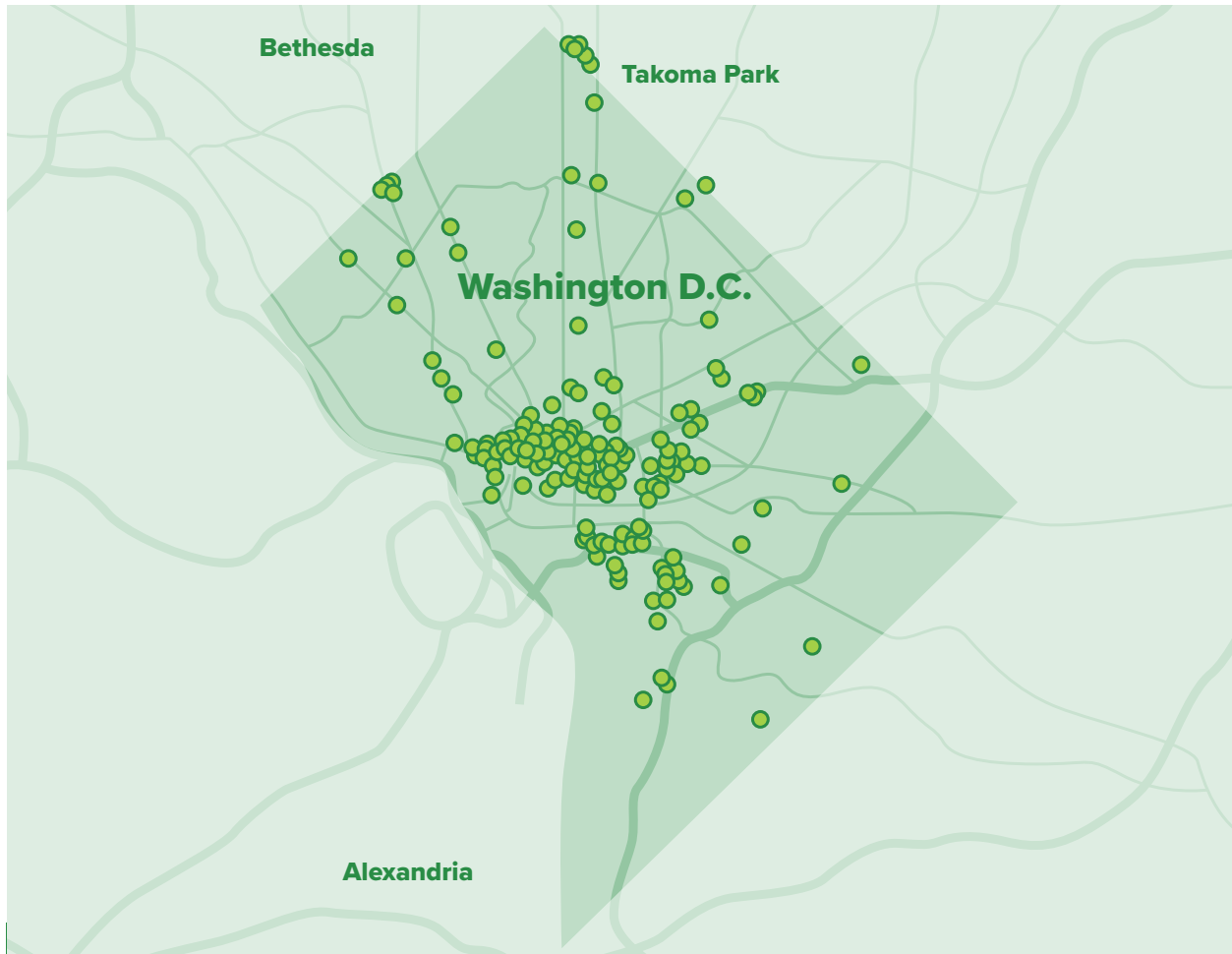
10 American Lung Association. Road to Clean Air: Benefits of a Nationwide Transition to Electric Vehicles. 2020.

### EVs as Percent of New Sales, Washington, D.C.



**FIG. 6**

EV registration continues to increase rapidly as a share of new vehicles.

**FIG. 7** Current EV Charging Deployment

237 public Level 2 EV charging stations with 628 charging ports; 8 public DCFC locations with 39 DCFC ports;  
46 private charging stations with 138 ports

were the most popular for manufacturer choice.

Following the national trend, battery electric vehicles (BEVs) have led in popularity for purchase over plug-in hybrid vehicles (PHEV) across the District. From 2016 to 2020, 62% of new EVs in DC were BEV.

### Current Available EV Charging

Available public EV charging in the District is shown in Figure 7.<sup>11</sup>

### Existing EV-Related Policies

The District of Columbia has several existing EV-related enacted policies and initiatives encouraging EV adoption and EV charger installation (Table 1). The District offers a few policies and incentives for qualifying EVs and infrastructure. Some of the newer programs, such as the utility programs offered by Pepco, are recent additions and are being evaluated for their effectiveness as EVs become more mainstream and more people begin to own them.

11 U.S. Department of Energy. Alternative Fueling Station Locator. Alternative Fuels Data Center. Accessed November 2021. <https://afdc.energy.gov/stations/#/find/nearest?location=DC&fuel=ELEC&country=US>

**Table 1 | Existing EV-Related Policies in the District of Columbia and Identified Target Market Sector**

	POLICY	PRIVATE/ RESIDENTIAL	PUBLIC/ COMMERCIAL	GOVERNMENT
MONETARY	<a href="#">Alternative Fuel Vehicle (AFV) Conversion Tax Credit</a>	●	●	
	<a href="#">AFV Infrastructure Tax Credit</a>	●	●	
	<a href="#">Reduce Registration Fee for AFVs and Fuel-Efficient Vehicles</a>	●	●	
	<a href="#">Plug-In Electric Vehicle (PEV) Title Excise Tax Exemption</a>	●	●	
OPERATIONAL INCENTIVES/ REQUIREMENTS	<a href="#">AFV Exemption from Driving Restrictions</a>		●	
	<a href="#">AFV Acquisition Requirements</a>		●	
	<a href="#">Passenger Vehicle Procurement Requirements</a>			●
	<a href="#">Emissions Reduction Plan for Transportation Network Companies (TNCs)</a>		●	
	<a href="#">ZEV Deployment Support (Fleet Electrification Requirements &amp; EV City Goals)</a>	●	●	
	<a href="#">EV-Ready Building Codes</a>	●	●	
CITY GOALS/ SUPPORTIVE EV PROGRAMS	<a href="#">Medium- &amp; Heavy-Duty ZEV MOU Signatory</a>	●	●	●
	<a href="#">Transportation and Climate Initiative Program (TCI-P)</a>	●	●	●
	<a href="#">AFV and Infrastructure Support</a>		●	
	<a href="#">Low-Emission Vehicle Standards</a>	●	●	●
UTILITY PROGRAMS	<a href="#">Utility EVSE Program Authorization</a>	●	●	●
	<a href="#">Potential Residential Time of Use Rate</a>	●		
	<a href="#">Public Charging Make-Ready Program</a>		●	
	<a href="#">EVSE Support for Buses, Taxis, and Ride-Share Vehicles</a>		●	



**EQUITY**

## EQUITY

## EQ.1

Analyze all transportation electrification plans, policies, and programs to prioritize and contribute to a green and equitable economy across all Wards.

The District recognizes how actions affect vulnerable, underserved, marginalized, low-income, and/or communities of color. Across the nation and within the District, the legacy of redlining and racial covenants have created persistent inequality in the present. Through these policies, the needs and concerns of communities of color have been excluded from the decision-making processes that impact their environment. As a result, disempowered by policy and its implementation, residents in these communities have been subjected to compounding negative impacts.

Bus depots, high-traffic roadways, and freight distribution hubs are often sited in low-income neighborhoods and communities of color, leading to greater exposure to toxic air pollution. The U.S. EPA notes that Black residents, regardless of income, have exposure rates 25% higher than white residents, leading to greater health complications such as heart disease, lung disease, and asthma.<sup>12</sup> Inclusion is a critical component of equity, and this requires communities of color and low-income residents to have the opportunity to formulate and guide the objectives of the Roadmap's implementation.

Community members in areas that have borne disproportionately the adverse impacts of transportation emissions, such as communities in Wards 5, 7, and 8, should be consulted as to the Roadmap's implementation. By strategic coordination with other local educational or training efforts, EV adoption can help overcome barriers to inclusion that

typically inhibit the participation of residents from under-resourced backgrounds and communities in the clean energy economy, and ensure the District avoids further exacerbating existing health and economic inequalities. This would require more direct investments and public financing.

**For actions in the Roadmap that would require legislation from the Council of the District of Columbia, a racial equity impact assessment (REIA) would need to be conducted.<sup>13</sup> An REIA examines how a proposed bill will affect different racial and ethnic groups in the District.**



<sup>12</sup> U.S. Environmental Protection Agency. Study finds exposure to air pollution higher for people of color regardless of region or income. September 20, 2021. Accessed October 28, 2021. <https://www.epa.gov/sciencematters/study-finds-exposure-air-pollution-higher-people-color-regardless-region-or-income>

<sup>13</sup> Council Office of Racial Equity. Racial Equity Impact Assessments. Accessed October 29, 2021. <https://www.dcraciaequity.org/racial-equity-impact-assessments>



# COMMUNITY ENGAGEMENT



## COMMUNITY ENGAGEMENT

- CE.1** Within six months of the Roadmap’s public release, continue community engagement convenings that make it easier for more people, particularly communities and people least represented, to gather input and feedback as Roadmap actions are implemented.
- CE.2** Foster and support engagement through at least six public events through Advisory Neighborhood Commission (ANC) engagement targeted to low/middle-income and working-class communities in Wards 5, 7, and 8 to continue to include their voices to identify actions needed to support a fair and equitable transition to electric vehicles.
- CE.3** Facilitate four EV-related training opportunities with labor unions, trade organizations, and other groups representing transit workers, electricians, or automotive service technicians to build a workforce that can support EVs and also deliver good-paying jobs for District residents by 2025.
- CE.4** Host six educational opportunities by 2025 to encourage ANCs, large DC-area employers, commercial entities, Business Improvement Districts (BIDs), property developers, and other site hosts to install EV chargers to support the needs of their residents, customers, employees, and stakeholders.
- CE.5** Within six months of the Roadmap’s public release, create an interagency task force to guide and support District agencies implementing actions to achieve transportation electrification.

DOEE prioritized equitable outcomes and stakeholder engagement during the Transportation Electrification Roadmap’s development and implementation. To truly ensure that electrification leads to improvement and empowerment in the District, the communities in the District impacted by electrification must be heard. To meet people where they are, various methods of engagement are employed to ensure the inclusion of the District’s multiple interests. This includes educating the public about the effort to electrify transportation modes as well as providing a platform for stakeholders to share their concerns and desires about the plan’s impact in the community. Inclusive engagement is an iterative approach. Its success is not only measured by the amount of community participation, but also through the incorporation of community feedback into the approach.

The vision of DOEE’s transportation electrification efforts is one where environmental justice issues have been addressed, under-represented residents have been able to actively participate, their voices have been empowered, and their experiences and needs have ensured that how transportation is electrified in the District happens with those needs and experiences in mind. The Stakeholder Engagement Plan (Plan) found in Appendix A was designed to achieve these objectives. Stakeholders reflective of the District’s various community interests were identified and added to the Stakeholder Roster, including individuals/residents, advocates, non-profit entities, and private retail/commercial interests. Central to the engagement plan was a series of virtual engagement sessions, which were promoted with the assistance of DOEE to solicit broad public participation. The robust



response to the Roadmap’s engagement efforts—good attendance at each session, discussion, email correspondence, and one-on-one meetings with interested parties—indicated strong interest in transportation electrification and validated the need for opportunities to receive public comments on the District’s transportation electrification plans.

## 1

### The Stakeholder Engagement Roster and Engagement Plan

The goal of the stakeholder engagement activities was to provide a space to illuminate the experiences and needs of under-represented District residents and to provide an opportunity for this insight to influence how a transition to emissions-free transportation will be implemented. In line with DOEE’s commitment to equitable outcomes, a Stakeholder Engagement Roster (Roster) was compiled by researching and identifying transportation/environmental/community advocates, non-profit entities, and private-sector interests who, together, could represent the diverse perspectives within the District. The Roster was further expanded after consultations with several District Government

representatives, many of whom undertake community engagement as part of their work. The contacts on the Roster were engaged for participation in the Stakeholder Engagement Feedback Sessions.

A Stakeholder Engagement Plan (Appendix A) was also developed, outlining the focus of each month’s virtual Stakeholder Equity Feedback Group convening, its target audience, and social media content developed to encourage public participation. DOEE’s Office of Community Engagement and Outreach (OCEO) promoted each session in various District newsletters and on official social media channels.

## 2

### The Stakeholder Equity Feedback Group

The Stakeholder Equity Feedback Group provided a dynamic forum for education, fostering inclusion, and gathering insights from the community. Overall, 198 people attended the eight virtual Stakeholder Equity Feedback Group sessions.

Each hour-long session was designed with three objectives. First, attendees were introduced to the goals of the District’s transportation electrification plan. Second, attendees were provided with an update on the analysis being done by the Electrification Coalition (EC), which would inform the policies and programs proposed to ensure the Roadmap’s success. Finally, each session ensured the opportunity for public feedback, encouraging the community’s sharing of its perspective on possible changes, improvements, anticipated impacts, or unintended consequences of the Roadmap’s proposed actions. To better facilitate discussion, some sessions included smaller breakout groups. As well, post-session surveys were sent out to participants to provide additional opportunities for input. Each session has been recorded for posterity and is available on the [District’s webpage](#).

A Transportation Needs Assessment survey was developed for the District to further understand the mobility experience for residents. The 32-question survey informed the process with a general

understanding of how residents currently move through the District. As well, the survey took a deeper dive into the specific mobility opportunities presented through the Roadmap, engaging participant insight into the likelihood of adoption.

Response to the Stakeholder Equity Feedback Group sessions has been very strong, with multiple parties reaching out to program staff with questions or to provide further feedback—via email, in separate meetings, or with invitations to make separate presentations to other interested groups.

### 3

#### Stakeholder Feedback Results and Equity Implications

Stakeholder feedback was received on virtually every aspect related to transportation electrification. However, the topic receiving the most feedback was EV charging and the equitable placement of EV chargers. Insight ranged from concerns regarding the ability of low-income families to take part in the electrification effort to how the public right of ways may be used to everyone’s advantage. Summary results organized by topic are provided in Appendix A.

This stakeholder engagement process is only the first step as the District begins this ambitious electrification undertaking. Although the process’s foundation is developed, inclusion is an iterative process and will continue throughout the implementation of the Roadmap to ensure the best possible outcomes for all of the District’s residents.

The completion of the Equitable EV Programs Engagement Workbook with DOEE leadership has established a solid framework to embed equity considerations into future engagement activities. As well, several organizations have self-identified as potential partners throughout this stakeholder process. The District will leverage these organizations’ existing relationships to engage specific audiences and participants as public engagement continues.

#### DOEE’S ENGAGEMENT

# 471

Registrants for the stakeholder feedback group

# 49

Stakeholders from various District Government departments

# 198

Stakeholder session attendees

# 26

Survey responses

# 8

Stakeholder feedback sessions

# 8

Additional email inquiries

# 7

External meetings

#### MOST POPULAR TOPIC

**Equitable EVSE Placement**  
(most attendants outside the initial orientation session)



# **ELECTRIC VEHICLE MARKET AND CHARGING NEEDS**

## ELECTRIC VEHICLE MARKET AND CHARGING NEEDS

- EV.1** Within one year of the Roadmap’s public release, using the charging gap analysis, identify 200 locations to install EV charging infrastructure to prioritize EV adoption, through incentives and priority funding, in areas historically overburdened by poor air quality.
- EV.2** Build out public Level 2 charging by increasing chargers at a 2% ratio of District-registered EVs by 2025 with an emphasis on installations in Wards 5, 7, and 8.
- EV.3** Build out workplace Level 2 charging by increasing chargers to 2% of the estimated commuters driving into the District by 2025.
- EV.4** Expand public EV charging by deploying chargers at 50 District-owned properties, such as libraries, parks, and recreation centers, by 2025 with an emphasis on installations in Wards 5, 7, and 8.
- EV.5** Pursue or develop grant opportunities to fund pilot projects that support vehicle electrification and the future of existing gas stations.
- EV.6** Partner with National Park Service and other federal agencies to install or prompt the installation of EV charging stations in parking lots by recreation sites, such as Fort DuPont Park and Rock Creek Park, and at the National Arboretum, by 2025.

With a goal of 25% of registered vehicles being EVs by the calendar year 2030, the District continues to prioritize a reduction in tailpipe emissions, advancing climate change mitigation, and advancing the equitable access of EV charging infrastructure. Sitting at the nexus of commuter towns in Maryland and Virginia, the District must consider policies it should implement to complement the existing and complex matrix of policies throughout the region. Those policies include incentives and regulatory forcing measures like the [ZEV program](#), which requires vehicle manufacturers to begin selling an increasing number of ZEVs in states adopting the program.

Achieving this goal requires many elements to align. Public EV charging will need to expand to address access issues for EV owners who may be unable to install charging at home. Dealerships serving District residents will need to change and expand their vehicle inventories as adoption increases in response to the District’s policies. At the same time, drivers will need to adjust their vehicle refueling behaviors.

To be responsive to the anticipated growth in EV adoption, the District needs to understand the likely trajectory of adoption in the forthcoming years, both within the District and in the larger metro region.

## FORECASTING EV ADOPTION - ANALYTICAL METHODOLOGY

To anticipate how consumer EV adoption throughout the District will grow and scale, an analysis was conducted using the National Renewable Energy Laboratory (NREL) Electrification Futures Study, which forecasts demand for electrification technologies state by state. The Automotive Deployment Options Projection Tool (ADOPT) tool was designed by NREL to estimate consumer choice in the light-duty vehicle market. This tool estimates sales based on multiple attributes, including vehicle price, fuel cost per mile, performance, demographics, and policies that may influence sales. Here, ADOPT was utilized to develop forecasts for high (favorable set of conditions for electrification), medium (electrification that is plausible but not transformational), and low (business as usual) levels of EV consumer adoption.

Utilizing District of Columbia Department of Motor Vehicle (DC DMV) data and applying it to NREL modeling, consumer EV adoption in the District could reach a projected range of 11% (low scenario) to 34% (high scenario) of new vehicles purchased by 2030 (Figure 8). The scenarios are all tightly aligned between 2020 and 2022. In 2023, the medium and high uptake scenarios accelerate and EV adoption begins to

increase rapidly. By 2027 and beyond, the medium and high scenarios are anticipated to diverge, reflecting lower battery costs and new vehicles expected to come to market.

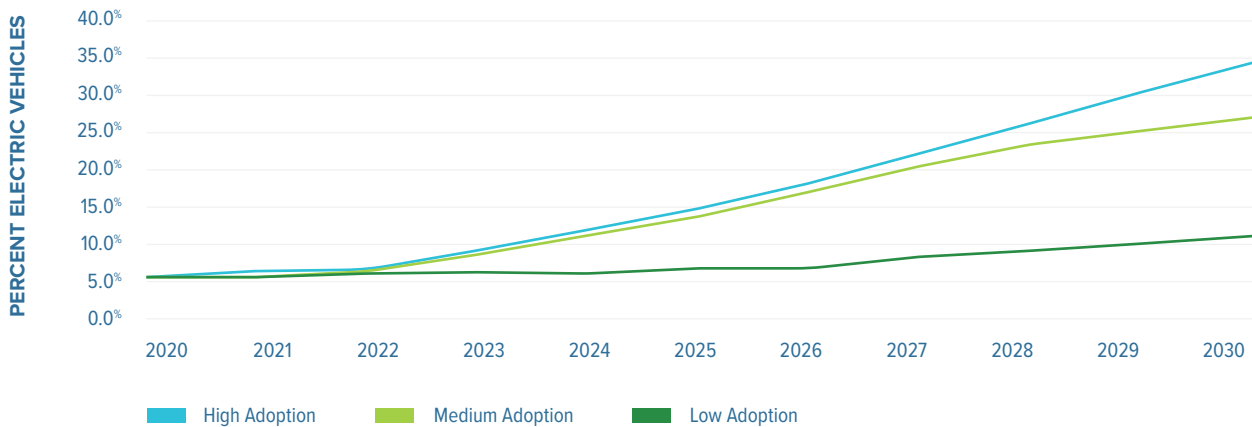
DC DMV data indicates there were 296,000 personal vehicles registered within the District at the end of 2020. Assuming this number of vehicles holds constant over time, the District could expect a range of 20,427 to 62,376 District-registered EVs and the associated charging needs by 2030.

## EV CHARGING STATIONS

Charging access is a crucial component of EV ownership. Publicly accessible EV charging supports current EV owners and encourages the new adoption of EVs for those who may be unable to install EV chargers at home. Many District residents live in multi-unit dwellings (MUDs) or do not have off-street parking, which is typically needed to make dedicated home EV charging feasible. The primary priority is deploying electric vehicle supply equipment (EVSE), or EV chargers, to support access for MUDs, and across public, private, and workplace locations.

As property owners with a vested interest in the community’s improvement, District Government facilities possess an opportunity to increase

**FIG. 8** Percent EVs of Total Registered Vehicles (PHEV and BEV), 2020–2030



**Table 2 | Estimated Number of EVs in Washington, D.C. by Scenario, 2020–2030**

SCENARIO	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
HIGH	10,049	11,673	12,220	16,779	21,886	26,993	33,194	40,307	47,785	55,263	62,376
MEDIUM	10,049	10,396	11,490	15,685	20,427	25,169	30,823	37,207	42,496	45,779	49,062
LOW	10,049	10,872	10,943	11,125	11,427	11,673	12,402	14,591	16,597	18,603	20,427

EV charging access. The District will evaluate potential District-owned properties where charging infrastructure can be installed. Through public-private partnerships, the District can accelerate EV charger expansion by offering a mechanism where EV charging equipment providers install, own, and operate EV chargers as public facilities. In this manner, owners can recoup the installation and operating costs, while the public has increased opportunities for EV charging. The District will also identify opportunities for reducing charging costs for low-income EV drivers through public-private partnerships.

Charging strategies must consider both Level 2 EV charging and Direct Current Fast Charging (DCFC) to account for a variety of charging needs. There are benefits and tradeoffs to the different levels of charging. Level 2 chargers are much less expensive to install and operate, leading to a lower cost of charging. In many scenarios, Level 2 charging can be installed in more locations with no or little electrical upgrades. However, Level 2 charging is best suited for locations where cars will likely be parked for longer durations—for example, in residential neighborhoods, retail centers, and fitness centers.

DCFC is not available to all PHEVs at this time. Most PHEVs are not capable of using DCFCs. However, for equipped cars, it is a preferred charging method for driving long distances or for vehicles that are driving all day, such as ride-hailing cars or taxicabs. DCFC is much more expensive to install and requires a much higher electrical demand, often requiring electrical equipment upgrades. In some instances, the available

power demand in a particular location may not be adequate for that charger. In turn, the cost to charge at one will be higher. DCFC will require a higher degree of installation planning. Figure 9 details the different levels of EV charging.

### Public Level 2 Charging

Figure 10 summarizes the number of estimated public Level 2 charging ports needed to support EV growth from 2020–2030. More deployment will be needed to meet the growing EV inventory.

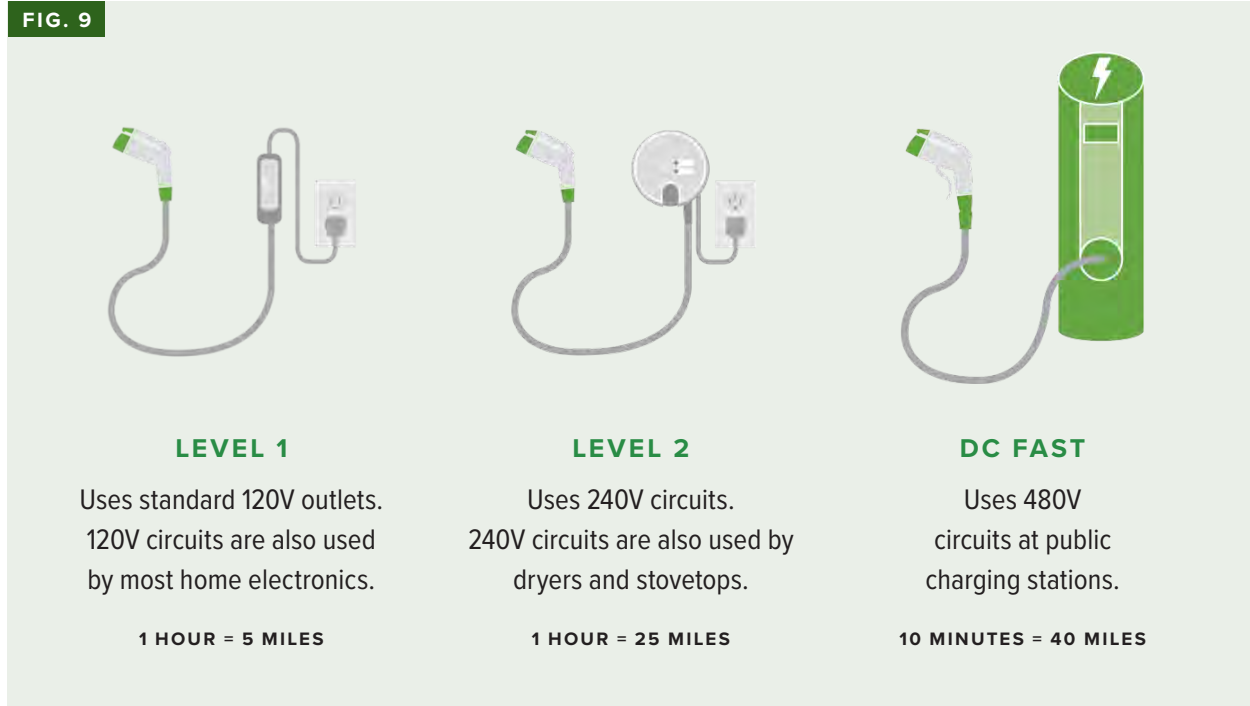
### Workplace Charging

An estimated 200,000 daily commuters enter the District,<sup>14</sup> primarily from Maryland and Virginia. Maryland has a goal to have 300,000 ZEVs on the road by 2025.<sup>15</sup> Virginia passed the Clean Cars Virginia bill requiring manufacturers to deliver an increasing percentage of EVs for sale in the state. With these neighboring states increasing their number of EVs, commuters will be driving these EVs into the District and may need to charge. Workplace charging needs, which are projected below, reflect that with an increase in District-registered vehicles and likely commuter uptake, additional workplace charging will be required. Figure 11 helps to illustrate the estimated number of

14 Metropolitan Washington Council of Governments. 2019 State of the Commute Survey Report. June 17, 2020. <https://www.mwcoq.org/documents/2020/06/17/state-of-the-commute-survey-report--carsharing-state-of-the-commute-travel-surveys/>

15 Maryland Department of the Environment. Zero Emission Vehicles. Accessed September 12, 2021. <https://mde.maryland.gov/programs/air/mobilesources/pages/zev.aspx>

## EV Charging Levels



workplace Level 2 charging ports needed to support EV growth in the region from 2020–2030. As the COVID-19 public health crisis decreases, there may be a shift to the return to the workplace. Target numbers may need to be revised based on the new normal once established.

### Direct Current Fast Charging

Direct Current Fast Charging (DCFC) provides quick, convenient charging for vehicles on the go and can be an excellent application for people passing through or areas with dense concentrations of EVs and especially high-usage EVs such as ride-shares and taxicabs. DCFC provides important access for both individual drivers and a transitioning taxi and ride-hailing fleet. Figure 12 helps illustrate the estimated number of DCFC ports needed to support EV growth in the region from 2020–2030. Building out a reliable fast-charging network will reduce barriers for these for-hire fleets, allowing for expanded electrification of multi-modal options.

Currently, the District is home to eight DCFC stations with 41 individual ports available for public use, slightly ahead of the recommended DCFC charging availability needed for 2021. However, to meet the ambitious goals established in the Roadmap, the District must plan to rapidly build out the DCFC network. To meet this need in 2022 and beyond, a Charging Plan of Action is included in Appendix B as a step-by-step guide for navigating the siting and deployment of EV charging for site hosts.

Additionally, as the District considers a Charging Plan of Action, it should also consider the role gas stations play in the future of EV charging infrastructure, including serving as electric mobility hubs. The opportunity to reimagine gas station functions could look like these “ehubs” that provide a range of mobility options specific to the needs of the surrounding neighborhood. In addition to EV charging, they could include electric micro-mobility options; services for users while they wait for their car to charge such as a small grocery store or café; and even storage and transport for last mile delivery.



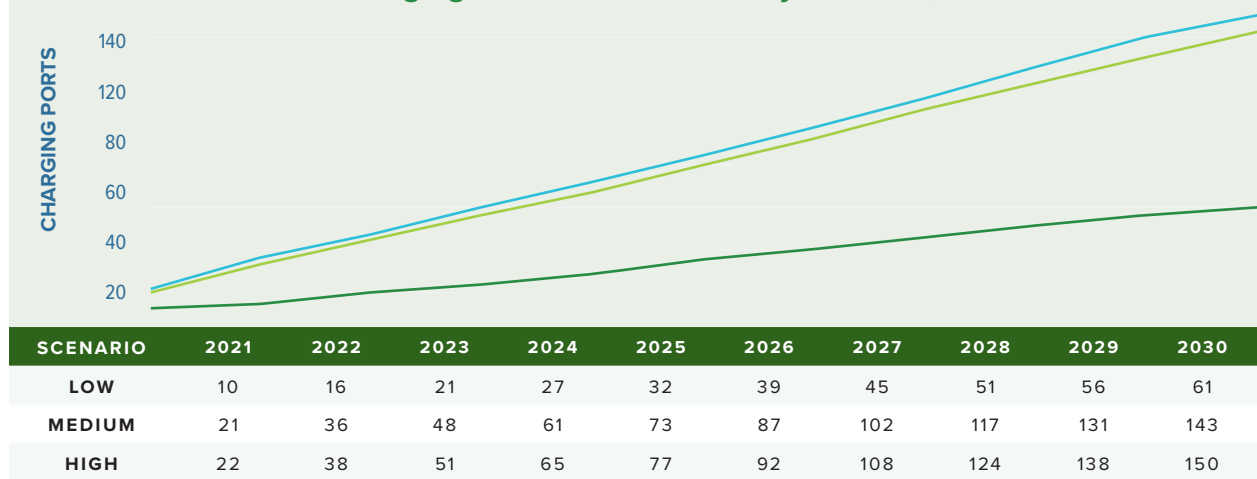
**FIG. 10** Est. Level 2 Charging Ports in the District by Scenario, 2020–2030



**FIG. 11** Est. Workplace Charging Ports in the District by Scenario, 2020–2030



**FIG. 12** Est. DC Fast Charging Ports in the District by Scenario, 2020–2030



■ High Adoption    
 ■ Medium Adoption    
 ■ Low Adoption



# **EDUCATION AND OUTREACH**

## EDUCATION AND OUTREACH

- EO.1** Offer public and private fleet managers suitable educational materials and sufficient resources by 2024 to support the transition to 100% electrified fleets by 2045.
- EO.2** Engage both community organizations and diverse public-interest groups through public meetings focused on the planning and implementation processes of the campaign to ensure that benefits are shared broadly, especially to low-income communities and/or communities of color, by 2024.
- EO.3** DOEE to create incentives for multi-unit dwelling (MUD) property owners to install EV chargers at MUDs so residents who do not have the opportunity to install their own charging equipment can charge their vehicles from home.
- EO.4** Connect with 100 local business leaders and employees to promote the benefits of EVs for them and the importance of accessible, low-cost workplace charging by 2024.
- EO.5** Educate 100 commercial property owners about the benefits that EV charging can provide tenants, their employees, and their customers by 2024.
- EO.6** Provide consumer adoption campaign materials to car dealerships within the DMV that educate and inform prospective EV buyers by 2024.
- EO.7** DOEE to host in a publicly accessible location EV and EVSE resources educating the public about EVs, their infrastructure, and available incentives within six months of public release of the Roadmap.

Engagement and education with District residents, businesses, organizations, and local officials is a critical component of accelerating local EV adoption rates and lowering the District's GHG and air pollution emission levels. Hands-on, tailored consumer engagement yields positive results, and the more directly a campaign can engage with its target audience, the better. Understanding what matters to District residents and what they require and desire to electrify their transportation—whether it is reduced total cost of ownership (TCO), how the vehicle feels to drive, reduced air and noise pollution benefits, or local

charging availability—has assisted in the development of a tailored EV consumer adoption campaign.

### CONSUMER EV ADOPTION CAMPAIGN

The District's Consumer EV Adoption Campaign engages local and EV industry stakeholders in strategic processes and actions that will stimulate EV adoption within the target area. The campaign has been designed to identify drivers of change in and around the District and organize them to

work in concert with one another to implement tailored, proof-of-concept strategies and actions that will help engage, educate, and excite local fleets and consumers about the benefits of adopting EVs. The elements of the Consumer EV Adoption Campaign are as follows:

### **Fleet Electrification**

Educating fleet managers about the operational and fiscal benefits of incorporating electric vehicles into their fleets, as well as providing clear-cut options and methods for EV adoption, is the foundation that fleets need to transition to electric. Engaging these fleets in the Climate Mayors EV Purchasing Collaborative is an effective way to educate fleet managers on what products are available, provide discounted procurement options, and facilitate connections with other fleets that have or are currently electrifying their fleets.

### **Prioritizing Diversity, Equity, and Inclusion**

Engaging community organizations and diverse public-interest groups in the planning and implementation processes of the campaign enhances the campaign's inclusivity and benefits for all residents, especially low-income communities and communities of color. Step-by-step guides for engaging local public-interest groups in the campaign planning and execution process are available in the consumer adoption campaign inventory.

### **Residential Charging**

Most EV drivers do more than 80% of their charging at home. In a dense metropolitan area such as the District, there is a large population that does not live in single-family homes where they can easily charge their vehicle and will be more reliant on accessible public charging stations. Engagement with local policymakers, multi-unit dwelling property owners, and EV charging solution providers will be crucial to educate them about the needs of residents and determine solutions for EV drivers to charge their vehicles at or near the home.

### **Workplace Charging**

Connecting with local business leadership and employees and educating them about the benefits of EVs and the importance of accessible, low-cost workplace charging can positively influence local EV adoption and EV charging expansion. It is recommended that business groups such as the Chamber of Commerce are engaged to reach a wide range of local businesses and promote involvement in workshops or webinars about workplace charging.

### **Public Charging**

Engagement with retail property owners, City Government, and Federal Government is necessary to educate them about the mutual benefits that installing EV charging can provide to property owners and local EV drivers, with benefits to the entire community of cleaner air to the extent EVs replace gas-powered vehicles. Points of interest, such as retail centers, and publicly owned locations, such as libraries, community parks, rec centers, and parking garages, are key locations for public EV charging stations, especially in a dense metro area where residents have limited access to at-home charging.

### **Dealership Engagement**

Identifying car dealerships that serve District consumers and informing them about the campaign, the importance, and benefits of their participation, as well as providing them with EV educational information and opportunities to engage with prospective EV buyers can increase EV sales and benefit dealerships and consumers. Target dealerships can receive basic EV and EV charging 101 documents, overview documents, and engagement opportunity information to support their consumer engagement and drive consumers towards the campaign.

### **Communications and Outreach**

Tailoring educational EV and EVSE resources, as well as promotional campaign materials, and making them easily accessible to consumers, will draw attention to

campaign initiatives and educate consumers about EVs. This will be accomplished through social media outreach, virtual and in-person engagements (in accordance with local COVID-19 laws and guidance), and creating an informational website/webpage.

### Ride-and-Drive Events

Providing an immersive, hands-on educational experience for consumers where they can drive a variety of available EVs (in accordance with local COVID-19 laws and guidance), learn about vehicle specifics and ownership benefits from campaign staff/volunteers, discover financial incentives, and get connected with local salespeople can significantly heighten local EV adoption.

# 6X

How much more an employee with access to workplace EV charging drives an EV than an average worker.<sup>16</sup>

By fostering an ecosystem of campaign stakeholders to strategize execution of these campaign elements, the District can accelerate consumer and fleet EV adoption.

<sup>16</sup> U.S. Department of Energy. Workplace Charging Challenge Progress Update 2016: A New Sustainable Commute. 2016.





# **EV-RELATED POLICIES**

## EV-RELATED POLICIES

POL.1

Develop incentives for expanding public and residential EV charging infrastructure through the EV make-ready building code and code changes for existing buildings by DOEE.

POL.2

Expand curbside charging access by offering a curbside charging program managed by DDOT by 2024.

POL.3

Develop multi-unit dwelling EV infrastructure grants to increase residential charging infrastructure for tenants by 2025.

POL.4

Expedite and streamline permitting of charging stations to reduce hurdles and shorten the timeline for EV charger installations through DCRA by 2024.

POL.5

Adopt Right-to-Charge legislation enabling MUD tenants and condominium-owners the right to install EV chargers, by 2025

POL.6

Explore additional opportunities for low-cost charging options through partnership opportunities to expand residential EV charging, by 2024.

POL.7

Develop EV purchasing incentives for new and used vehicles to increase EV adoption for taxicab fleets and low-income drivers.

POL.8

Develop low-income EV leasing incentives to increase EV adoption in a market segment not currently reached.

While the District should overall prioritize mode shifting for the transportation space and GHG impacts specifically to incentivize walking, biking, and mass transit, the policies here are to help those who are looking to replace gas-powered internal combustion vehicles with electric vehicles. Electric vehicles and associated infrastructure have had higher upfront costs than comparable conventional gas vehicles, though upfront price parity with gas vehicles is expected to be achieved by 2025, if not sooner. EVs offer a potential lower total cost of ownership due to lower maintenance costs with fewer moving parts<sup>17</sup> and lower refueling costs, especially with home charging.

In our approach to mode shift then electrify the rest, to drive early adoption to more mass-scale adoption, a complementary suite of supportive EV and charging infrastructure policies are needed to make a critical difference in driving the uptake of EV adoption and achieving the District's long-term emission reduction goals.

Cities and states with the greatest EV adoption have strong and comprehensive supportive policies that

17 Preston, B. Pay Less for Vehicle Maintenance with an EV. September 20, 2020. Consumer Reports. Accessed October 28, 2021. <https://www.consumerreports.org/car-repair-maintenance/pay-less-for-vehicle-maintenance-with-an-ev/>

are combined with a mix of actions from local entities, regional groups, and utilities.<sup>18</sup> The following section provides a framework to maximize EV adoption and emission reductions in the District’s transportation sector while also including policy implementation across all transportation modes.

EV charging infrastructure is a key component of supporting growth of the EV market in the District. A 2020 study by *Consumer Reports* identified concerns around EV charging as the highest-ranked barrier for potential consumers to purchase an EV; “not enough charging stations” was the highest-ranked concern, selected by 48% of respondents as a top three concern. Additionally, four of the top five and five of the top nine incentive programs identified in the survey as most likely to encourage EV adoption involved EV charging.<sup>19</sup> Thus, policies and incentives around EV charging infrastructure are an imperative complement to driving EV adoption within the District.

These policies and incentives should also be designed with access and equity in mind. While the prototypical EV owner has had access to dedicated parking and home charging, the next waves of EV owners will be those who need comparable charging opportunities in dense urban areas, in MUDs, and in areas with no dedicated parking spot to charge. This is particularly relevant for the District, where single-family homes make up a small portion of the overall residential building stock. Policies should also be equitably designed to ensure access to charging infrastructure in historically disadvantaged communities. Building out an EV charging network within the public right-of-way will be a key component of the District’s strategic plan. Sufficient infrastructure will provide the visibility and availability needed to reduce adoption barriers and enable those communities to realize all the benefits of EV adoption, such as lower operational costs and improved air quality.

18 The International Council on Clean Transportation. Evaluating electric vehicle market growth across U.S. cities. September 2021. <https://theicct.org/publications/ev-us-market-growth-cities-sept21>.

19 *Consumer Reports*. Consumer Knowledge and Interest of Electric Vehicles. December 2020. <https://advocacy.consumerreports.org/wp-content/uploads/2020/12/CR-National-EV-Survey-December-2020-2.pdf>

### Transportation Modes Cost Analysis

An annual cost comparison between various personal transportation options using District-specific transportation data is illustrated in Table 3. Electrified public transportation is the most efficient

**Table 3 | Annual Avg. Fuel & Upkeep Cost Comparison Between Transportation Options**

	ANNUAL VEHICLE MILES TRAVELLED IN THE DISTRICT (MILES)	MILES PER GALLON (2018 LDV AVG.)	COST PER GALLON	KILOWATT HOUR (KWH) PER MILE	COST PER KWH	UPKEEP COST PER MILE	ANNUAL TOTAL FUEL AND MAINTENANCE COST
ICE	7,013	24.9	\$2.39	N/A	N/A	\$0.079	\$1,227.17
BEV	7,013	N/A	N/A	0.270	\$0.13	\$0.024	\$414.47
E-BIKE	7,013	N/A	N/A	0.020	\$0.13	\$0.046	\$340.83



and cost-effective form of long-distance commuting. However, the District is not forecasted to mode shift all private vehicle travel to public transportation or zero-emission options such as walking or non-electric biking. Therefore, the District is expected to need to emphasize and incentivize the use of electrified personal transportation vehicles for those unable to mode shift and to meet the needs of public and private fleet owners, including public transit operators. The data below highlights the operational financial benefit of shifting as many commuters away from ICE vehicle commutes in gas-powered vehicles and towards more efficient and cost-effective private transportation modes such as electric bikes and EVs. The typical gas vehicle costs almost three times more to operate and maintain compared to an EV in the District and over three-and-a-half times more to operate and maintain compared to an electric bike. Further, as battery costs decrease and energy density in batteries continues to improve, the cost savings of using EVs and electric bikes over conventional gas-powered vehicles will continue to increase. Incentivizing the use of EVs and electric bikes would therefore not only substantially reduce transportation emissions in the District but would also increase the discretionary income of its residents.

The analysis above reinforces the need to prioritize transportation policies highlighted in the [Greenlining Institute's equitable mobility framework](#). MoveDC, the long-term transportation plan, is focused on investing in transportation programs that address future needs of all District residents. In addition to programs and funds for walking, biking, and public transportation, available funds can be allocated by prioritization towards electrifying private vehicle sharing, commercial and government fleets, followed by policies that support electrification of private vehicles to advance electrified transportation, which will eliminate emissions.

### Policy Recommendations and Impact

A strategic framework for emissions reduction and equity policy prioritization guided policy recommendations. The prioritization framework

is based on the Greenlining Institute's urban transportation equity analysis and provides the basis for all policy recommendations provided. The goal of the transportation strategy (Figure 13) is to increase access to high-quality mobility options, reduce air pollution, and increase access to economic opportunities in low-income communities of color. This framework will help to support the District in its efforts to mode shift, reduce vehicle miles and emissions, and improve transportation equity.

There are a host of policies that municipalities can enact to encourage EV adoption. Policy recommendations come from the comprehensive analysis of transportation policy options based on emission impact, equity impact, and relative financial costs. Those that are of high impact and most beneficial are the recommendations to undertake first.

Preparing for 25% of District-registered vehicles by calendar year 2030 requires equitable and robust charging opportunities. It enables consumer confidence and supports public and private-sector fleet transition to EVs.

One of the most cost-effective policies any municipality can implement is requiring new buildings to be pre-wired and ready for EV charging. Adopting EV-ready building codes offers significant equity benefits, as the policy applies to MUD buildings and commercial buildings where workplace charging can add charging for those without home charging access. The District has passed an EV-ready building code requirement for new or substantially renovated MUDs or commercial buildings with three or more off-street parking spaces. Under this building code, these facilities must include EV make-ready infrastructure for 20% of the parking spaces—meaning wiring and the electrical capacity to support charging must be in place. DOEE is determining incentives for property owners who install EV make-ready infrastructure in a greater percentage than required.

Increasing home charging access for residents in MUDs is critically important for accelerating EV adoption. Several jurisdictions have enacted laws to address

**FIG. 13** Current EV Charging Deployment



District Electrification and Equity Strategy Prioritization (Descending)

tenant and condominium owners’ right to install EV chargers. For instance, in California, residential and commercial condominiums, cooperatives, planned communities, and residential and commercial lessors may not unreasonably restrict unit owners and lessees from installing EV chargers in their designated parking spaces.<sup>20</sup> Massachusetts signed into law a home rule petition for the City of Boston that grants a right to Boston condominium owners to install EVSE on or near their parking spaces.<sup>21</sup> The right to charge is subject to reasonable restrictions, and the unit owner or lessee is responsible for all costs.

In tandem with ensuring the right to charge, creating incentives or providing grants to increase residential charging at MUDs is important for improving equitable access. Moreover, educational materials for property owners that lay out the key information they need to make the decision to install EV chargers and effectively navigate the installation process on their property will further support EV expansion.

Additionally, expanding charging in the public right-of-way at parking spots along the curbside will provide more charging options for residents, commuters, and visitors. DDOT designed a rulemaking that supports the expansion of publicly accessible EV chargers. When the rulemaking is released, it will include a wide promotion with accompanying material to explain the program and educate District residents of its purpose.

The District will also consider other low-cost charging options to expand residential charging access. These can include opportunities through partnerships or innovative solutions such as creating specifications for charging from residents’ houses.

One barrier for increased EV charging installations is complex and lengthy permitting processes. This can be remedied by streamlining the permitting process for approving and installing charging infrastructure. It can entail an online permitting process and

20 See Cal. Civ. Code. §§ 4745, 4745.1, 1947.6, 1952.7 and 6713.

21 See 2018 Mass. Acts ch. 370.



centralized permitting. A step-by-step guide or checklist also helps clarify the process making it easy to follow and complete. A few cities, such as Chicago, Illinois; Houston, Texas; and Rochester, New York, and the state of California, have streamlined their permitting processes.<sup>22</sup>

With the high priority of more public transit and active transportation trips, the District is implementing policies and programs that increase access to these modes of transportation. However, there will be trips that use a single-occupancy vehicle (SOV), be it a personal vehicle or car-share, or vehicles that taxi or ride-hailing fleets use. A common way to provide incentives for EV purchases is through rebates. Funding for rebates can be raised through a variety of revenue

streams, including fees for registering conventional gas or diesel vehicles, gasoline taxes, or general fund dollars. The District will identify and incorporate transportation equity goals as part of any incentives programs. Programs can be structured in a variety of ways. For example, eligible vehicles can have a price cap or applicants could have to meet an income requirement. The Clean Vehicle Assistance Program provides grants and affordable financing to help low-income Californians purchase a new or used hybrid or electric vehicle.<sup>23</sup> Rebate programs offered can include the purchase of EVs or the expansion of EV chargers for light-, medium-, and heavy-duty vehicles. Developing leasing incentives will also open up the EV market to a market segment not currently reached.

22 Electrification Coalition and American Cities Climate Challenge. Electrifying Transportation Municipalities: A policy toolkit for electric vehicle deployment and adoption at the local level. August 2021. <https://www.electrificationcoalition.org/wp-content/uploads/2021/08/Electrifying-Transportation-in-Municipalities-FINAL-9.9.21.pdf>.

23 Clean Vehicle Assistance Program. Accessed on September 29, 2021. <https://cleanvehiclegrants.org/>



# **MUNICIPALITY ENGAGEMENT**

## MUNICIPALITY ENGAGEMENT

- ME.1** DOEE to meet quarterly with Pepco to discuss infrastructure plans and prioritized locations.
- ME.2** Propose optimal electric rate design, including shifting EV charging to off-peak hours, for both light-duty vehicles and buses in coordination with Pepco, the Public Service Commission, and other stakeholders by 2025.
- ME.3** Analyze costs/benefits of the District’s fleet vehicles with the DRVE Tool and other tools within six months of the Roadmap’s public release.

## CURRENT ELECTRIC UTILITY TRANSPORTATION ELECTRIFICATION PROGRAMS

On September 6, 2018, Pepco submitted a Transportation Electrification Program (TEP) to the Public Service Commission (PSC) of the District of Columbia, as directed in Order No. 19143. On April 12, 2019, the PSC approved Pepco to provide “make ready” infrastructure to support the EV charging stations as a part of Offerings 7, 8, 10, and 11.<sup>24</sup> The definition of what is included in “make ready” infrastructure is pending an Order by the Commission.<sup>25</sup>

24 DC Public Service Commission Order No. 19898, April 12, 2019. <https://edocket.dcpssc.org/apis/api/Filing/download?attachId=84361&guidFileName=c302b307-c4b3-40e3-bf2e-3c8d9e064e64.pdf>

## BEST PRACTICES AND CASE STUDIES OF BENEFICIAL EV ELECTRICITY RATES

The District supports the development of beneficial EV TOU rates. Further, we recommend that customers who purchase energy from other suppliers and who own EVs still be permitted to take advantage of the TOU delivery charges through this rate. While it is critically important that supply rates be time-differentiated to incentivize customers to shift load to cleaner, non-peak periods, there are still potential benefits associated with time-varying delivery rates that should not be neglected. A well-designed TOU will help to ensure that new and

25 DC Public Service Commission Order No. 21162, June 3, 2022. <https://edocket.dcpssc.org/apis/api/Filing/download?attachId=169859&guidFileName=c20d5904-a1b7-47df-b035-f69632e62c75.pdf>



**Table 5 | Summary of Approved Offerings as a Part of the Pepco TEP<sup>26</sup>**

	DESCRIPTION	NOTES
OFFERING 1	Residential Whole House TOU Rate	Pepco was directed to file an updated tariff to facilitate the deployment of EV charging stations.
OFFERING 7	Public Neighborhood Smart Level 2 EVSE	Approved for up to 55 public charging stations (35 Smart L2 and 20 DCFC) and to provide “make ready” infrastructure. Pepco directed to detail distribution rates for these chargers.
OFFERING 8	DC Fast Chargers	
OFFERING 10	Electric Taxi / Ride-share Infrastructure	Directs Pepco to update tariffs as necessary to ensure that EV charging station owners/operators can offer services under these tariffs, up to 10 Smart L2 and DCFC.
OFFERING 11	Electric Bus Infrastructure	Approved for the deployment of “make ready” infrastructure for public busing, and develop necessary tariffs for owners/operators, up to 5 depot and 1 on-route chargers.

existing load associated with customer adoption of EVs does not result in unmanaged consumption that leads to costly increases in system capacity, which could ultimately hinder the ability of the District to cost-effectively achieve its climate goals through electrification.<sup>27</sup> Electricity rates need to be designed in a way that allows EV owners to easily realize fuel savings over traditional vehicles. Figure 15 details some of these rate design considerations.

Another significant component of rate design is a demand charge. One of the primary considerations to the deployment of DCFC and the electrification of large fleet depots is the demand charges that can quickly ruin the business case for owners/operators.

In particular, DCFC with low utilization rates, as can be expected in the early EV market, and fleet facilities with significant electricity requirements can find demand charges, which are based on the maximum amount of electricity used at any point in time during the billing cycle, an insurmountable challenge to achieving profitability. While proper charging strategies should be utilized, demand charges provide guides to avoid significant impacts on the grid. The District recommends that the long-term solution to tariffs for DCFC charging will be based on new tariffs designed based on marginal costs.<sup>28</sup> Listed below are some examples of strategies to address early adoption use cases and overcome demand charge issues.<sup>29</sup>

- **EV-specific rate structures** – In response to 80% of RTD’s electric bus fleet fuel costs being

26 DC Public Service Commission, Order No. 19898, April 12, 2019. <https://edocket.dcpssc.org/apis/api/Filing/download?attachId=84361&quidFileName=c302b307-c4b3-40e3-bf2e-3c8d9e064e64.pdf>

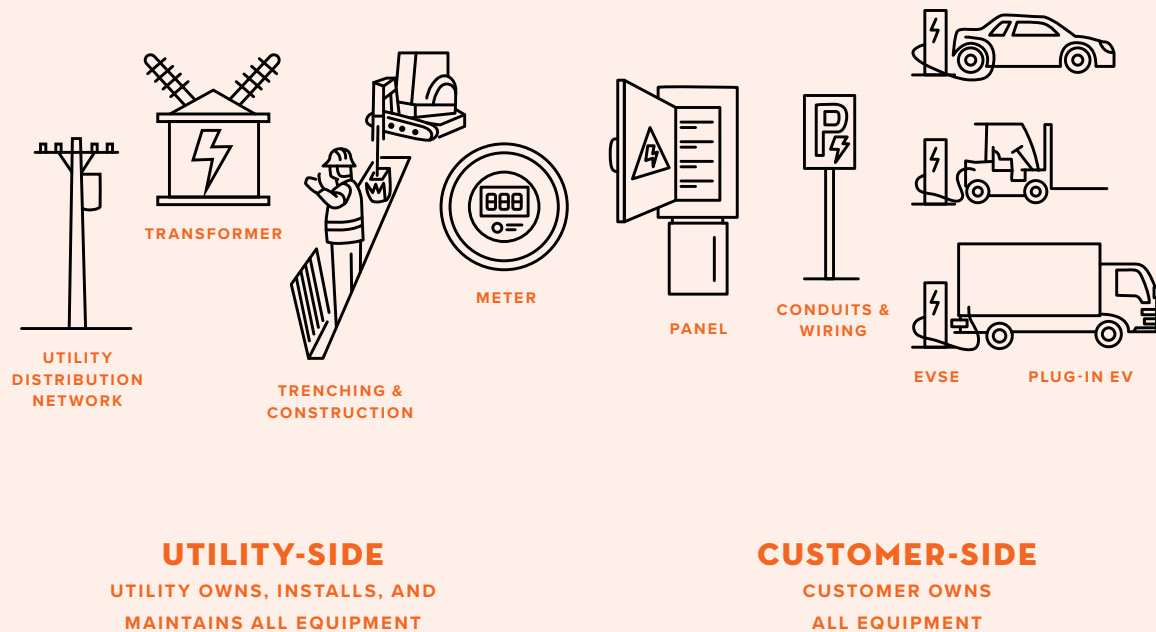
27 District of Columbia Government, Consolidated Initial Comments on the Potomac Electric Power Company’ Climate Solutions Plan Filings, Formal Case 1167, June 17, 2022. Pg 21-22. <https://edocket.dcpssc.org/apis/api/Filing/download?attachId=170187&quidFileName=ed999dca-24db-4f5d-8b1e-d34b970fac5f.pdf>

28 Ibid, pg. 22

29 Sierra Club, Plug In America, Electrification Coalition, and Forth Mobility. AchiEVe Model Policies to Accelerate Electric Vehicle Adoption. August 2020.

FIG. 14

## Make-Ready Infrastructure



Jessica Russo, NRDC

attributed to demand costs, Xcel Energy created a fleet-specific rate, removing demand charges and creating a TOU rate to incentivize RTD to achieve even greater savings by charging during off-peak hours.

- **Subscription fees** – Pacific Gas & Electric Company has suggested a subscription fee based on the throughput of chargers (in place of a demand charge) in combination with strong time-of-use rates.
- **Pause or cancel demand charges** – Southern California Edison has a five-year demand charge holiday (2019-2023) and will be phased back in over 2024-2028.
- **Temporarily reduce demand charges** – The Public Service Commission in New York has approved an off-bill demand-charge discount

- that declines over time and is intended to offset the disincentive to invest in DCFC while utilization rates are low.

## DEMAND LOADS

### Analysis of District 24h-Demand Load

A 24-hour demand load analysis examines the fluctuation in electricity consumption throughout the day. In doing such an analysis, decision-makers can better understand consumption behavior and can design tariffs to send price signals to consumers about shifting their behavior, or can implement grid upgrades in response to growing peak loads. DOEE is undertaking a study to forecast the additional electric load required for building and transportation electrification in the District, and will release that study later this year.

FIG. 15

### Rate Design Program Considerations

- 1 Rates should be designed to promote efficient use of fixed system resources, which will lead to reduced costs for all utility customers.
- 2 Rates should be easy to understand and predictable.
- 3 Rates should be designed with end users in mind.
- 4 Time-varying volumetric rates are generally preferable to demand charges.
- 5 Non-coincident peak demand charges should generally be avoided.
- 6 It may be appropriate to set rates to recover marginal costs rather than embedded costs; rates that recover marginal costs prevent new EV load from increasing costs for other customers, while promoting adoption of EVs.
- 7 Programs that rely on the price signals inherent in rate design to deliver grid and user benefits should ensure users actually see those price signals. If signals are not passed through to the drivers who decide when to charge, then charging behavior will not be affected and neither grid nor user will benefit.

### Policy Recommendations for Load Flexibility Programs to Shift EV Electricity Demand

Managing EV charging and its impact on the grid is crucial for utilities, ratepayers, and EV owners alike. Demand-side management of electric vehicles can avoid the construction of stranded utility investments. Additionally, well-designed rates and demand response programs can allow EVs to act as grid assets, smoothing peaks and allowing for more efficient grid management. One such way of shifting the electric load curve is through the design and implementation of time-of-use (TOU) rates, as illustrated in Figure 18.<sup>30</sup> TOU rates allow the utility to send consumers price signals and encourage them to shift their charging behavior to off-peak times. In doing so, TOU rates communicate when grid capacity is stressed and can help to increase utilization, and thus efficiency, of the grid by incentivizing EV charging during off-peak hours. This creates downward pressure on electricity rates for all ratepayers by increasing the utilization of grid infrastructure without increasing peak demand.

Well-designed TOU rates and other policies to shift demand load fall under an umbrella of time-varying rates, including subscription rates, off-peak credits, real-time pricing, variable peak pricing, critical peak pricing, and critical peak rebates.<sup>31</sup>

- Subscription rates: customers pay a fixed monthly fee to consume unlimited electricity during specified times.
- Off-peak credits: fixed or variable incentive that provides a bill credit in exchange for limiting consumption to specified times.
- Real-time pricing: variable, hourly pricing that is determined by day-ahead or real-time spot market prices.

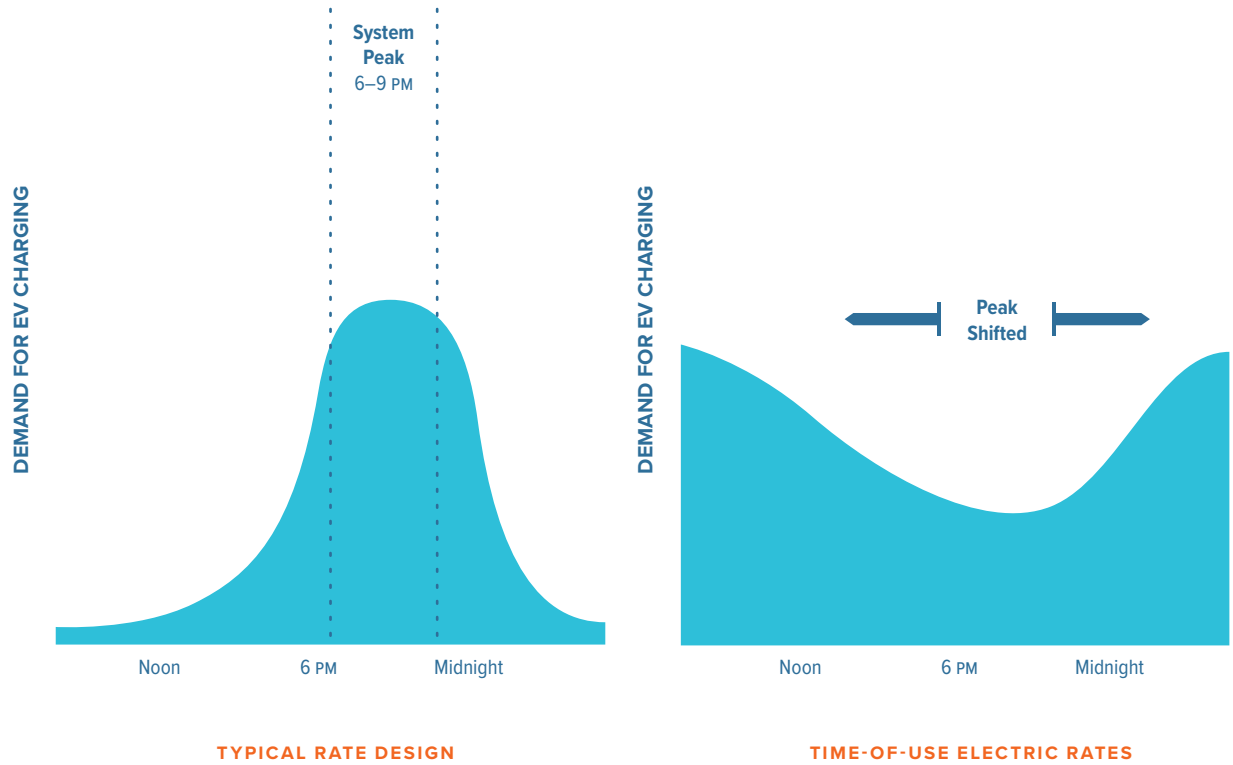
30 Regulatory Assistance Project. Roadmap for Electric Transportation: Policy Guide. February 2020.

31 Smart Electric Power Alliance. Residential electric vehicle time-varying rates that work: Attributes that increase enrollment. November 2019.



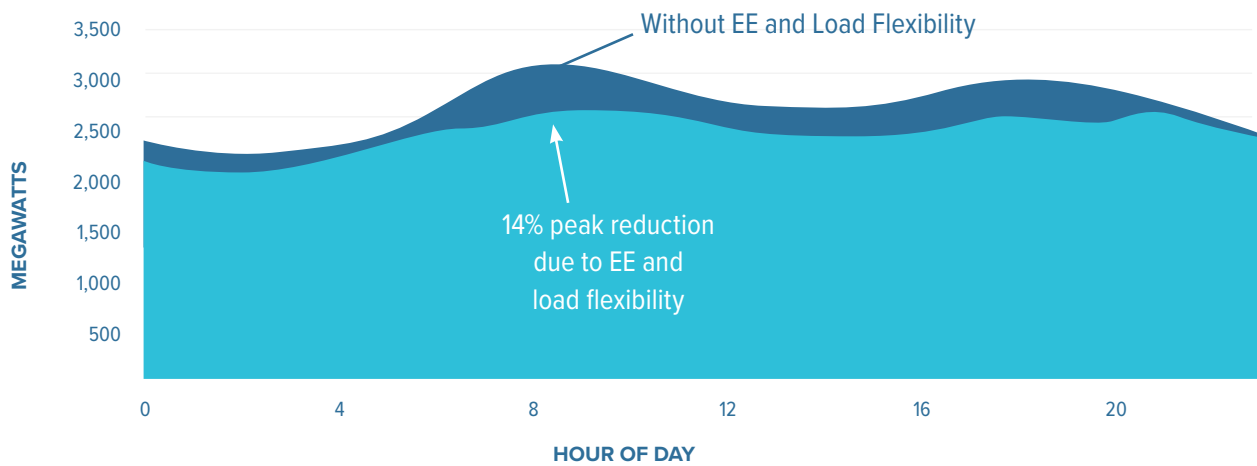
**FIG. 16**

**Shifting of EV Charging Behavior Away from Peak Periods in Response to Time-Varying Rates**



**FIG. 17**

**Mitigated 2050 Pepco DC Load on Peak Day**



Peak demand reduced through energy efficiency and load flexibility.

- Variable peak pricing: a combination of TOU and real-time pricing where price intervals are constant but allows peak pricing to change depending on the day.
- Critical peak pricing: higher rate during designated peak times on a limited number of days during the year to reflect higher system costs.
- Critical peak rebate: utilities pay customers a rebate for each kWh reduced during peak hours of peak demand events.

Microsoft Excel-based tool that enables fleet managers to easily evaluate their potential savings by switching to EVs (Figure 19). The tool includes options to select from a variety of procurement ownership structures, vehicle types, charging configurations, and other scenarios.

NREL’s EVI-Pro Lite is a tool that can project EV demand for charging infrastructure and forecast large fleet load profiles by using vehicle travel patterns and vehicle and charging station attributes to simulate scenarios (Figure 20).

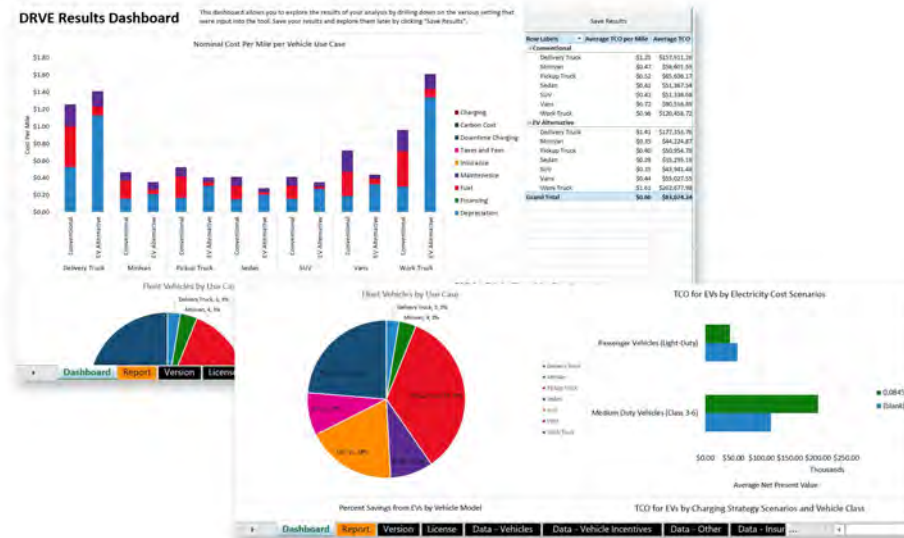
### METHODOLOGIES TO MAXIMIZE PREDICTABILITY AND SAVINGS FROM EV CHARGING

There are tools available for fleet managers to conduct their own analyses. The Electrification Coalition’s Dashboard for Rapid Vehicle Electrification (DRVE) is a

### Public Service Commission Litigation

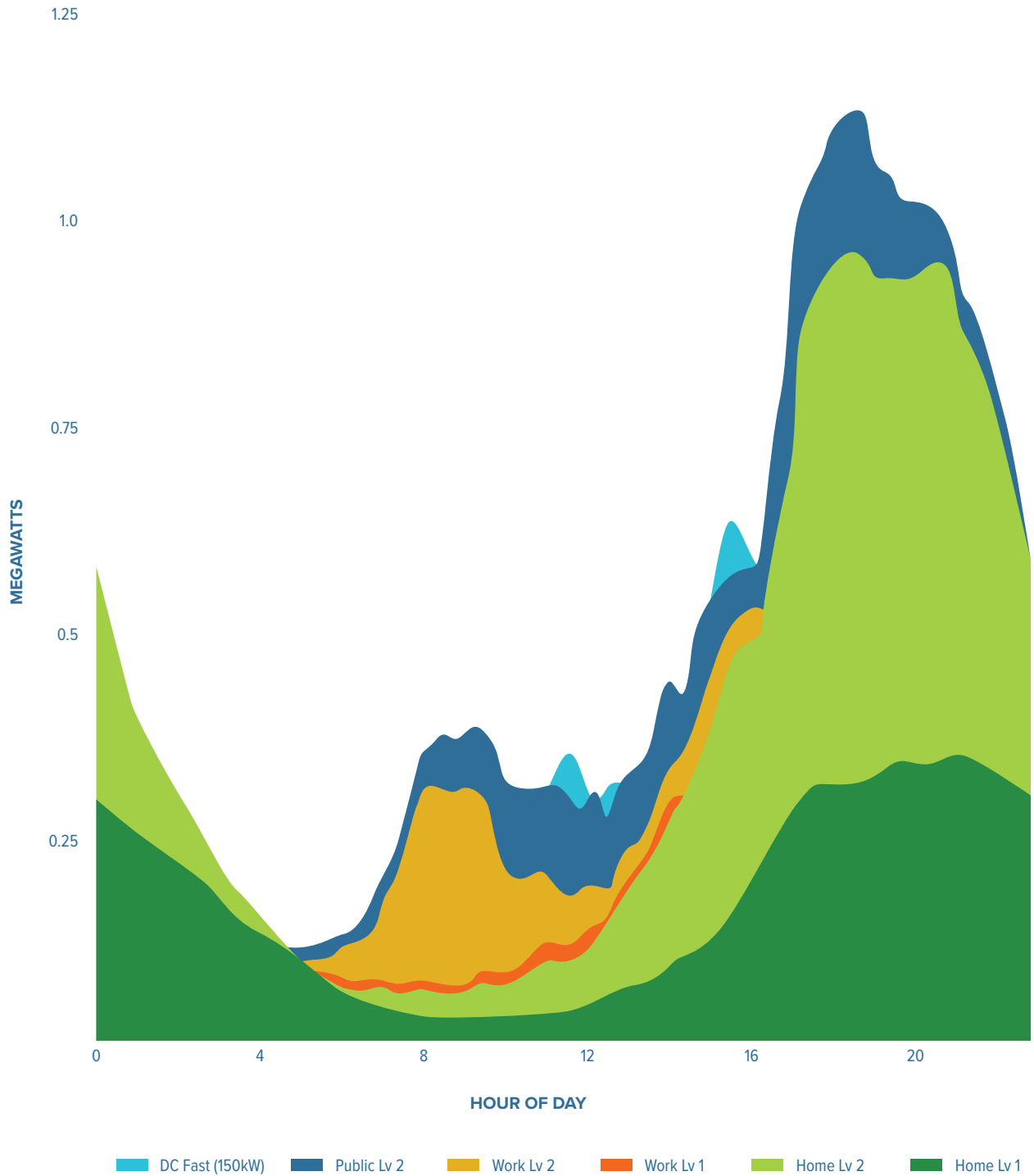
Both Pepco and the PSC will play a significant role in ensuring the electric distribution grid is prepared for the District’s accelerating adoption of EVs. This includes grid modernization, and moving towards processes that enable V2G and V2X technologies that allow EVs to interact with and provide support to the electric distribution system.

**FIG. 18** DRVE Results Dashboard



Dashboard for Rapid Vehicle Electrification (DRVE) Tool enables fleet managers to evaluate how to switch to EVs.

### Weekday Electric Load



**FIG.19**

Electric Vehicle Infrastructure Projection Tool provides a simple way to estimate how much electric vehicle charging you might need and how it affects your charging load profile.



# **BUS FLEET TRANSITION**

## BUS FLEET TRANSITION

- BFT.1** Adopt and follow the DC Circulator Sustainability Plan that identifies the timeline and pathway to full electrification of the DC Circulator fleet by 2045.
- BFT.2** Pilot a 24-month program, comprising five to 10 type A battery electric buses and five to 10 electric passenger vans, in the OSSE fleet to gain operating and maintenance experience with electric buses, vehicles, and infrastructure.
- BFT.3** OSSE will continue to work with OCFO and complete by the end of 2022 a vehicle budget to purchase electric school buses to meet goals in the medium- and heavy-duty vehicle MOU.
- BFT.4** Train first responders in proper techniques to respond to incidents involving electric vehicles, particularly to address the differences in vehicle design that can present different hazards in a crash situation compared to vehicles with an internal combustion engine.
- BFT.5** Develop public messaging by 2024 around the public health and air quality benefits that electric buses offer the communities where they operate.
- BFT.6** DOEE and DDOT will collaborate with the Washington Metropolitan Area Transit Authority (WMATA) to identify opportunities to share infrastructure and optimize the complete transition to, and operation of, electric transit buses, thereby reducing greenhouse gas emissions and improving air quality.

## BUS FLEET TRANSITION AND RECOMMENDATIONS

In addition to increasing biking and walking to 25% of commuter trips by 2032, the Sustainable DC 2.0 Plan also aims to increase the use of public transit to 50% of all commuter trips across all wards. Reasons behind this effort include improving public health by decreasing air pollution, increasing access to low-cost forms of transportation, and reducing traffic congestion. The electrification of these transportation options is especially critical as it also contributes directly to the District's goals to reduce GHG emissions. Reducing SOV trips supports the increased adoption of mass transit, which in turn drives down emissions across the District. In the CEDC Plan, modeling demonstrated that electric buses have the greatest potential for reducing transit bus fleet emissions.

As laid out in the CEDC Act, 100% of the public buses in the District, including school buses, will be replaced with electric buses upon the end of their useful life. Currently, the District is already in the process of transitioning the public buses in DDOT's Circulator system to battery electric buses (BEBs). Moreover, the Office of the State Superintendent of Education (OSSE) will assess and plan the transition of the District's school bus fleet to electric buses—both the Circulator bus fleet and OSSE's school bus fleet.

The Washington Metropolitan Area Transit Authority (WMATA) announced in September 2021 that Metro will have a ZEV bus fleet by 2045.<sup>32</sup> As WMATA finalizes its fleet transition plan, the District will work with the battery electric team to lower barriers identified in its plan, and to hasten projects for BEB operations in the District. Additionally, the District will formalize what qualifies as

a low-emission vehicle to ensure the transition to ZEV is clear. Along these lines, it is imperative that a regularly scheduled working group provides guidance towards WMATA to help WMATA meet and exceed the goals established in the stated ZEV plan.

Partnering with WMATA to transition the fleet of transit buses to BEBs will further drive down GHG emissions and eliminate air pollution caused by diesel fuel, decreasing exposure to air toxins for both residents and visitors.

In July 2020, the District Government signed an MOU with 15 states in a commitment to phase out fossil fuel-burning medium- and heavy-duty truck and bus sales by 100 percent by 2050, with a target for 30 percent of new truck and bus sales to be zero-emission by 2030.<sup>33</sup> The Roadmap supports the actions of the MOU, with concurrent goals to support electrification adoption. While the Roadmap identifies a fleet transition plan for the District's school and public buses, the Roadmap is an adaptive and dynamic document, which will include more goals of the MOU in the future.

### Transit Bus Fleet

The District has set a goal to electrify the entire Circulator transit bus fleet by 2045. These efforts began in April 2018 with the [Circulator Electric Bus Pilot](#) initiated by DDOT to assess and demonstrate the benefits of battery electric bus operations over a traditional diesel-powered fleet. Based on the results from the two-year pilot, DDOT has committed to transitioning its entire fleet to electric buses.

At the same time, DDOT is currently developing its DC Circulator Sustainability Plan, which includes a comprehensive fleet transition plan. Presently, additional vehicle and charging procurement plans are well underway.

To further increase the emissions reductions from an electric fleet, work has already begun to develop a

solar photovoltaic array on a new bus-charging facility with support from a Low No Grant from the Federal Transit Administration awarded in 2021 and funding from DOEE. It is recommended that DDOT continue the planning and transition it has already begun, continuing to take advantage of federal funding opportunities and opportunities to partner with other District agencies.

### School Bus Fleet

The first step in developing a plan for full fleet electrification is to gain an understanding of the existing vehicle makeup and fleet characteristics. The EC has developed a total cost of ownership analysis, based on data provided to EC by OSSE staff. The parameters used to build a total cost of ownership model that compares the existing fleet to an EV alternative fleet are 12,000-mile average annual vehicle miles traveled (VMT) per unit and an average eight-year service life. The increased upfront cost of electric school buses is not anticipated to be overcome by the reduction of fuel and maintenance expenses in the near term. At the time of the analysis, no electric passenger vans are available directly from manufacturers. It is also important to clarify that the analysis considers only vehicle purchase prices and fleet operational costs. The analysis does not factor in the significant externalized costs of reduced air quality associated with internal combustion engines.<sup>34</sup> Addressing air quality impacts from internal combustion engines and other sources at the global level could offset the costs of policies to address climate change.

### Duty-Use

The total OSSE fleet is made up of 594 vehicles. Eighty-four percent of the fleet is comprised of short school buses with 531 units. Full-sized school buses make up 2% of the fleet at 11 total units, and there are two pickup trucks. Vans and school buses are used to

32 WMATA. Zero-Emission Buses. Accessed September 18, 2021. <https://www.wmata.com/initiatives/plans/zero-emission-buses.cfm>

33 DOEE. Medium and Heavy-Duty Zero Emission Vehicles. Accessed October 20, 2021. <https://doee.dc.gov/service/mhd-ze-vehicles>

34 Vandyck, T., Keramidas, K., Kitous, A., Spadaro, J., Van Dingenen, R., Holland, M., & Saveyn, B. 2018. Air Quality Co-Benefits for Human Health and Agriculture Counterbalance Costs to Meet Paris Agreement Pledges. *Nature Communications* 9, 4939. <https://doi.org/10.1038/s41467-018-06885-9>

transport special-needs students to various schools across the area with some routes extending into Maryland and Virginia. Because of the unique nature of the fleet (primarily class A (short) school buses and vans with some required to operate longer routes), the vehicle makeup and duty cycle for this particular fleet poses some unique but not insurmountable challenges for electrification. The challenges posed are less associated with vehicle capability and more associated with the cost to transition in the market currently available. Within the next two years, electric passenger vans will provide opportunities to reduce fleet operating costs through fuel and maintenance spend reductions.

### Operations

The duty cycle of the OSSE fleet is very well suited to electrification because buses and vans will have an opportunity to charge overnight and again mid-day. For longer routes, it may be necessary to charge buses and vans between the morning and afternoon routes. Not every vehicle will require supplemental, mid-day charge sessions. To best identify buses and vans that require mid-day charging, the fleet should utilize experience gained from the pilot as well as route mapping or fleet management software paired with telematics, with longer-range vehicles being assigned to longer routes and schedule charging sessions after both runs each day.

### Capital Budget Plan

With the recognition of the District's goal to completely electrify the OSSE bus fleet, infrastructure upgrades required should be included in the Capital Budget Plans in addition to the increased upfront cost and lower lifetime costs of new electric buses. To include accurate cost projections, depots that will be electrified should be evaluated by existing staff and/or an electrical contractor in conjunction with charging station representatives and representatives from electric school bus manufacturers.

In addition to the near-term costs associated with infrastructure and vehicles, a budget should be

included to provide existing maintenance staff with training. On the topic of staff training, courses will be available through EVSE and bus manufacturers in the near term. Once the program scales, additional training courses should be investigated in conjunction with a local technical college. Explore maintenance offerings available from charging station vendors and vehicle manufacturers. Most vendors provide extended warranties on equipment and offer ongoing maintenance programs that will provide operational cost savings and reduce potential downtime of the fleet. Ensure service-level agreements align with the "mission critical" nature of the OSSE fleet.

To begin the school bus transition process to an electric fleet, a 24-month pilot program is detailed in Appendix C. The pilot program is based on an analysis of the current vehicle makeup and operational needs of the fleet. School buses, like transit buses, are considered "mission critical" applications, meaning there is very little room for having units out of service with charging issues or maintenance concerns. OSSE will prioritize leading the electric bus pilot program with the bus depot planned at 1600 W Street NE. The electric buses provide an opportunity to begin the transition to quiet, clean school buses next to a residential community.





**FEDERAL  
GOVERNMENT FLEET  
COORDINATION**



## FEDERAL GOVERNMENT FLEET COORDINATION

**FGC.1** Identify opportunities, by 2023, for shared infrastructure with the Federal Energy Management Program, which helps the federal fleet community implement EVs and charging infrastructure.

**FGC.2** Coordinate, by 2023, bulk vehicle purchases and charging infrastructure with large District agency fleets and federal fleets acquiring light-, medium-, and heavy-duty electric vehicles.

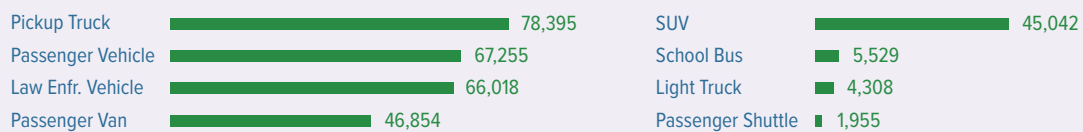
The District is in a unique position as our country’s seat of government. With the Federal Government’s large footprint in the District boundaries, there is a substantial opportunity to streamline transportation electrification efforts and deliver significant economies of scale through coordinating infrastructure planning and bulk EV fleet purchases with our federal partners. Figure 22 shows the federal fleet profile excluding the United States Postal Service. The figure illustrates that the largest portion of the fleet is pickup trucks, followed by passenger vehicles and law enforcement vehicles. These types of vehicles are part of the District’s fleet. Electric vehicle models for pickup trucks and passenger vehicles are increasing in availability in the next few years.

Efforts currently underway to examine grid demand within the District will likely uncover demand overlap between the District and federal fleets as well as the overlap of the needs to serve commuting workers. These common areas offer an opportunity to plan for shared EV charging infrastructure. By reducing duplicative efforts, coordinated infrastructure planning results in fewer chargers needed, leading to the potential for reduced installation time, reduced operating costs, and a greater opportunity to take advantage of grid capacity. This last point will have

the secondary benefits of reducing the need for additional upgrades to grid infrastructure, reducing overall demand, and potentially lowering costs for all electricity consumers in the District. It is recommended to connect with the Federal Energy Management Program, which helps the federal fleet community implement EVs and charging infrastructure.

District fleets should coordinate with federal fleets to buy EVs in bulk when applicable. Capitalizing on these economies of scale leads to reduced upfront costs and has proven to be a successful model across the country. Opportune partnerships for the District include the National Park Service, shuttle services for federal employees in the Washington, DC area, and other federal agencies acquiring light-, medium-, and heavy-duty electric vehicles. Coordinating vehicle procurement and charging infrastructure can lead to cost savings through bulk purchases. Also, understanding federal plans for electrification can help the District pace and locate its investments to take advantage of potential shared opportunities and avoid unnecessary costs and infrastructure upgrades. The coordination and sharing of infrastructure will assist in ensuring that charging infrastructure meets the current and future needs of the federal and District fleets.

**FIG. 20 Federal Fleet Inventory** (Does not include the United States Postal Service fleet)





# ADAPTIVE AND DYNAMIC ROADMAP

The transportation electrification market, technology, and opportunities are at the same time emergent and rapidly evolving. An approach that is static or too prescriptive will be unable to provide the flexibility needed to take advantage of new information, more appropriate technologies, and synergies that may arise in the future. The Roadmap's recommendations are meant to deliver short-term and long-term actions that, along with input from the community and stakeholders, provide governance and guidance for achieving the District's transportation goals.

The recommendations will be evaluated by 2025 and every two years to ensure that the programs, activities, and initiatives are still aligned with the District's goals. As technologies mature, more vehicle and charging options will become available and behaviors related to

the use of electric transportation should be assessed to ensure the transportation needs of residents are being met with the best fit options available.

Upcoming opportunities that are quickly becoming more feasible include the availability of more medium- and heavy-duty vehicles. The District will need to lead as an example in the transition to electrify its own medium- and heavy-duty vehicle fleet and support fleets operating in the District by offering resources as more viable options to electrify become available. Light-duty vehicles are continually advancing, and as range considerations increase, charging options and behaviors may evolve, requiring the District to assess charging strategies. For example, while near-term strategies such as Level 1 charging or mobile charging strategies may be the most expedient and cost-effective now, as the market matures, these strategies may be replaced by other charging models that better serve the needs of District residents.

As well, from the participants' perspective, the accessibility of any program is a matter of its ability to respond to the current state of residents and businesses. Whether it is income levels, the language spoken, or cultural shifts in how we move, change within the District is guaranteed to happen in some form. The success of any activity is reliant on its ability to evolve and meet participants where they are. A regular re-evaluation of activities will provide an opportunity for practical and accessible alignment with District residents while assuring transportation electrification goals are met.





# CONCLUSION

The Roadmap details the District’s plan of action to expedite the transition of our local transportation sector to zero-emission vehicles by 2045. It is one part of the larger transportation shift the District is employing. The District’s Sustainable DC 2.0 Plan sets ambitious mode shift targets to reduce SOV use, but it is still anticipated that even with the District’s mode shift goals, 25% of commuter trips will remain as passenger vehicles.

To reach the District’s carbon-neutral goal while meeting the mode shift goals, the most effective way to achieve these mode share targets is with electrified transit vehicles in addition to transitioning any vehicles left to ZEVs such as EVs served by renewable electricity.

For the District to have the greatest impact in creating an electric future that will create participation for and

benefit all District residents, a plan must be set forth that measures growth from an established baseline. The District must transition its own fleet vehicles, especially transit vehicles. Public programs need to include the recommendations of stakeholders that live in disadvantaged and low-income communities because their participation will ensure that programs are considering diversity, equity, and inclusion. By thoughtfully considering policy options available to the District, the pathways that are chosen will be the ones that have the highest level of impact and fill gaps that will result in the advancement of the EV market and the District. All these strategies together will result in the District meeting the ambitious goals outlined in this Roadmap.





# APPENDIX A

## STAKEHOLDER ENGAGEMENT RESULTS

Concerns about charging infrastructure were the dominant theme throughout the live stakeholder feedback sessions, post-session survey responses, email correspondence with interested parties, and individual meetings. Most District residents were concerned about the lack of personal driveways (off-street parking) in densely populated neighborhoods, which would impede many potential EV drivers from conveniently charging overnight. Remedies offered to address this issue focused on taking advantage of existing amenities—the use of the tree lawn spaces to install EV charging equipment; facilitating EV charging from streetlights; or the lowest-cost option, which would take advantage of residential electricity rates and extended EV charging cables (at 120V or even 240V) from the home to the curbside parking location.

Despite an acknowledgment that battery density is predicted to increase appreciably in the near term, a distributed network of 120V outlets (from streetlights “and other powered installations”) was widely supported by participating stakeholders as providing significant benefits without the need for voltage upgrades. The rationale for Level 1 “trickle charge” speeds is that it would still provide enough charge to a depleted EV

(and especially a PHEV) battery within a few hours to enable short trips within the District. Such a trip would presumably be to another location where a longer charging session can be completed, such as at a residential/overnight charging spot. Reference was also made to the savings potential for residents with rooftop solar due to increases in their SREC allotment—perhaps revealing this insight as coming from one of a small and rather privileged subset of District residents, yet who would be more likely to adopt EVs in the nearer term.

The home-to-curbside charging option was also rationalized as a direct equity action, both at an individual and systems level. Low-speed Level 1 charging is an open and interoperable standard for curbside charging that can “enable residents of all income levels to conveniently and affordably gain access to EV charging.” With EV adoption will also come increased development of EV charging stations to support these vehicles—so while power demand to homes is likely to rise as EV penetration increases, grid improvements to accommodate this growth in demand should not necessarily be prioritized to fast-charging locations and modes. Even if ultra-fast charging becomes the norm, there may likely still be

a substantial number of on-road vehicles incapable of charging at those speeds. This complement would include used EVs, which are more likely to be driven by lower-income drivers. Increasing access to Level 1 curbside charging is also seen to alleviate anticipated congestion at public EV charging stations as more and more people seek use of the facility.

When juxtaposed with the cluster of current public EVSE locations in the Central Business District, the lack of EV charging in Ward 7 underscores the need for the District government to ensure proportional EVSE buildout around the city. This rather apparent fact seems to be at odds with the logic of building facilities where the resource is needed and in demand. Participating stakeholders stressed the need for the District to provide its residents with a more active voice and role in determining where EV charging stations should be placed.

Several residents, who either own an EV currently or are keen to own one, discussed the potential of “sharing” Level 2 charging supply with other needful EV drivers in their neighborhoods, citing current frustrations with the lack of charging opportunities within walking distance of their homes. While such arrangements would be informal, it was suggested that the District Government take steps to encourage this resource-sharing by mapping private alleys where charging could take place. The consideration of these arrangements reveals that cost and convenience of EV charging are primary metrics for equity, where a gap exists between those who can charge conveniently from their driveways at the lowest electricity rate (single-family homeowners) and those who can only access charging by paying third-party vendors at charging hubs (apartment-dwellers, for instance). In pursuing the equitable development of EVSE, the District is encouraged to include commercial entities with large parking footprints (like supermarkets) as EVSE site hosts, especially in neighborhoods with limited parking.

All stakeholders agreed that third-party EV charging station vendors have an important role to play in

increasing the availability of public-access EV charging sites throughout the District. Multiple references to “public-private partnerships” arose during feedback, and there was widespread endorsement of Montgomery County’s action earlier this year to request proposals from EVSE vendors regarding the development of vendor owned-and-operated charging infrastructure on specific county-owned sites.

At least one comment linked vendor profit motives to enhanced equity, acknowledging that equitable EVSE access must also be measured by the operational status of EV charging equipment, not just its location.

Charging station companies were also keen to provide feedback on the Roadmap since the District presents an opportunity at the intersection of various factors they consider when making a business case for a location—population size and density, a concentration of residents without dedicated off-street parking, a recognition of environmental justice components, and action on rate design. Rate design—specifically the design of utility demand charges—was cited as perhaps the biggest market transformation aspect for fast charging installations, with the ability to make or break an operation’s financial feasibility.

Applauding the initial objectives laid out by the Roadmap, charging station companies stressed the need for flexibility concerning rate structures. Objectives can help inform performance targets and provide guidance; supported by a flexible structure for demand charges, this will allow the charging market to evolve and charging station needs to evolve along with it. Flexible demand charge rate structures have been instituted in several other states to address this issue with both short and long-term solutions; examples from California and Wisconsin were referenced.

This Stakeholder Feedback series was welcomed as another platform to provide feedback on transportation needs, though, for participants, the line between transportation electrification planning and general transportation planning was frequently blurred. As was reiterated, this Roadmap is an effort to complement (not replace) the moveDC initiative, the District’s long-

range multimodal transportation plan. The Roadmap's focus is on switching the primary fuel for transportation modes to electricity, as opposed to shifting transportation modes and promoting active and public transportation (moveDC). One area of overlap with moveDC, however, was on electric bicycles (e-bikes), expanding access to which was confirmed by moveDC representatives as a near-term program goal of that plan. Received public feedback confirmed that support for e-bikes is high, but that e-bike theft is an issue plaguing current riders and inhibiting more widespread adoption. To realize the full potential for e-bikes to displace internal-combustion engine use, e-bike and general bike theft must be addressed robustly.

Aside from some survey questions specific to e-bikes, however, no moveDC inquiries on electrification priorities for low-income communities had been completed. MoveDC representatives advised that the manifestation of electric transportation in these communities must be carefully socialized. While there may be a tendency to liken the public benefits of transportation electrification to that of community solar, the current value proposition for EV charging stations is inherently different. A more apt comparison may be to that of a protected bike lane—an amenity in the public space which is not primarily used by most residents. This perception reinforces fears of green gentrification in low-income neighborhoods, a harmful impact of market development that exacerbates inequality and displacement. It was suggested that an analogy to bikeshare stations (which are owned by local governments but managed by a full-service operator) be considered for EV charging stations to enhance equity. That is, the equipment could be collaboratively procured by District Wards and sited under the guidance of each Ward's Advisory Neighborhood Commission (ANC).

Many concerns were expressed about the successful engagement of low-income communities in the District. Aside from electric micro-mobility modes and the electrification of public transit, these residents face high price barriers to accessing zero-emission transportation options in any near or medium

timeframe. Suggestions to overcome this barrier focused mainly on targeted subsidies, with the acknowledgment that purchase incentives for these residents must be focused on not new EVs but pre-owned ones—the market for which has yet to mature at scale. There is also broad support for an ICE vehicle trade-in program to incentivize residents to surrender their older-model, high-polluting ICE vehicles. Yet while the ideal equal incentive from the District's perspective would prioritize the use of active transportation, public transit, and zero-emissions vehicles, the commitment to equitable outcomes demands that a participating resident not be overburdened in terms of cost, time, or convenience.

Purchase incentives for used EVs could form part of a conventional vehicle trade-in offer and would also stimulate the used-EV market and encourage adoption among lower-income residents, just as they would for new EVs. The potential for coordinated EV procurement programs ("EV Group Buys," for both new and used EVs) generated a lot of interest. The District's implementation of such a purchasing program would involve coordination with auto dealerships in neighboring suburban jurisdictions, an idea that energized many stakeholders. A repeated concern was that the District's transportation electrification efforts must address commuters who drive in to the District for work, and to whom many residents assign a significant share of the city's automobile emissions. Perhaps revealing unfulfilling experiences at these area dealerships, stakeholders also voiced the need for a training program for dealership staff that would help them more effectively market and sell electric vehicles to potential buyers. Such training is a key aspect of a successful EV purchasing program. Demonstrating the demand for EVs with auto manufacturers, as well as the coordination of dealership EV inventories and pricing discounts, are other major pillars of EV Group Buys programs.

EV purchase incentives, collaborative procurement programs, and working with partners in Metropolitan Washington are all activities that could help promote

innovation in EV manufacturing and demonstrate strong demand for EVs in this region. These strategies could be applied to accelerate not just consumer EV adoption, but private fleet adoption as well. One anticipated issue regarding fleet electrification is the cost related to charging, installing infrastructure, and deploying new vehicles while trying to maintain an operational schedule. Businesses may also face difficulties taking advantage of the cheapest times to charge their fleet while maintaining business activities. Guidance, support, clarity, and flexibility from the utility, the Public Service Commission, and the District Government will be needed to make this transition smooth and economically beneficial for businesses.

The District's Electric Vehicle Readiness Amendment Act of 2020 was applauded by stakeholders, yet most felt that it does not go far enough concerning retrofitting older residential and commercial buildings. Issues like this were identified as at the core of inequity. A coordinated strategy (including an efficient permitting process) is needed to engage property owners and facilitate EVSE installations in buildings, persuading by way of incentive and not mandate. Feedback from small businesses in the EVSE installation and management space specifically referenced commercial real estate accounting practices as a barrier to organic EVSE development in present structures, especially in those rated less than A-class. Property owners face upfront costs for assessments, engineering, and design work even before determining to proceed with installation of EV charging. If the decision is made to install EV infrastructure, however, financing mechanisms like PACE (property assessed clean energy) can spread the costs over many years (up to 20) by making them an assessment on property taxes. Thus, both current and future tenants who benefit from the capital improvements will pay. If, however, the determination is made not to install EV infrastructure, the upfront costs that went into that determination are sunk costs that would likely be passed on to current tenants. One suggestion is for the District to reimburse EVSE site hosts for these costs—or otherwise assist prospective site hosts to undertake

these initial investigations in kind. The DC PACE program is available to building owners and developers to assist with financing clean energy projects such as installing EV infrastructure.

School bus electrification received unanimous stakeholder support. Participants cited the healthy air, reduced transportation emissions, and quieter operating experience as the benefits most important to them. These benefits are also directly impactful to the children passengers, and many stakeholders were familiar with the respiratory issues that lead to missed school days and poor focus in class. They further recommended that the reduction in NO<sub>x</sub>/Particulate Matter (PM)/CO<sub>2</sub> emissions facilitated by electric school buses be better demonstrated to the public, as well as the promotion of testimonies from other area school districts (Montgomery County Public Schools) that have successfully deployed electric school buses. Together with transparency about the transition budget, these suggested actions would be very persuasive to influential school boards, PTAs/parents, and others from the education community. With the endorsement of these groups, a broad base of support can be built, which could lend credibility to the overall transportation electrification plan. This may even lead to an appetite to test the advanced capabilities of these assets to enhance resiliency of the distribution grid (Vehicle-to-Grid applications).

As with transit bus electrification, most stakeholders agreed that priority electric school bus deployment areas should be those which are facing negative respiratory impacts and/or poor air quality. Areas where the buses sit idle for long periods or where there is stop-and-go traffic typically develop lower air quality due to the tailpipe traffic emissions—focusing electric school bus deployment in these areas will directly address environmental justice and the effects of transportation-related emissions on the most vulnerable. Other good routes on which to prioritize electric school bus deployment include those on which children experience the highest “seat miles traveled,” being exposed to traffic exhaust for the longest periods. School bus programs tend to generate

a fair amount of political interest, which, if leveraged effectively, could catalyze winning broad support for transportation electrification programs and their supporting expenditures.

With these recommendations to achieve equitable transportation electrification, the District is cautioned to think carefully about which incentives or programs would be equitable to fund through utility bill fees (a fundamentally regressive mechanism) or through the District tax system (more progressive structure).

## FUTURE OF ENGAGEMENT

The monthly Stakeholder Engagement Feedback sessions ended in August when the EC began to compile the comments and insights captured throughout this Roadmap development process to produce this final report. Yet the District is just beginning its journey towards transportation electrification, and several recommendations proposed within this Roadmap report are still some time away from informing the real, tangible opportunities that District residents and businesses can leverage to access the benefits of emissions-free transportation. As the stakeholder engagement activities took shape, it was agreed that a true commitment to equity requires community engagement to continue into the implementation of the recommended policies and programs to increase EV adoption. Considerations as to the form and character of future engagement on transportation electrification in the District became foundational principles that underpinned EC's Stakeholder Engagement activities.

Recordings of each virtual engagement session are available on a webpage ("Electric Vehicles Resources") on the DOEE's website, along with the associated slide presentations and discussion questions. Equitable outcomes are enhanced by making this record of engagement activities available on-demand to the public, to which parties may refer as the Roadmap is implemented—this provides stakeholders with some measure of accountability, and increases the integrity

of the implementation process. Other resources developed during the Roadmap, such as educational information on EVs, available models, and current incentives, are also hosted on this webpage. It is envisioned that this Electric Vehicles Resources webpage will be a one-stop informational resource for District residents as vehicle electrification increases. It will be updated regularly as policies and programs to increase EV adoption are advanced by the District Government.

Much thought was given to which organization might be capable of effectively maintaining engagement with community stakeholders, continuing after the EC had completed the initial stakeholder feedback during the Roadmap's development. A core group of external partner organizations with established community ties was initially sought to take up this responsibility, supported and convened by DOEE/the District Government and with the required capacity-building provided by the EC. This plan was reconsidered in light of feedback received and capacity limits in favor of a strategy that would resolve any public uncertainty about responsibility, anchor leadership of future engagement efforts securely within the District government, and take advantage of agencies' existing technical expertise and public engagement efforts. This "council" or "task force" would provide the public with updates (via the DOEE webpage and other promotional media) on the steps that the District is taking to achieve vehicle electrification, as well as review and incorporate feedback from representative public stakeholders (many of which were identified through the Stakeholder Equity Feedback Group) to address needs and concerns about the form and impact of this transition.

It is recommended that this proposed overseeing entity be situated in the Office of the Deputy Mayor for Operations and Infrastructure (DMOI), who will have the authority to compel various District agencies to prioritize work on vehicle electrification and request budget enhancements to support the same. This overseeing entity would manage a multi-agency task



force comprised of staff from District agencies and initiatives that in some way intersect with, impact, or can otherwise support the multi-faceted nature of vehicle electrification. Alongside DOEE's Renewable Energy and Clean Transportation Branch and the Department's Office of Communication, Engagement, and Outreach (OCEO), it is recommended that DOEE's Urban Sustainability Administration (specifically the Sustainability and Equity branch) and Air Quality Division, and the new District Office of Racial Equity, be represented. Staff from other Departments (including the Department of For-Hire Vehicles and the DC Green Bank) also self-selected as part of an intragovernmental group of stakeholders providing feedback on the Roadmap's development—representation from these and other agencies would provide comprehensive support to implementation oversight. It has additionally been suggested that transportation electrification strategy and planning be incorporated more holistically as a part of the District's Clean Energy Plan. This may help alleviate capacity constraints specific to DOEE and, with any luck, streamline cross-agency input, implementation, and the incorporation of public feedback.

While convening the Stakeholder Feedback Group, the EC simultaneously undertook efforts to strengthen DOEE's capacity to make equity, accountability, and transparency central to the continued public engagement activities that will accompany any implementation. EC advised DOEE leadership on the completion of an internal resource<sup>35</sup>—tailored to the District's transportation electrification context—and which would provide a process framework for equitable engagement. This activity also challenged DOEE to identify both intragovernmental and external partners (advocates, community organizations, private and non-profit interests) that can support the department in soliciting broad-based public input to ensure effective, impactful, and equitably beneficial policy and program implementation.

## The Continuous Feedback Loop and Enhancing Engagement

As evinced by the long-running community engagement efforts of Solar for All or moveDC, making the time to sincerely talk with community stakeholders and listen to their concerns is the first step towards developing respect, trust, and eventually a satisfying experience for participants. The Stakeholder Equity Feedback Group convenings were in large part listening sessions, a safe space for members of the public to voice their needs and any outcomes, consequences, or impacts they anticipate as a result of the EV adoption actions proposed by the Roadmap. Public feedback received during the Roadmap's Stakeholder Engagement sessions can serve as a launching point for a continuous feedback loop (assessment, modification, planning, implementation), from which a discussion about improvements can then begin.

As community engagement continues, the key to empowering participants and ensuring equitable outcomes is to demonstrate to said participants that they were not merely consulted about their concerns, or “asked for the sake of asking”—but that their time and participation were consequential and bore some influence on the ultimate implementation actions. It is therefore proposed that some kind of council, comprised of community stakeholders, oversee implementation of the Roadmap recommendations. One suggestion for manifestly empowering these established community-equity stakeholders is to grant them power to flag action(s) as objectionable to District decision-makers—or otherwise interrupt the implementation process. Another approach is to take a more positive view of a possible policy or programmatic impasse and have decision-makers try to include measures that address community concerns as much as possible.

The outreach and engagement activities during the Roadmap's development must be understood as only the first step towards informing and involving communities in equitable transportation electrification planning. The Stakeholder Equity Feedback sessions

35 Adapted from the USDN's Guidebook to Equitable Clean Energy Programs

were conducted over a brief period when one considers the scope and timeline of the Roadmap’s goals. While the EC team is pleased with the overall quantity and quality of feedback received, both a broadening and deepening of the pool of participants will provide important opportunities to enhance the public’s familiarity with the District’s transportation electrification goals, what it means for communities, and the actions and advocacy these communities must pursue to make the most of this historic moment.

The coronavirus pandemic, and the associated restrictions on in-person gatherings, had a marked impact on the individual public stakeholder engagement that was possible during the Roadmap development. Community-level participants in the virtual stakeholder sessions skewed towards those that were more of higher economic means—those that were technologically savvy, already knowledgeable about electric vehicles, and could speak to the current lack of EV charging resources in their neighborhoods. The character of the participants and the virtual-only sessions did provide benefits to future engagement, such as the ability to keep a record of the sessions for future referral. As the District Government continues community engagement, in-person meetings with the community are highly recommended—as referenced above, several District initiatives (moveDC, the Urban Sustainability Office) have existing community engagement footprints that could pivot to support public engagement specific to transportation electrification.

The entities and individuals that comprised the Stakeholder Feedback Group were ultimately those who were looking for opportunities to provide feedback on vehicle electrification. They consistently made time to participate in the sessions and provide thoughtful feedback. Others were not as easy to engage in this Roadmap undertaking—and it must be recognized that this is not necessarily due to a lack of concern or interest. Rather, one persistent obstacle is that many groups that could provide unique and impactful insights towards equity view transportation electrification as an issue that is literally out of their economic reach.

Electric vehicles are still largely viewed as luxury toys, to the extent that the timeline for their theoretical adoption by those of low/middle-income or working class is far enough out to be irrelevant. It is recommended that DOEE and other leadership from the District Government make a special effort to involve these communities in electrification planning. Concerted action with the types of entities listed below can help enhance future engagement efforts:

### **Institutional Stakeholders:**

#### **Advisory Neighborhood Commissions (ANCs)**

District agencies and DOEE specifically can build more direct engagement with ANCs, which are designed to provide essential representative services to their constituents and communities. ANC involvement is anticipated to be especially valuable with regards to equitable access to EV charging stations, communities’ gentrification fears associated with EV charging station development. Furthermore, many ANCs have specified transportation committees, to which this task would be aptly designated.

#### **WMATA**

As communicated repeatedly by District residents concerned about air quality and supportive of transit electrification, the transition of WMATA passenger bus assets is a critical component to meaningful transit electrification in the District. WMATA is a linchpin in any efforts to decrease the District’s greenhouse gases, through both increased ridership on Metro and the speed with which it transitions to zero-emissions buses.

#### **Northern Busbarn Neighbors (NBN)**

The Roadmap stakeholder sessions provided an opening for community group NBN to dialogue with DOEE. NBN’s main concern is carbon emissions from transportation, of which NBN alleged WMATA “is one of the most consistent, abusive” emitters in the region. NBN sought to leverage its common ground with DOEE to compel WMATA to abandon its plans for additional diesel-bus assets and maintenance garages; DOEE seized this opportunity to connect with local advocates. Continued conversations with WMATA, along with

their own pilot project on deploying electric buses, contributed to the release of WMATA’s own plan to achieve a 100% zero-emissions bus fleet by 2045.

### **Pepco**

The District’s electric utility no doubt has an important role to play as transportation electrification accelerates. As an electricity subject-matter expert with a wide base of constituents, Pepco is both a necessary technical and implementation partner and a source of vital information for clients and vendors alike, trusted by many. Deepened, continued coordination with the District of Columbia’s Public Service Commission and the broader District Government as it implements actions related to this Roadmap will be necessary. See corresponding chapter, Electric Vehicle Charging—Policies and Incentives.

### **Ratepayer advocates (e.g., DC Office of the People’s Counsel)**

As the potential for incentives are explored to encourage EV adoption, necessary conversations must be had about how such incentives will be funded. If any utility rate-based funding mechanism is considered, a commitment to equity demands that utility ratepayer advocates be included in the decision-making process.

### **Labor unions, trade organizations, and other groups representing transit workers, electricians, or automotive service technicians (e.g. GreenWrench)**

EV adoption will not only impact consumers but will depend on the participation of a variety of workers. While transit workers and electrical installers may view the EV transition wholly positively, auto workers especially may become defensive. Maintaining an open dialogue with these groups and crafting solutions to their concerns will be crucial to obtaining their support.

### **Large DC-area employers**

The availability of workplace EV charging amenities will be crucial to encourage emissions-free vehicles in the District by supplementing the electric supply needs of EV drivers. Employers and commercial entities should be engaged, coordinated, and incentivized to provide EV charging and/or petition their property managers.

### **Commercial entities, Business Improvement Districts (BIDs), Property developers (e.g. District of Columbia Building Industry Association)**

As potential EV charging station site hosts, these interests will play an important role in building confidence in the availability of accessible EV charging resources. This will be especially pivotal in neighborhoods where curbside and residential charging may be challenging to develop at a required scale.

### **Automobile dealerships (e.g., Washington Area New Automobile Dealership Association)**

Auto dealerships must be ready and prepared on the front lines of EV adoption. Staff must be knowledgeable about the features of the electric vehicles offered, but good staff can also speak to charging locations and any available incentives.

### **Federal Government**

As the largest employer, large fleet purchaser, and owner of a significant share of our parklands and recreational sites where charging stations might be located, and as a stakeholder itself in meeting nationwide goals relating to greenhouse gases. With the recent requirements of federal fleets to transition to electric, there are significant opportunities to knowledge-share.



# APPENDIX B

## MODELING METHODOLOGY

This analysis utilizes EV adoption scenarios developed by the National Renewable Energy Laboratory (NREL) for each U.S. state, developed for their Electrification Futures Study that forecasts demand for electrification technologies through 2050. NREL utilized their light-duty vehicle consumer choice model, Automotive Deployment Options Projection Tool (ADOPT), to develop forecasts for low, medium, and high levels of consumer adoption, along with different rates of technology performance and cost improvements. ADOPT accounts for economic, policy, infrastructure, and other factors that influence consumer vehicle choices.

Each scenario's projected EV share of registered vehicles is adjusted to Washington, D.C.'s estimated baseline for EV adoption. Figure 23 is a key summary of inputs and aspects of each scenario.

### **Electric Vehicle Infrastructure Projection Tool (EVI-Pro)**

To develop EV charging station projection and planning benchmarks for Washington, D.C., this analysis relies on NREL's EVI-Pro model studies and EVI-Pro Lite online tool, which were developed to provide guidance on EV charging infrastructure planning to regional and city

stakeholders.<sup>36</sup> NREL's analyses consider both needs for adequate coverage, i.e. "need access to charging anywhere a drivers' travels take them," and capacity, i.e. "increase supply of stations proportional to utilization" and demand. This section of the analysis is designed to quantify the number of chargers needed to address capacity, based on the EV adoption scenarios developed. In the siting analysis framework, the issue of coverage, and ensuring an even and equitable distribution, is addressed below.

The EVI-Pro Lite tool assumes in its model that drivers prefer to do the majority of charging at home (if available) utilizing Level 1 or 2 charging, with "[Level 2] workplace charging, public L2 charging, and DCFC charging used to fill gaps in daily charging needs (in that order)." Access to only Level 1 charging at home primarily impacts charging needs for PHEVs with lower electric ranges, which means PHEV drivers may need to

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36 Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite. <https://afdc.energy.gov/evi-pro-lite>. National Plug-In Electric Vehicle Infrastructure Analysis. NREL, 2021. <https://www.nrel.gov/docs/fy17osti/69031.pdf>

## HIGH – NREL HIGH SCENARIO

**“Assumes a more favorable set of conditions for electrification—including a combination of technology breakthroughs, policy support, and underlying societal and behavioral shifts that yield an electrification transition.”**

Intended to represent a scenario enabling the District to reach its climate goal of reducing GHG emissions by 56% by 2032 (supported by its additional goal to reach 100% clean energy by 2032).

## MEDIUM – NREL MODERATE SCENARIO

**“Intended to reflect an electrification future that is plausible but not transformational.”**

Assumes gasoline and electricity fuel price projections from EIA AEO.

Assumes battery cost reduction trajectory reaching \$135/kWh by 2050.

## LOW – NREL REFERENCE SCENARIO

**“Business-as-usual outlook where only incremental changes with respect to electrification occur.”**

Includes policies that existed in 2017.

Excludes potential of dramatic societal, technological, or behavioral shifts.

Relies on EIA Annual Energy Outlook (AEO) projections of EV adoption.

rely on their gasoline engine or find additional charging away from home to complete some daily trips. Otherwise, it is assumed that BEVs with 100+ mile ranges have sufficient range to cover typical daily travel needs (such as low mileage, inner-city driving common within the District), though the model does incorporate typical frequencies of long-distance travel.

Most of NREL’s EVI Pro case studies have assumed that all or nearly all EV drivers have access to charging at home, which does not hold for an urban setting like Washington, D.C. The EVI-Pro Lite model does enable adjustments to the share of drivers with access to charging at home (with the default being 100%). This analysis accounts for the District’s context by including an estimate for the share of residents that would likely be able to charge at home, as described in the key inputs below.

## Geographical EV Charging Siting – Analytical Methodology

To identify and forecast regions and areas of most need for EV charging expansion, an assessment was conducted using a variety of tools and resources. Key demographic and socioeconomic data were used from OpenData DC, capturing various census and government-collected data.<sup>37</sup> Additional datasets were also acquired, highlighting District-owned parking property and multi-modal transit routes, providing an additional lens of interpretation for how cohesive EV charging and multi-modal networks can provide improved transportation options for residents.

<sup>37</sup> OpenData DC <https://opendata.dc.gov/>

Utilizing these key datasets and inputs, an assessment was conducted of priority EV charging areas using the Regional EV Charging Infrastructure Location Identification Tool (ILIT), developed by M.J. Bradley & Associates and Georgetown Climate Center to identify future charging infrastructure development planning.<sup>38</sup> Three scenarios were created to assess key charging location recommendations across key parameters, including:

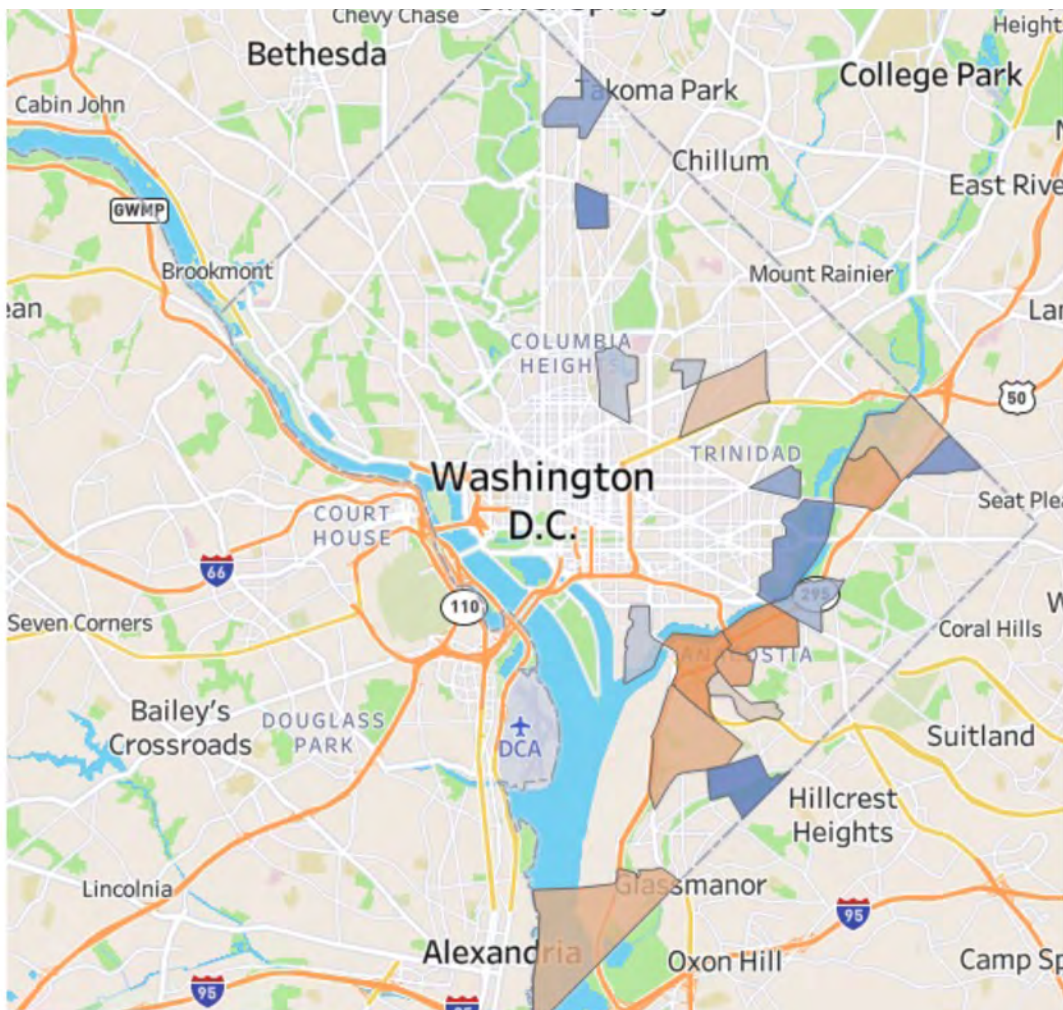
- Prioritization of environmental justice communities.
- Addressing “gap fill” of nearby EV charging stations.
- Locations in high traffic/utilization areas.
- To identify and forecast regions and areas of most need for EV charging expansion, assessment was conducted using a variety of tools and resources.

38 Regional EV Charging Infrastructure Location Identification Tool (ILIT)

Each scenario can be found below:

**Environmental Justice and Equity Priority**

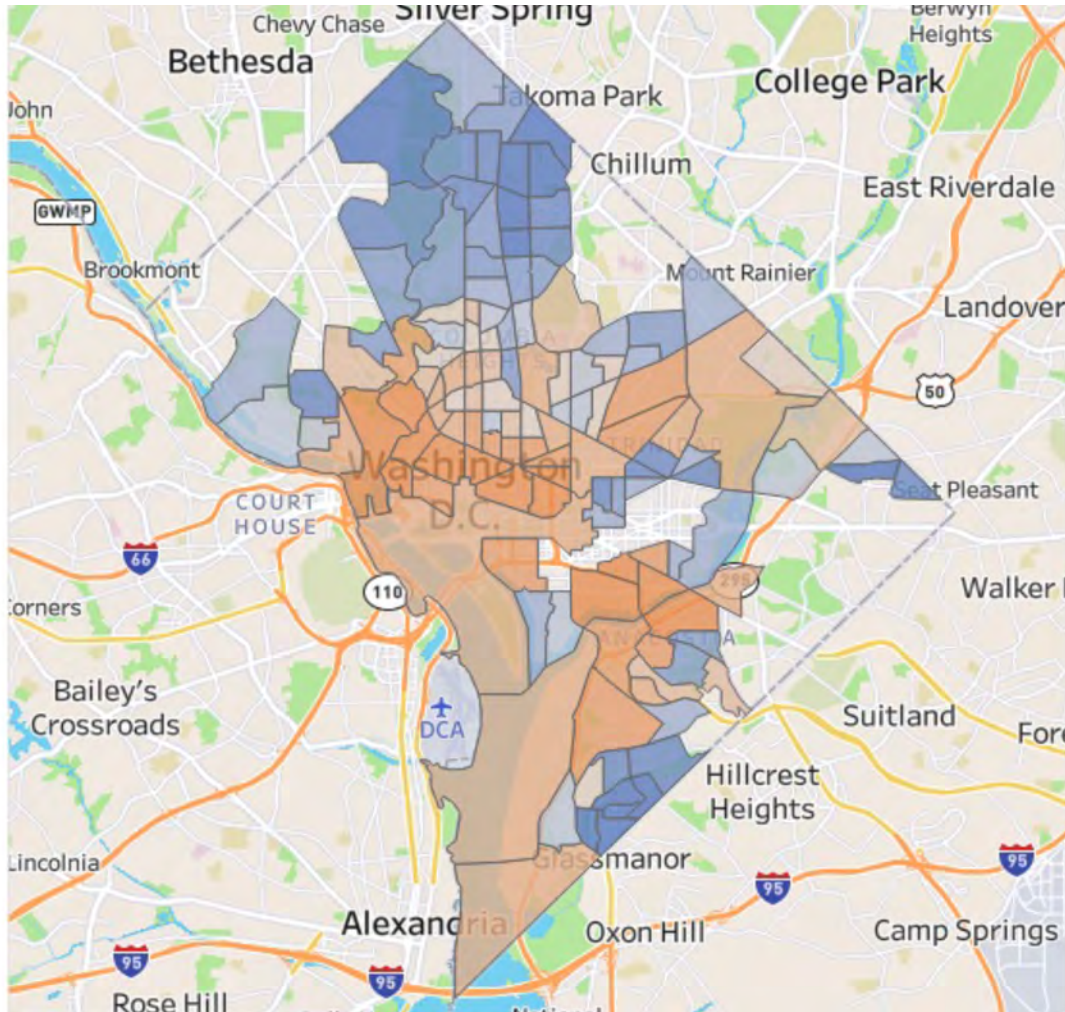
When specifically focusing on environmental justice and equity communities, census tract areas outside the District core become of specific importance, both accounting for community composition and higher-than-average exposure to surface-level emissions.



RANK	TRACT ID	ZIP CODE	NEIGHBORHOOD(S)
1	11001007401	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
2	11001009602	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
3	11001007406	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
4	11001004701	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
5	1001009603	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
6	11001007408	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
7	11001007703	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
8	11001007708	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
9	11001007504	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
10	11001007502	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
11	11001007409	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
12	11001009907	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
13	11001009802	20032	Bellevue, Congress Heights, Washington Highlands
14	11001009810	20032	Bellevue, Congress Heights, Washington Highlands

### EV Charging Station Proximity Priority

Prioritizing charging stations to areas without present EV charging creates general priority within the downtown centers and surrounding areas. Residential areas receive lower prioritization in turn, due to having access to at-home charging.



RANK	TRACT ID	ZIP CODE	NEIGHBORHOOD(S)
1	11001005600	20037	Foggy Bottom, West End
2	11001007200	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
3	11001007100	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
4	11001004100	20008/20037	North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park/ Foggy Bottom, West End
5	11001000100	20007/200037	Glover Park, Georgetown, Burleith, Foxhall Village, Foxhall Crescent, Massachusetts Avenue Heights /Foggy Bottom, West End



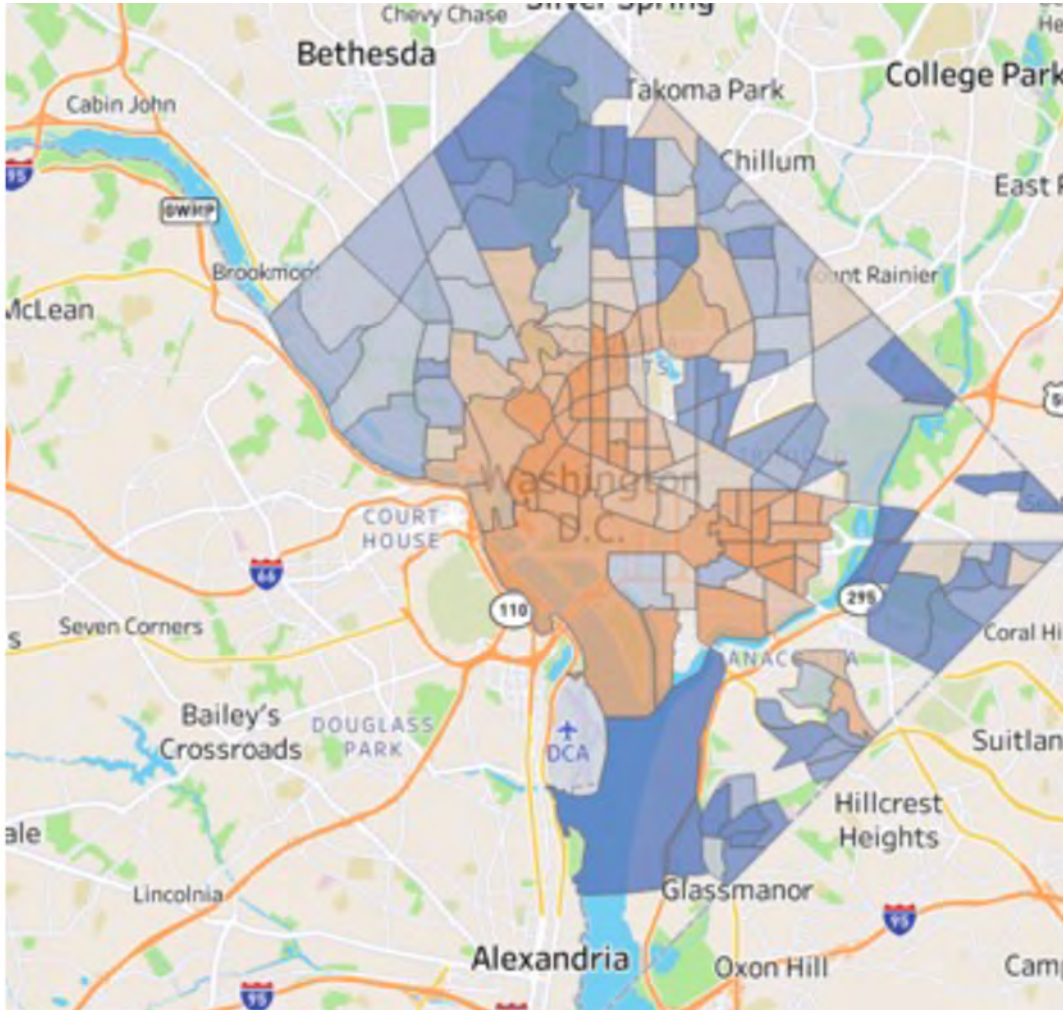
6	11001010500	20003/20024 20053/20204	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle/Southwest Waterfront, Downtown
7	11001005800	20008/20009 20036/20037	North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park/ Adams Morgan, Lanier Heights, Columbia Heights/ Dupont Circle/ Foggy Bottom, West End
8	11001005800	20001/20004 20005/20045 20535	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Penn Quarter, Mall/ Logan Circle, Downtown
9	11001005900	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
10	11001007000	20003/20390	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
11	11001007601	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
12	11001005201	20005/20009 20036	Logan Circle, Downtown/ Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
13	11001004702	20001/20002	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
14	11001010700	20006/20036 20037/20427	Foggy Bottom, West End, Dupont Circle
15	11001007503	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
16	11001010100	20001/20005 20006	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Logan Circle, Downtown/Foggy Bottom, West End
17	11001007401	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
18	11001010200	20024/20202 20228/20260 20553	Southwest Waterfront
19	11001000202	20007	Glover Park, Georgetown, Burleith, Foxhall Village, Foxhall Crescent, Massachusetts Avenue Heights
20	11001004701	20001/20002	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington

21	11001000501	20008	North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park
22	11001006900	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
23	11001006202	20001/20002 20003/20004 20006/20024 20037/20230 20245/20418 20506/20520 20540/20551 20560/20566	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington / Capitol Hill, Lincoln Park, Southeast, Barney Circle, Navy Yard, Hill East/ Penn Quarter, Mall/Foggy Bottom, West End/Southwest Waterfront
24	11001006500	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
25	11001007406	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside
26	11001009102	20002/20018	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park/ Woodridge, Langdon, Brentwood, Gateway, Fort Lincoln
27	11001004902	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
28	11001008803	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
29	11001003800	20009	Adams Morgan, Lanier Heights, Columbia Heights
30	11001007407	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside
31	11001007408	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside
32	11001004802	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
33	11001005002	20001/20005	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Logan Circle, Downtown
34	11001010600	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
35	11001010800	20006/20037 20052/20240 20405/20520	Foggy Bottom, West End

36	11001004600	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
37	11001007502	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
38	11001002302	20010/20017 20317	Mount Pleasant, Park View/Michigan Park, University Heights, Brookland
39	11001007604	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
40	11001007803	20019	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville
41	11001008804	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
42	11001000400	20007/20008 20016	Glover Park, Georgetown, Burleith, Foxhall Village, Foxhall Crescent, Massachusetts Avenue Heights/ North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park/American University Park, Tenleytown, Mclean Gardens, Wesley Heights, Spring Valley, Palisades
43	11001003700	20009	Adams Morgan, Lanier Heights, Columbia Heights
44	11001004002	20009	Adams Morgan, Lanier Heights, Columbia Heights
45	11001004202	20009/20036	Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
46	11001004901	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Penn Quarter, Mall/ Logan Circle, Downtown
47	11001007603	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
48	11001007709	20019/20020	Kenilworth, Eastland Gardens, Mayfair, Central Northeast, Benning, River Terrace, Greenway, Fort Dupont, Marshall Heights, Capitol View, Lincoln Heights, Deanwood, Northeast Boundary, Burrville /Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillsdale
49	11001011100	20002/20018	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington / Woodridge, Langdon, Brentwood, Gateway, Fort Lincoln
50	11001005301	20009/20036	Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle

### High-Traffic Throughput Priority

Prioritization of charging spreads across the District, accounting for high commuter traffic that passes through all portions of the District throughout the day. Charging recommendation remains concentrated on the city center but includes other highly trafficked areas in turn.



RANK	TRACT ID	ZIP CODE	NEIGHBORHOOD(S)
1	11001003800	20009	Adams Morgan, Lanier Heights, Columbia Heights
2	11001004201	20009/20036	Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
3	11001004300	20009	Adams Morgan, Lanier Heights, Columbia Heights
4	11001008100	20002/20003	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington / Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
5	11001005600	20037	Foggy Bottom, West End

6	11001008302	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
7	11001005002	20001/20005	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Logan Circle, Downtown
8	11001005201	20005/20009 20036	Logan Circle, Downtown/ Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
9	11001005301	20009/20036	Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
10	11001007200	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
11	11001010700	20006/20036 20037/20427	Foggy Bottom, West End, Dupont Circle
12	11001006900	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
13	11001008200	20002/20003	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington /Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
14	11001008200	20009/20010	Adams Morgan, Lanier Heights, Columbia Heights/Mount Pleasant, Park View
15	11001003700	20009	Adams Morgan, Lanier Heights, Columbia Heights
16	11001005500	20008/20009 20036/20037	North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park/ Adams Morgan, Lanier Heights, Columbia Heights/Foggy Bottom, West End
17	11001004100	20008/20037	North Cleveland Park, Forest Hills, Kalorama Heights, Cleveland Park, Woodley Park/Foggy Bottom, West End
18	11001004002	20009	Adams Morgan, Lanier Heights, Columbia Heights
19	11001004202	2009/20036	Adams Morgan, Lanier Heights, Columbia Heights/Dupont Circle
20	11001004901	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
21	11001008402	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
22	11001007901	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
23	11001010800	20006/20037 20052/20240 20405/20520	Foggy Bottom, West End
24	11001011000	20024/20319	Southwest Waterfront

25	11001006700	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
26	11001008301	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
27	11001002802	20009/20010	Adams Morgan, Lanier Heights, Columbia Heights/Mount Pleasant, Park View
28	11001006600	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
29	11001008002	20002/20003	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington /Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
30	11001003600	20009	Adams Morgan, Lanier Heights, Columbia Heights
31	110010008001	20002	Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington
32	11001002302	20010/20017 20317	Mount Pleasant, Park View/ Michigan Park, University Heights, Brookland
33	11001002900	20010	Mount Pleasant, Park View
34	11001006400	20003/20024 20593	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle /Southwest Waterfront
35	11001005001	20001/20005 20009	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/ Logan Circle, Downtown/ Adams Morgan, Lanier Heights, Columbia Heights
36	11001006202	20001/20002 20003/20004 20006/20024 20037/20230 20245/20418 20506/20520 20540/20551 20560/20566	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Capitol Hill, NoMa, Langston, Ivy City, Trinidad, Carver, Kingman Park, Edgewood, Eckington / Capitol Hill, Lincoln Park, Southeast, Barney Circle, Navy Yard, Hill East/ Penn Quarter, Mall/Foggy Bottom, West End/Southwest Waterfront
37	11001010100	20001/20005 20006	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/ Logan Circle, Downtown/Foggy Bottom, West End
38	110010004902	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
39	11001004400	20001/20009	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/ Adams Morgan, Lanier Heights, Columbia Heights
40	11001000100	20007/20037	Glover Park, Georgetown, Burleith, Foxhall Village, Foxhall Crescent, Massachusetts Avenue Heights/Foggy Bottom, West End

41	11001006801	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
42	11001004801	20001	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
43	11001006802	20003	Capitol Hill, Lincoln Park, Southeast, Navy Yard, Hill East, Barney Circle
44	11001007502	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside
45	11001000202	20007	Glover Park, Georgetown, Burleith, Foxhall Village, Foxhall Crescent, Massachusetts Avenue Heights
46	11001007604	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside
47	11001005800	20001/20004 20005/20045 20535	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park
48	11001003100	20001/20010	Mt. Vernon Square, Chinatown, Shaw, Judiciary Square, Truxton Circle, Bloomingdale, LeDroit Park/Mount Pleasant, Park View
49	11001003900	20009	Adams Morgan, Lanier Heights, Columbia Heights
50	11001007605	20020	Anacostia, Barry Farm, Buena Vista, Douglass, Dupont Park, Fairfax Village, Garfield Heights, Good Hope, Hillcrest, Woodland, Knox Hill, Fort Davis Park, Penn Branch, Randall Highlands, Fairlawn, Hillside



# APPENDIX C

## SCHOOL BUS FLEET TRANSITION PLAN

The successful transition of the OSSE fleet will be dependent on the District’s ability to deploy sufficient charging infrastructure. Detailed below are recommendations based on analysis of the current vehicle makeup and operational needs of the fleet. School buses, like transit buses, are considered “mission critical” applications, meaning there is very little room for having units out of service with charging issues or maintenance concerns. Thankfully, the technology has matured and maintenance requirements will be fewer with electric drivetrains as compared to their conventionally fossil-fueled counterparts. Based on existing fleet composition, there are two primary vehicle sizes: Class A school bus configurations and passenger vans. The recommendations are broken into two sections: pilot phase and fleet transition.

### PILOT PHASE FOR CLASS A ELECTRIC SCHOOL BUS AND PASSENGER VAN

The development of a 24-month pilot program, comprised of 5-10 type A battery electric buses and 5-10 electric passenger vans, is a recommended best

practice. Charging requirements, available range, and ADA requirements may vary between class A school buses and electric passenger vans. With electric passenger vans expected to come to market directly from manufacturers in 2022, there is an opportunity to achieve significant cost savings with these models before Class A electric school buses will achieve cost parity with existing ICE models. The primary goal of the pilot will be to prove the concept and to ensure a successful full fleet transition with minimal impact to daily operations and service delivery.

There should be multiple manufacturers in consideration for the pilot to provide a fair comparison of options. The purchase of these initial pilot buses should come in addition to the existing ICE fleet. Consider extending replacement cycles of upcoming vehicle replacements now, if possible, to reduce total expenditure and the implementation of existing ICE units that may not come up for replacement until after 2030. Take advantage of the leverage opportunities such as the [ACT buyers guide](#) or the [Climate Mayors EV Purchasing Collaborative](#) when selecting bus make and models.



### Information and data to be collected from pilot

Specific data points and operational information should be collected and analyzed. These critical pieces of information are energy costs and consumption and all maintenance records including down time of charging stations and buses, and should be collected for comparison against existing fleet maintenance costs. In the maintenance records, it is critical to collect information associated with vehicle down time and charging station down time.

It will be helpful to inform future transition timelines and procurement decisions based on service delivery. Information should be collected from both internal OSSE staff and external riders and community sources. Ideally, service delivery will be improved with electric buses. Specific data points should include driver experience, rider experience, input from maintenance staff, and community impacts related to noise reduction and decreased emissions and air quality improvements.

Energy consumption data should be collected to compare both fuel spend reductions and to quantify actual environmental benefits available from the electric buses.

It will be necessary to establish clearly defined roles and responsibilities for tracking data points. OSSE will assign the role to existing staff member(s) and clear procedures should be defined. For example, the staff member(s) tasked with tracking pilot data should establish an organized database that is sortable by date and specific topic related to BEB operations. The quality of this data will be a critical component of assessment after the pilot has concluded to inform large-scale electrification. Energy consumption will also be tracked by software associated with the charging stations. It is a best practice to have a secondary method for tracking consumption and other expenses associated with bus operations.

### Pilot phase Step 2

Once the data collection procedure has been established, OSSE will need to determine the domicile location of the initial pilot bus project. All depot sites

should be evaluated for space requirements of EVSE, electrical capacity/upgrades required to install initial charging stations, and routes. The site evaluations should include representatives from DGS, Pepco, and the EVSE vendor.

Selection of an EVSE vendor for the pilot should happen with input from selected BEB manufacturers. Items that should be accounted for when making this decision are cost of stations, historical reliability, and experience from other end users in addition to software interoperability based on recommendation from bus manufacturers. Charging speed and capacity for EVSE should match bus manufacturer recommendations. Executed contracts for charging station vendors are available for public agencies through the Climate Mayors EV Purchasing Collaborative. These contracts are maintained by Sourcewell and can be leveraged by the District of Columbia. Significant cost savings are available through cooperative purchasing in the form of direct purchase price reductions and the conservation of staff time that would otherwise be required to develop an RFP and subsequent bid process.

Once the location of the initial pilot depot has been selected, a request to install one charging station per BEB to be deployed in the pilot will need to be submitted to DGS to initiate the process of site design, budgeting, and ultimate approval to move forward with the infrastructure upgrades.

### Install infrastructure

As bus depot upgrades and renovations are planned, added electrical capacity and electric bus charging infrastructure will be assessed and included as needed. Significant cost savings can be found through avoiding the need to retrofit/increase electrical capacity at depots multiple times. Building upgrades should include longer raceway and conduit run than will initially be required to support the pilot program.

### Vehicle selection

After charging station installations and electrical upgrades are underway at the pilot depot, orders should be placed for 5-10 type A electric buses and 5-10 electric passenger vans.

Vehicle procurement through a purchasing collaborative has the potential to offer cost-effective vehicle options. It is recommended to leverage opportunities such as the [ACT buyers guide](#) or the [Climate Mayors EV Purchasing Collaborative](#) when selecting bus make and models.

Recommended electric vehicle options and associated lifecycle costs are detailed in the graph below.

The electric school bus segment continues to mature with class A school buses being available from multiple manufacturers. Within the Class A segment, there are electric retrofit models and direct from the factory electric options. It is recommended that the fleet incorporate models from multiple manufacturers in the pilot program to evaluate software integration and vehicle performance before building a fleet around any specific model.

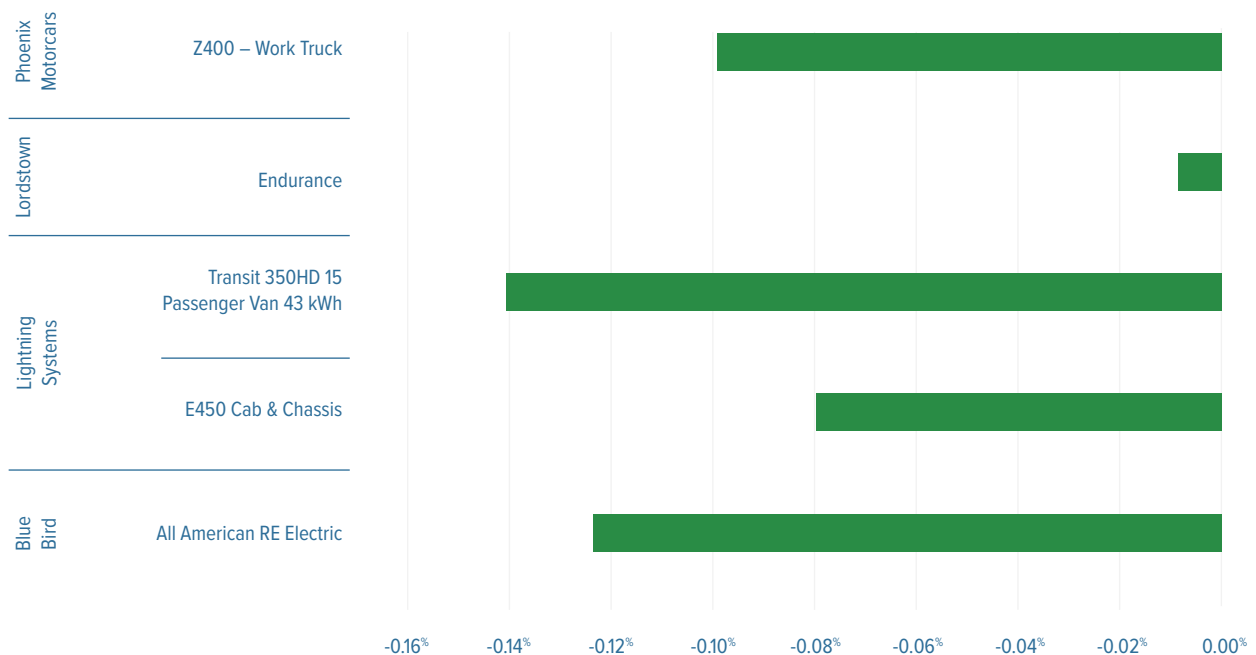
**Innovative Financing Options**

There are several innovative financing options for school bus electrification programs available to

the OSSE fleet today. One of the primary options to consider has been employed by Montgomery County School District<sup>39</sup> and leverages the offering of a third-party vendor to reduce costs and assist with operations. In addition to being a cost-effective option for procurement of vehicles and charging stations this option can help to add resilience to the electrical grid. The vendor will work with Pepco to evaluate charging requirements and help with design of an electrified charging depot retrofit. Electricity is managed closely with a portion being sent back to the grid. The ability to utilize bus assets for energy storage can be particularly helpful to offset increased purchase price of vehicles and charging station installation because the service charges a fee to the local utility and a portion of this fee is shared between the fleet operator and the vendor.

39 Clean Technica. Largest electric school bus order in US History – Montgomery County orders 326 buses (just to start). Accessed on February 26, 2021. <https://cleantechnica.com/2021/02/26/largest-electric-school-bus-order-in-us-history-montgomery-county-orders-326-buses-just-to-start/>.

**Percent Savings from class A electric school buses and passenger vans by vehicle model**



Other innovative procurement options include vendor financing, applying for federal grants, local utility partnership, DC Green Bank financing and local grant programs. All avenues should be considered and investigated prior to purchase of initial vehicles to be used in the pilot.

Exploring the possibility of working with Pepco on a “make ready” pilot program is highly recommended. In this scenario, Pepco would be responsible for installing increased electrical capacity at depots. This would remove the financial responsibility from the District for most upgrades that will be required.

There are also battery lease options which separate the battery from the bus. The District could retain ownership of the vehicles while eliminating the need to purchase the expensive battery pack. This arrangement could be negotiated with a third-party vendor and would be a viable option to reduce upfront capital costs associated with more expensive BEBs.

Lastly, a standard lease option should be evaluated for feasibility. By structuring a lease for buses and/or charging stations, the District’s ability to shift financial exposure and risk to an outside organization. By paying only for the use of the vehicles and charging stations, costs can be spread across the life of the equipment and the total expense would be reduced to a percentage of the overall cost. Payments would be structured to a residual which could be recouped in the aftermarket where there is a potential for profit to be used for subsequent procurements.

### **Testing for 6–12 months**

Phase one of the pilot should focus on familiarization of staff with the new electric vehicles, charging stations, software and operational procedures. The goal of the first months of the pilot should be to test assumptions and normalize daily routines. Vehicles should be driven on all routes and normal operating conditions should be replicated as closely as possible. Collect energy consumption and range data along with driver feedback.

Once initial testing has been completed and all buses and vans have been driven under normal conditions prior to driver training, initiate a driver training program.

Working with the manufacturers, provide training focused on energy consumption and range extending techniques. Once driver training has been completed, run vehicles on routes anticipated for near term electrification ensuring range and battery capacity data is collected. Compare pre driver training range and post driver training range and present findings to staff.

Maintenance staff training should also be completed during the first 12 months of the pilot. Maintenance training will be organized directly through bus and charging station manufacturers. Training should cover both bus and EVSE. In some instances, manufacturers will provide training on site while some training may be offered at manufacturer facilities. Based on staff experience, develop roles and responsibilities for existing staff related to charging station and electric bus maintenance and include these roles and responsibilities in new hire qualifications. Consider creating a new fleet staff position that includes electrical experience.

This phase of the pilot will uncover any possible software interoperability issues, vehicle maintenance issues, EVSE issues and will surface any procedural inefficiencies. Use this time to refine daily operations and inform initial route decisions. After the initial 12-month pilot has been completed, integrate electric buses into daily operations.

Data collection should continue through the next 12 months of regular use as BEBs are used on routes and continue to refine operational processes to ensure high level of service delivery and staff normalization. A concurrent study to compare maintenance and fuel cost between the ICE vehicles and the EV counterpart.

### **Recommendations**

The speed of the electric transition will be directly related to the existing vehicle replacement cycle and the Districts ability to make necessary electrical upgrades to bus depots and the installation of charging stations. It may be necessary to explore the development of new depots if space requirements are deemed to be insufficient at existing depot locations.

## Fleet Transition

To achieve the goal of fully electrifying the OSSE bus fleet will require time, access to capital, manufacturer partnership, utility partnership, staff acceptance, software investment and inter-departmental cooperation. Because of the unique operational requirements associated with the OSSE fleet, it is highly recommended to establish route assignments for specific buses. Shorter routes, and those serving historically underserved populations should be electrified first with longer routes coming online as battery technology allows. This is particularly important in the pilot and near-term electric buses. Establishing assigned routes will ensure sufficient range is available to support daily operations. Assigning routes will also allow the fleet to focus emissions reductions and to leverage air quality improvements available from electric buses in areas that currently suffer from concentrated air pollution.

### STEP 1

Assess the ability to expand charging access. The initial depot that was electrified for the pilot program should be prioritized for additional charging stations. As detailed above, this depot should have conduit and electrical capacity capable of supporting the additional charging stations needed to expand the total electric vehicle fleet. This depot should be maximized to allow as much access to EVSE as possible with charging station installation happening as the demand increases.

### STEP 2

Identify the second depot for electrification. This depot will support further fleet electrification. Identifying this next location can be accomplished by cross referencing top bus candidates for electrification against the fleet replacement schedule. Bus routes serviced from this depot should also be considered, with priority given to historically underserved communities. Electrical requirements will need to be assessed and necessary infrastructure upgrades will need to be made to the facility to support the capacity of electricity that will be required. It is highly recommended to consider future

capacity requirements to reduce future expenses associated with additional retrofit of the depot.

Once charging requirements are defined, it will be necessary to coordinate the required building and electrical capacity upgrades required with Pepco. The Department of General Services (DGS) must be a part of this process. DGS will coordinate the construction and installation of charging stations. Once space and electrical capacity is maximized at each depot, the process should begin again at subsequent depots as needed to facilitate full fleet electrification.

### Fleet Charging

Most Class A electric school buses are capable of charging via both level 1 (120v) level 2 (240v) and DCFC (400 + volts). Depending on battery state of charge upon arriving back to the depot after routes have been completed, it is feasible to use more cost-effective level 2 charging to operate some bus routes. However, fleet operations can be streamlined by providing access to DCFC and this should be prioritized. The total number of charging ports to install at each depot will depend on the number of vehicles and the make/model of these vehicles domiciled at each depot. With larger Class A buses given a 1:1 port to vehicle ratio and passenger vans given a 2:1 vehicle to port ratio. Electric passenger vans will not require as much electricity to operate as larger, class A electric buses and it may be possible to reduce the total number of charging ports dedicated to this segment of the fleet. Vehicles used in the pilot program should be given a dedicated charging port.

### Track data/software integration

A critical component to successfully managing an electric bus fleet is the software used to track bus usage, maintenance, electricity use, range and to properly map and manage routes. Proper software integration is critical and must be updated and synced between bus and charging station. Cost savings can be had by programming stations to initiate charging sessions during off-peak hours when electricity costs are lowest. Working with a third party, electric bus service provider can greatly assist with charge management in addition to providing financial assistance.

## First Responder Training

The procedures used by first responders, responding to an incident involving an electric vehicle are different from when responding to an ICE vehicle.

While the risk of an electric vehicle fire is considerably less than that of a conventional ICE vehicle, with one EV manufacturer reporting one fire for every 205 million miles traveled, it is necessary to provide training to all first responders who may be called to an incident involving an EV. Trainings are available through some EV manufacturers and through the NFPA (National Fire Prevention Association). When organizing a training program, ensure the courses offered qualify under NTSB regulations.

## Messaging of Public Benefits of Electric Buses

Messaging about the public benefits of electric buses is very important so that the general public will gain awareness and knowledge about the District's efforts to reduce air pollution by transitioning from diesel buses to electric buses. Through stakeholder meetings, health benefits were identified as the most important talking point. Below are examples of messages that will resonate most with residents to be used in public messaging:

- Electric buses don't emit any tailpipe pollution, eliminating exhaust that is linked to asthma attacks, respiratory illness, and cancer. Replacing all of America's school buses with electric buses could avoid an average of 5.3 million tons of greenhouse gas emissions each year.  
<https://calpirg.org/feature/cap/electric-buses-healthy-kids#:~:text=Electric%20buses%20don't%20emit,attacks%2C%20respiratory%20illness%20and%20cancer.&text=California%20is%20already%20plugging%20into%20electric%20buses%20in%20a%20big%20way.>
- There's preliminary evidence that [retrofitting school buses to pollute less improves kids' test scores](#), because the negative effects of air pollution on brain development are well-documented.

<https://www.vox.com/future-perfect/2021/4/6/22364385/one-small-idea-in-bidens-infrastructure-plan-with-big-benefits-electric-school-buses>

- Replacing diesel buses with electric avoids emissions of harmful local pollution, which directly improves public health. King County, Washington, estimates that each of its electric transit buses reduces health and environmental damages by more than \$100,000 over its lifetime compared with diesel buses.  
<https://files.wri.org/s3fs-public/expert-note-electric-buses.pdf>
- Diesel exhaust is classified as a carcinogen by the International Agency for Research on Cancer, and inhaling diesel pollution can impair lung function and aggravate asthma symptoms. The lung conditions caused by diesel pollutants also put Americans at increased risk and vulnerability for respiratory illnesses, such as COVID-19.  
<https://files.wri.org/s3fs-public/expert-note-electric-buses.pdf>
- Zero Emission Buses with diesel oxidation catalysts, devices designed to reduce harmful pollutants in tailpipe emissions, will reduce children's exposure to diesel exhaust and reduce the air pollution from diesel school buses by approximately 50 percent.  
<https://floridadep.gov/air/air/content/dera-past-projects>
- On average, a school bus produces noise levels of 85 decibels and the EPA recommends avoiding anything higher than 80 decibels. Electric vehicles reduce noise pollution, making them a safer alternative.  
<https://firststudentinc.com/resources/schools/benefits-of-adding-electric-school-buses-to-your-fleet/>



# APPENDIX D

## AGENCY ROLES AND RESPONSIBILITIES

ACTION	DESCRIPTION	LEAD AGENCY	COLLAB. AGENCY
EQ.1	Analyze all transportation electrification plans, policies, and programs to prioritize and contribute to a green and equitable economy across all Wards.	DOEE	ORE
CE.1	Within six months of the Roadmap’s public release, continue community engagement convenings that make it easier for more people, particularly communities and people least represented, to gather input and feedback as Roadmap actions are implemented.	DOEE	
CE.2	Foster and support engagement through at least six public events through ANC engagement targeted to low/middle-income and working-class communities in Wards 5, 7, and 8 to continue to include their voices to identify actions needed to support a fair and equitable transition to electric vehicles.	DOEE	
CE.3	Facilitate four EV-related training opportunities with labor unions, trade organizations, and other groups representing transit workers, electricians, or automotive service technicians to build a workforce that can support EVs and also deliver good-paying jobs for District residents by 2025.	DOEE	DOES
CE.4	Host six educational opportunities by 2025 to encourage Advisory Neighborhood Commissions (ANCs), large DC-area employers, commercial entities, Business Improvement Districts (BIDs), property developers, and other site hosts to install EV chargers to support the needs of their residents, customers, employees, and stakeholders.	DOEE	

CE.5	Within six months of the Roadmap's public release, create an interagency task force led by the Office of the Deputy Mayor for Operations and Infrastructure (DMOI) to guide and support District agencies implementing actions to achieve transportation electrification.	DMOI	DOEE
EV.1	Within one year of the Roadmap's public release, using the charging gap analysis, identify 200 locations to install EV charging infrastructure to prioritize EV adoption in areas historically overburdened by poor air quality through incentives and priority funding.	DOEE	
EV.2	Build out public Level 2 charging by increasing chargers at a 2% ratio of District registered EVs in the District by 2025 with emphasis on installations in Wards 5, 7, and 8.	DDOT	
EV.3	Build out workplace Level 2 charging increasing chargers to 2% of the estimated commuters driving into the District by 2025.	DDOT	
EV.4	Expand public EV charging by deploying chargers at 50 District-owned properties by 2025 with emphasis on installations in Wards 5, 7, and 8.	DGS	
EO.1	Offer public and private fleet managers suitable educational materials and sufficient resources by 2024 to support the transition to 100% electrified fleets by 2045.	DOEE	
EO.2	Engage both community organizations and diverse public-interest groups through public meetings focused on the planning and implementation processes of the campaign to ensure benefits are shared broadly, especially to low-income communities and/or communities of color by 2024.	DOEE	
EO.3	DOEE to create incentives for multi-unit dwelling (MUD) property owners to install EV chargers at MUDs so residents can charge their vehicles from home, those who may not have the opportunity to install their own charging equipment.	DOEE	
EO.4	Connect with 100 local business leaders and employees to promote the benefits for them of EVs and the importance of accessible, low-cost workplace charging by 2024.	DOEE	
EO.5	Educate 100 commercial property owners about the benefits that EV charging can provide tenants, their employees, and their customers by 2024.	DOEE	

<b>EO.6</b>	Provide consumer adoption campaign materials to car dealerships within the DMV that educate and inform prospective EV buyers by 2024.	DOEE	
<b>EO.7</b>	DOEE to host in a publicly accessible location EV and EVSE resources educating the public about EVs, their infrastructure, and available incentives within six months of public release of the Roadmap.	DOEE	
<b>POL.1</b>	Develop incentives for expanding public and residential EV charging infrastructure through the EV make-ready building code and code changes for existing buildings by DOEE.	DMOI	
<b>POL.2</b>	Expand curbside charging access by offering a curbside charging program managed by DDOT by 2024.	DDOT	
<b>POL.3</b>	Develop multi-unit dwelling EV infrastructure grants to increase residential charging infrastructure for tenants by 2025.	DMOI	DDOT
<b>POL.4</b>	Expedite and streamline permitting of charging stations to reduce hurdles and shorten timeline for EV charger installations through DCRA by 2024.	DCRA	
<b>POL.5</b>	By 2025, adopt Right-to-Charge legislation enabling MUD tenants and condominium-owners the right to install EV chargers.	DOEE	
<b>POL.6</b>	By 2024, explore additional opportunities for low-cost charging options through partnership opportunities to expand residential EV charging.	DOEE	DDOT
<b>POL.7</b>	Develop EV purchasing incentives for new & used vehicles to increase EV adoption for taxicab fleets and low-income drivers.	DMOI	DFHV
<b>POL.8</b>	Develop low-income EV leasing incentives to increase EV adoption in a market segment not currently reached.	DMOI	DOEE
<b>IN.1</b>	DOEE would meet quarterly with Pepco to strategize infrastructure plans and prioritize locations.	DOEE	Pepco, DMOI
<b>IN.2</b>	DOEE, in collaboration with agency fleets, will propose optimal electric rate design for both light-duty vehicles and buses in coordination with Pepco, the Public Service Commission, and other stakeholders by 2025.	DOEE	Pepco, PSC



<b>IN.3</b>	District Government will, by 2025, adopt policies with the Public Service Commission and Pepco that encourage shifting EV charging to off-peak hours.	DOEE	Pepco, PSC
<b>IN.4</b>	Analyze costs/benefits of the District's fleet vehicles with the DRVE Tool and other tools within six months of the Roadmap's public release.	DPW	DOEE
<b>BFT.1</b>	Adopt and follow the DC Circulator Sustainability Plan that identifies the timeline and pathway to full electrification of the DC Circulator fleet by 2045.	DDOT	
<b>BFT.2</b>	Pilot a 24-month program, comprising five to 10 type A battery electric buses and five to 10 electric passenger vans, in the OSSE fleet to gain operating and maintenance experience with electric buses, vehicles, and infrastructure.	OSSE	DOEE
<b>BFT.3</b>	OSSE will continue to work with OCFO and complete by the end of 2022 a vehicle budget to purchase electric school buses to meet goals in the medium- and heavy-duty vehicle MOU.	OSSE	OCFO, DMOI
<b>BFT.4</b>	Train first responders in proper techniques to respond to incidents involving electric vehicles, particularly to address the differences in vehicle design that can present different hazards in a crash situation compared to vehicles with an internal combustion engine.	DMOI	
<b>BFT.5</b>	Develop public messaging by 2024 around the public health and air quality benefits that electric buses offer the communities where they operate.	DOEE	DDOT
<b>BFT.6</b>	Over the next five years, DDOT will collaborate with the Washington Metropolitan Area Transit Authority (WMATA) to identify opportunities to share infrastructure and optimize the complete transition to, and operation of, electric transit buses, thereby reducing greenhouse gas emissions and improving air quality.	DDOT	WMATA
<b>FGC.1</b>	Identify opportunities, by 2023, for shared infrastructure with the Federal Energy Management Program which helps the federal fleet community implement EVs and charging infrastructure.	FEMA	
<b>FGC.2</b>	Coordinate by 2023 bulk vehicle purchases and charging infrastructure with large District agency fleets and federal fleets acquiring light-, medium-, and heavy-duty electric vehicles.	DOEE	



**This roadmap was developed with support from the Electrification Coalition.**

About the Electrification Coalition: The Electrification Coalition is a nonpartisan, nonprofit organization that promotes policies and actions to facilitate the widespread adoption of plug-in electric vehicles (EVs) on a mass scale in order to overcome the economic, public health and national security challenges that stem from America's dependence on oil. For more information, visit:

**[ELECTRIFICATIONCOALITION.ORG](https://www.electrificationcoalition.org)**



