WASHINGTON AREA
BUS TRANSFORMATION
PROJECT

Project Overview

White Paper #1

October 2018

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Table of Contents

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1. Project Background

The purpose of this white paper is to provide a high-level overview of the Bus Transformation Project and lay out a scope and path forward

An appendix to this paper provides members with important background information on bus service in the region, current trends and challenges affecting bus service, and preliminary views of stakeholders gathered through interviews conducted to date.

In reviewing this paper, Committee members should keep the following in mind:

1. What are the key problems this effort should tackle?
2. What is our vision for regional mobility?
3. What goals should the regional bus system have in light of this vision?
4. What are the key challenges the bus system must address to achieve those goals?

1.1. Bus in the Region Today

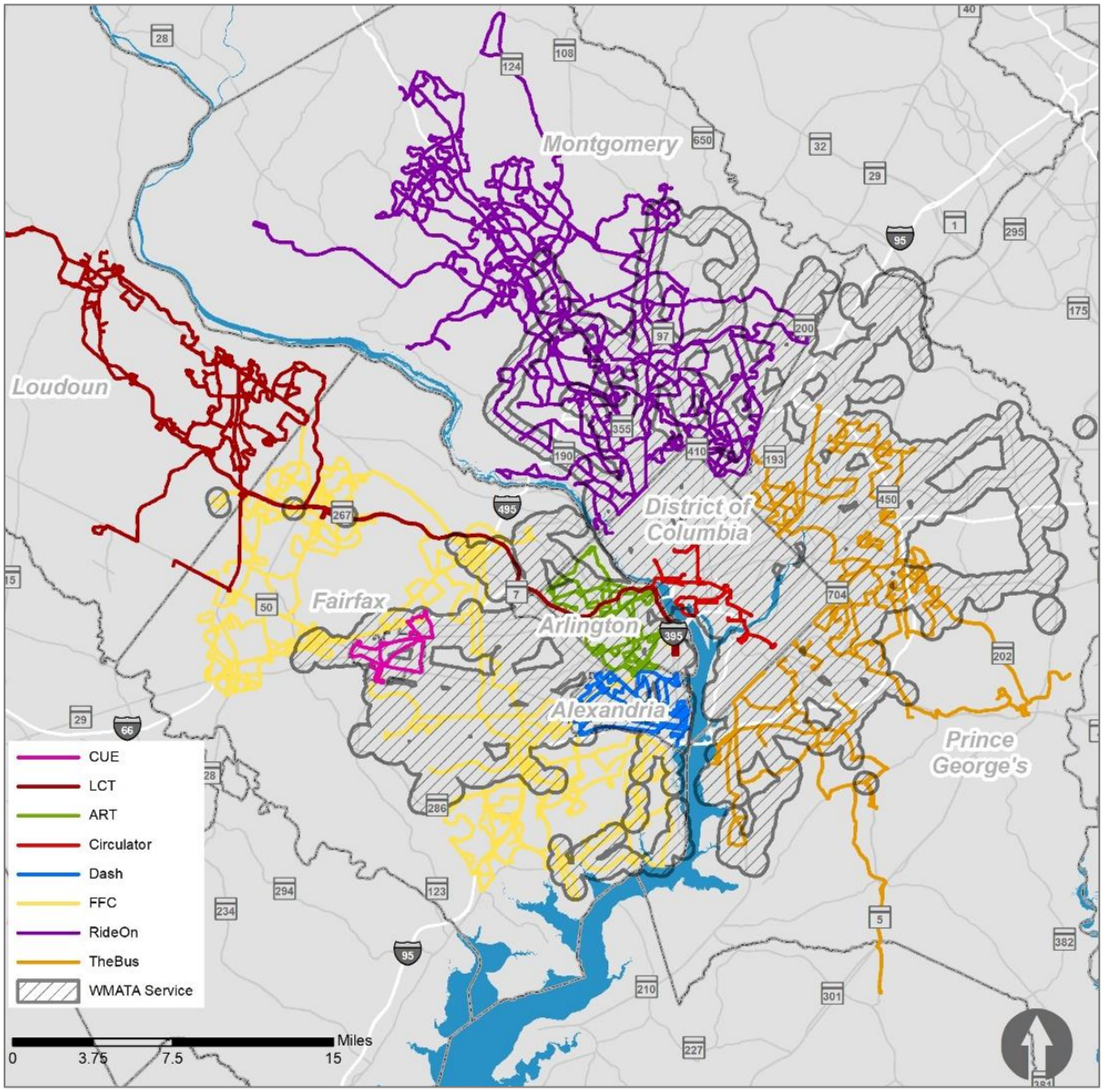
The Washington Metropolitan Area relies on a multi-entity, multi-modal transportation network that provides approximately 19 million trips per day. Buses are an integral part of this network, connecting residents to jobs, education, healthcare, and social gatherings. Nine local bus operators – Metrobus, ART, DC Circulator, Fairfax Connector, Ride On, TheBus, DASH, and Loudoun County Transit – provide over 164 million trips annually.[1]

While there are many modes of mobility in the region, bus continues to be the most cost-effective solution for large-scale transportation. Buses leverage existing roadway infrastructure; furthermore, the establishment of new bus routes does not require significant capital expenditure. In a region where development opportunities around rail stations are nearing capacity, the bus system provides opportunity for transit-oriented development, while providing an affordable transportation option for a large portion of the region's population, many of whom rely on it as a means of traveling to work, school, shops, social gatherings, and other destinations.

Collectively, bus operators across the region provide coverage to the majority of individuals in the area. 81 percent of people in the region are within a quarter-mile of transit, including 94 percent of the transit-dependent population.[2] During peak travel periods, 48 percent of people across the region, including 77 percent of the transit-dependent population, have access to high-frequency service (available within 15 minutes or less).[3]

[1] 2017 National Transit Database (NTD). Does not include local commuter services (MTA Commuter, PRTC).
[2] Transit dependent individuals are low-income (less than $30,000 annual household income) with no personal car.
[3] Foursquare ITP analysis; WMATA 2014 Passenger Survey; US Census 2011-2016 Five-Year Estimates.

Regional Bus Operator Coverage in the Washington Metro Area:



Source: Foursquare ITP analysis

1.2. The Problem

Despite the expansive reach of bus, providers across the region are contending with significant challenges, including decreasing bus speeds, ridership declines, and mounting operational pressures.

Bus speed is decreasing

In the last 10 years, the average speed of Metrobus-operated buses has declined by nine percent from 11 miles per hour to 9.7 miles per hour.[4] One of the reasons for reduced bus speed is traffic congestion. According to the INRIX Global Traffic Scorecard, the Washington area is the 6th most congested metro area nationally, and the 18th most congested in the world. The worst congestion occurs during the morning and afternoon/evening commutes, when drivers are in congestion 23 percent of all time spent behind the wheel. Accounting for less busy non-peak weekday hours and weekends, Washington area drivers are in congestion 11 percent of all time spent behind the wheel.[5]

Closely linked to the congestion issue is the fact that roadway space is becoming increasingly scarce. In addition to constraints from increased on-street parking, bus stops, and curbside developments, bus also has to contend with the elimination of historical bus lanes. Bus lanes first appeared in the DC area in the 1960s but were phased out the following decade. One example is the Shirley Highway Busway, which opened in 1969. By the 1970s, over 50 percent of all the passenger traffic on the Shirley Highway – the portion of I-95/I-395 from Woodbridge to the Potomac River – traveled via bus. A few years later in 1974, Virginia opened up the busway to high-occupancy vehicle users, and restrictions on single-passenger cars have been gradually reduced since then.[6] While bus remains the highest-capacity way to move people on the roadway, the decreased speed of bus is a significant challenge to its viability.

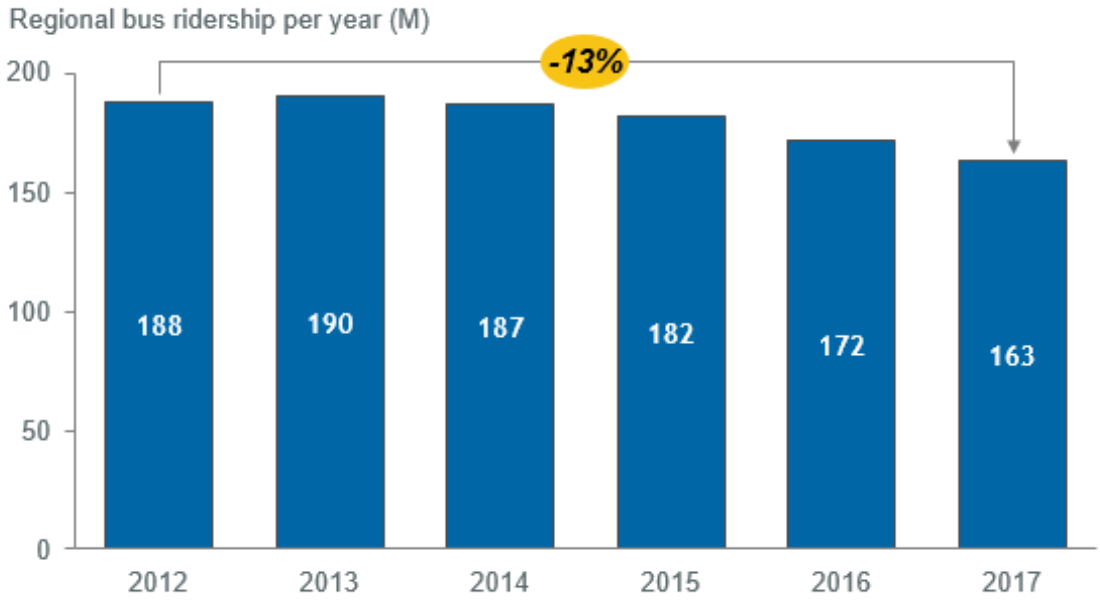
Bus ridership declining

Bus ridership is rapidly declining around the nation. In the Washington Metropolitan area, across all regional operators, ridership fell by 13 percent from 2012 to 2017, and the rate of decline is increasing.[7] One of the reasons for ridership decline is changing customer expectations. Today, people expect frequent, reliable, and convenient transportation, and for many of the region's residents, the current bus system is not meeting those needs. Mobility has become increasingly personalized for each user, and bus has not adapted accordingly.

Riders now have more mobility options than ever before, including Transportation Network Companies (TNCs) such as Uber and Lyft, as well as bike-sharing and scooter-sharing companies. These newer mobility modes are leveraging advances in technology to offer on-demand sourcing and real-time arrival and departure data. The introduction of new pooling services, coupled with a large supply of venture funding, has driven down the cost of using TNCs. In an increasingly competitive mobility landscape, bus is struggling to maintain its value proposition.

[4] National Transit Database (2008-2017).
[5] INRIX Global Traffic Scorecard (2017).
[6] *"BRT Might Be Cheap to Build, But it's Cheaper to Destroy."* Greater Greater Washington (2012).
[7] NTD data (2012-2017).

Washington Area Regional Bus Ridership, 2012-2017:



Source: JCC Monthly Ridership Reports, NTD Database.

Mounting pressure on bus operating model

Metrobus' operations are funded by fares and an operating subsidy, which is comprised of financial contributions from state and local jurisdictions. As of FY2019, WMATA must comply with a three percent cap on operating subsidy growth for bus and rail, which was imposed by state legislatures.[8]

Given current ridership trends and cost structures, Metrobus will struggle to meet the subsidy growth cap while maintaining current service levels. At the same time, it is not clear that local bus operators are sufficiently organized to fill service gaps that could be left by Metrobus. Without a clear plan for bus on a regional level, the Washington area may be unable to meet the mobility needs of riders. Funding has always been a challenge for bus in the region, but this subsidy growth cap creates an even greater urgency around regional collaboration on bus service.

1.3. The Opportunity

This Bus Transformation Project presents an opportunity to make buses work again for the region by driving maximum value from our existing roadway infrastructure; improving access to reliable, convenient transit; and speeding up reliable point-to-point travel for workers, tourists, and families.

The project is not focused on one bus provider or one local system. Rather, it is about *regional collaboration* across a confederation of systems, all of which have a stake in the future role of bus.

Transforming bus in the region is a unified effort that will require participation of regional stewards, jurisdictional leadership, departments of transportation, roadway operators, transit providers, transit advocates, and the customers and businesses that rely on transit. This effort necessitates

[8] WMATA FY19 Budget.

thoughtfulness and statesmanship as stakeholders will inevitably be faced with difficult tradeoffs. Parties involved in this work will need to engage at a deep level to understand the consequences of various decisions and make informed choices about the best path forward.

This year marks over two decades since the region's stakeholders came together to deliver the 1997 Blue Ribbon Mobility Report, a landmark consensus on the future of the region's bus system. In the 1990s, the region's bus systems were failing, but with joint-problem solving and political will, the region was able to address that challenge. Today, the region is again at a crossroads, with another opportunity to bring leaders together to address the system's problems and agree on a bold, sustainable future for bus.

1.4. The Promise

The promise of the Bus Transformation Project is to develop a regional mobility strategy that clearly defines the role of bus service and bus operators, advances innovations, thinks boldly about the future, and creates a roadmap to get there. It has the potential to enable a region mired in congestion and lost productivity to advance an easier, faster, safer, and more sustainable way to get around. It also has the potential to accelerate the economic potential of the region by connecting its vibrant neighborhoods to places of interest via low-cost transportation. In the process, this transformation will help balance the area's high cost of living and allow the region to compete nationally and globally for top talent and companies.

As part of this effort, it will be necessary for the project to form an understanding of the region's vision for mobility and determine the goals for bus service in light of that vision.

1.4.1. The Region's Mobility Goals

The project will rely on existing consensus views on goals for regional mobility as a foundation. Regional decisions on bus service involve WMATA member jurisdictions, as well as the State of Maryland, the Commonwealth of Virginia, the U.S. Department of Transportation, the Northern Virginia Transportation Commission, the Washington Suburban Transit Commission, the Metropolitan Washington Council of Governments' Transportation Planning Board, and others. Nearly all of these governments and organizations have enumerated goals for transportation in their respective mobility plans.

Across these plans, three key goals for mobility are primary[9]:

1. *Improve access* for all individuals to safe, affordable, reliable, high-speed, high-capacity, high-frequency transportation.
2. *Strengthen and connect communities* by providing economic development opportunities, lowering the high cost of living, enhancing competitiveness, and reducing congestion and pollution.
3. *Manage resources* effectively by ensuring long-term fiscal sustainability of mobility options.

The Bus Transformation Project has built on these regional mobility goals to define the goals for bus in the region.

[9] *Maryland 2040*, MDOT (2018); *moveDC plan*, DDOT (2014); *TransAction plan*, NVTA (2017); *Constrained Long-Range Transportation Plan*, Transportation Planning Board (2016); *Visualize 2045 Plan*, MWCOG (2018).

1.4.2. Goals for Bus in the Region

On September 12, 2018, more than 120 stakeholders from the region gathered for a Bus Transformation Project Kick-off Summit, during which they discussed aspirations for the future of bus in the region. Participants included jurisdiction representatives and regional bus operators, labor union representatives, and advocacy organizations, among others.

Based on the Summit discussion, five preliminary goals for bus in the region emerged[10]:

1. Provide a *safe and reliable* transit option that efficiently connects people to places in the region.
2. Deliver a *convenient, user-centered* mobility option that provides integrated information on services.
3. Maintain a transit mode that is *financially sustainable* in the long-term.
4. Support *economic development* across the region.
5. Ensure *affordable, equitable opportunities* for people to access transportation.

1.5. Stakeholders

By establishing the Bus Transformation Project, the region seeks to develop a new strategy for the provision of service and funding for bus service, as well as a roadmap for implementing that strategy. The Project is a regionally-developed action plan that will be based on input from a diverse set of stakeholders in the area.

AECOM, The Boston Consulting Group, and Foursquare Integrated Transportation Planning (Foursquare ITP) are working together to provide relevant project management, analytical, strategic, communication and expert support and advice to the project.

The project is overseen by a four-part Project Committee structure, which will provide strategic insights and ensure overall project progress:

1. *Executive Steering Committee*: Recognized leaders who are closely involved with strategy development and manage political risks and benefits to the region.
2. *Strategic Advisory Panel*: Senior staff and appointed members who review major work products and advise the consultant team.
3. *Technical Team*: Recognized discipline leaders within Metro and senior jurisdiction transit staff who review technical and financial analyses.
4. *WMATA Leadership Team*: Decision-makers within Metro who manage and evaluate actions that affect the organization and its operations.

The project is also heavily engaging with the public and representative stakeholders, including elected officials, local bus operators, unions, riders and non-riders, business groups, and community-based organizations. Input from stakeholders will be gathered through surveys, focus groups, workshops, and public engagement forums. Public communications on the project will be shared regularly, to ensure that a broader audience from across the region is informed of progress and able to provide thoughtful input.

[10] Goals are currently being refined by key stakeholders.

1.6. Progress to Date

The Bus Transformation Project team used the lead up to the Kick-off Summit to prepare the analytical groundwork and preliminarily engage with over 50 key stakeholders. The Project team conducted an assessment of the current system as well as a review of regional and national peer systems.

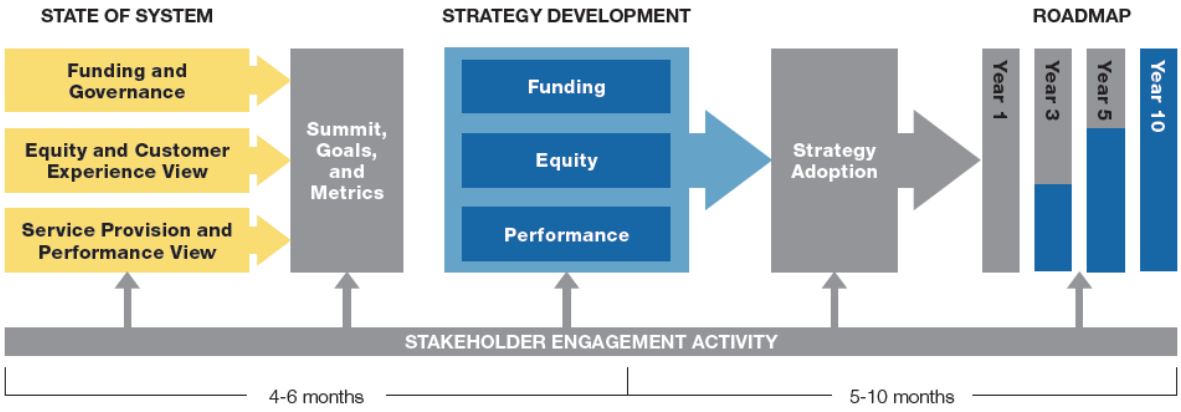
The Project Team launched a public engagement process on September 17 with the opening of an online survey that seeks to gather input from riders and non-riders to understand their opinions, preferences, and desires for bus service in the region. In addition to being available online, the survey is being administered on tablets at 18 “pop-up” events throughout the region.

As immediate next steps, the project seeks to:

1. Align the Executive Steering Committee on the proposed scope.
2. Continue to engage with the public and stakeholders to understand views.
3. Continue to develop a robust evaluation of the current state of the bus system in the region.
4. Build a set of strategic options in response to the fundamental scope questions and analyze relevant trade-offs.

2. Path Forward

2.1. Project Roadmap



With the Summit complete, the project is now entering the Strategy Development phase. This process will entail defining goals and metrics, identifying various strategic options, and highlighting the benefits, challenges and risks associated with each. Continued collection and synthesis of stakeholder insights will inform the development and prioritization of these options.

Based on the strategy, 1-, 3-, 5-, and 10-year roadmaps will be developed to clearly identify what WMATA and its partners need to do to make the strategy a reality. The actions in the roadmap will identify impacts of implementing certain strategies, and the specific owner of each action. The roadmap may cover, but not be limited to, changes to:

1. Network structure
2. Route and line operations
3. Service standards (classification of service, frequency, span, reliability)
4. Facilities (garages, bus stops, amenities)
5. Funding and financing
6. Cost structure and cost allocation
7. Technology
8. Fare policies and collection
9. WMATA Board policies
10. Management, administration, and organizational structure
11. Labor structure and delivery methods (work rules, collective bargaining agreement, contracting)
12. Fleet improvements

Appendix

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A-1. History of Regional Mobility

The groundwork for the current configuration of bus service in the region was laid over 50 years ago, when the region formed WMATA in 1967 and voters committed to finance Metro costs the following year. WMATA was created as an interstate compact by the Signatories—DC, Maryland, and Virginia—to plan, develop, finance, and operate a comprehensive mass transit system for the Washington Metropolitan Area. In 1973, WMATA bought four bus operators in the region because they were becoming insolvent, and Metrobus was formed.[11]

While Metrobus was the primary regional bus operator in the early 1970s, the region experienced rapid growth in public transit options over the next two decades, as jurisdictions began offering locally-operated services as a lower-cost (to the funder) alternative to existing Metrobus service. Concurrent with this bus operator proliferation was the expansion of Metrorail, which had moved beyond its sole Red Line operation in 1976 to covering several parts DC, Maryland, and Virginia.[12]

Bus Operator	Start of Operations
Ride On	1975
CUE	1980
DASH	1984
Fairfax Connector	1985
TheBus	1986
ART	1998
DC Circulator	2005

A-2. Overview of Regional Bus Operators

In addition to Metrobus, seven regional bus providers offer services in Maryland, Virginia, and the District:

Ride On is the bus system for Montgomery County, Maryland. With an annual operating budget of $110 million in 2016, it covers a service area of nearly 500 square miles and a population of approximately 972,000 people. In 2016, Ride On had a fleet of 338 buses and an average weekday ridership of approximately 80,000.[13]

Fairfax Connector is the bus system for Fairfax County. With an annual operating budget of $81 million in 2016, it covered a service area of approximately 400 square miles and a population of 1.1 million people. In 2016, Fairfax Connector had a fleet of 303 buses and an average weekday ridership of approximately 30,000.[14]

[11] WMATA Compact, 2009.
[12] www.wmata.com; www.dashbus.com; www.arlingtontransit.com; www.dccirculator.com; www.montgomerycountymd.gov; www.princegeorgescounty.md.gov; www.fairfaxva.gov; www.dccirculator.com.
[13] National Transit Database, 2016 Annual Agency Profile: Ride-on Montgomery County Transit.
[14] National Transit Database, 2016 Annual Agency Profile: Fairfax Connector Bus System.

The *DC Circulator* is a partnership between the District Department of Transportation and the DC Surface Transit, which envisioned efficient and low-cost public transit across the District for residents and visitors. The Circulator offers six routes across DC and into Rosslyn, VA for only $1. With a fleet of 67 buses, it provides nearly five million trips annually.[15]

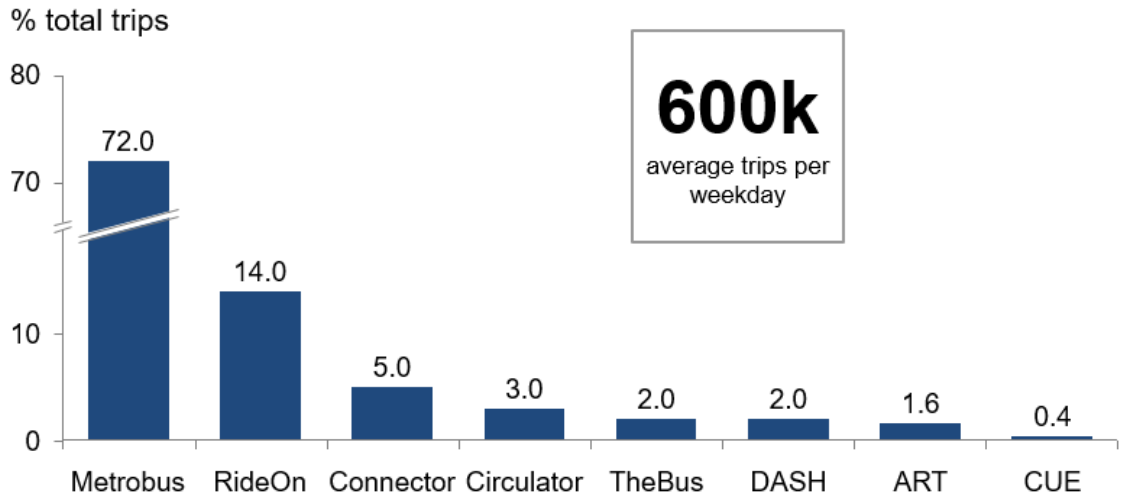
TheBus is Prince George's County's dedicated bus service that operates 28 routes[16], covering a limited service area of nearly 500 square miles and a population of 900,000 people with low-frequency service. With an annual operating budget of $30 million in 2016, TheBus provided nearly 13,000 trips on an average weekday with a fleet of 93 buses.[17]

DASH is the City of Alexandria's bus system, providing service across 16 square miles for a population of roughly 140,000 people. With an annual operating budget of $16 million in 2016, DASH provided nearly 14,000 trips on an average weekday with a fleet of 85 buses.[18]

ART offers bus service in Arlington County across 26 square miles for a population of 230,000 people. With an annual operating budget of $12 million in 2016, ART had an average weekday ridership of nearly 11,000 with a fleet of 65 buses.[19]

CUE, The City of Fairfax City – University Energysaver bus system, provides service to George Mason University, shopping centers, Vienna Metro Station, and other locations[20] across a service area of six square miles with a population of nearly 23,000 people. With an annual operating budget of $3 million in 2016, CUE provided 2,400 trips on an average weekday with a fleet of 12 buses.[21]

Percent of Total Weekday Trips by Bus Provider:



Source: National Transit Database 2015

[15] www.dccirculator.com.
[16] www.princegeorgescountymd.gov.
[17] National Transit Database, 2016 Annual Agency Profile: Prince George's County Transit.
[18] National Transit Database, 2016 Annual Agency Profile: City of Alexandria.
[19] National Transit Database, 2016 Annual Agency Profile: Arlington Transit – Arlington County.
[20] www.fairfaxva.gov.
[21] National Transit Database, 2016 Annual Agency Profile: City of Fairfax CUE Bus.

A-3. Stakeholder Perspectives

To date, the project has conducted interviews with nearly 50 stakeholders from multiple jurisdictions within the Compact area. They have shared valuable insights from the state, regional, and local levels, and provided valuable operator, rider, and government perspectives.

Five key themes have emerged from initial interviews:

1. *Bus service must become rider-focused*: One of the key insights from these interviews was that bus service needs to focus on customer priorities: greater convenience, enhanced safety, increased reliability, higher frequency, and a better environment. User-centricity emerged as an essential driver of interest in bus versus other transit options.
2. *Technology can drive service improvement*: Stakeholders indicated strong interest in seeing technology used to enhance the bus experience through real-time service updates, on-demand trip-sourcing capabilities, and mobile fare payments. A few jurisdictions have already made technological integration a key component of their bus goals.
3. *Need to wrestle with the role of TNCs vs. bus service*: Respondents had mixed views on the rise of TNCs. Some were interested in seeing TNCs provide micro-transit or last-mile solutions, which allow buses to focus on more productive routes. Others worried TNCs were decreasing bus ridership and increasing congestion. Nevertheless, all stakeholders agreed that there is an urgent need to determine how bus service fits into the mobility landscape.
4. *Improved coordination is vital to the effort*: Some stakeholders believe coordination across agencies is strong in some areas, but most asserted that more clarity is needed on responsibilities and decision-making structures. There was also a clear interest in ensuring close collaboration between WMATA and jurisdictional partners.
5. *Funding decisions should be clear and fair*: A number of respondents indicated that the funding formula is not perfect today. Some noted that it is difficult to understand how the formula works, and others cited ambiguity in regional versus non-regional cost allocation. Other concerns included inconsistent application of the service type definitions (which can dis-incentivize investment in transit) and a perception that bus is sidelined for rail, despite similar ridership. Among the stakeholders surveyed, there was a strong interest in ensuring that decisions on who pays what are equitable.

A-4. State of the System

In developing the regional strategy for bus service that aligns with the aforementioned goals, the project must address seven fundamental challenges:

1. How will bus meet changing *customer needs*?
2. What types of bus service does the *region need*?
3. How will bus keep up with *evolving technology*?
4. How will bus maintain a *sustainable cost structure*?
5. How will key stakeholders *coordinate across the region* (could include governance structures, shared facilities, routing efficiencies)?
6. What *roles* should the region's various bus operators play?
7. How will the region decide *who pays* for service?

A-4.1. Bus is Not Meeting the Value Proposition of Being Reliable and Affordable

Bus service in the region has not fully met the customer expectation of reliability, which is a key driver of rider satisfaction with transit. Unreliable trip start and end times are a source of customer frustration, as are systemic incidents that affect reliability. As an example, Metrobus temporarily pulled 164 buses from service in March 2018 due to two incidents in which engines cut off at low speeds.[22] Metro deployed 80 reserve buses to make up for the loss, but the shortage continued. Two weeks after that incident, 20 trips in Northern Virginia were cancelled due to an equipment shortage, which disrupted the morning commute for four days.[23]

Affordability is another customer expectation that bus continues to contend with. In 2017, regular Metrobus fares rose to $2 from $1.75, a 14 percent increase. At the same time, Express Bus fares rose from $4 to $4.25 and Airport Bus fares rose from $7 to $7.50. While Metrobus fares continue to be among the lowest nationally, recent fare increases–and any future increases–could affect customer satisfaction with bus and make bus less competitive in comparison with other modes.[24] Furthermore, some low-income riders who may not be able to afford higher-priced services could be priced out of bus services if fares continue to increase.

A-4.2. Need for Bus to Quickly Adapt to Changing Technology Landscape

Five technology trends are driving the future of mobility:

1. *Shared mobility platforms* allow riders to connect with shared transportation options when it is most convenient.
2. *Connectivity-enabled traffic management* leverages big data and the Internet to reduce congestion and improve trip time.
3. *User-centric design* increases customer expectations that systems will adapt to their individual needs and habits.
4. *Automated mobility* allows vehicles to navigate roadways without human interaction.
5. *Vehicle electrification* enables vehicles to reduce emissions and ongoing costs.

These technological advances have the potential to not only change bus service as we know it today but will also make a range of bus alternatives more viable as competition.

Shared Mobility Platforms

The use of shared transportation has risen significantly in recent years as urbanization grows and greater focus is placed on environmental and economic concerns. There is more interest than ever in car-sharing, ride-sharing, bike-sharing, and scooter-sharing services. Meanwhile, technological innovation has allowed for the rise of shared mobility platforms that offer customers on-demand transportation options with real-time arrival, pickup, and departure information and seamless payment options.

[22] "*Metro removes 164 buses from operators for safety checks following two incidents of engine cutoffs."* WMATA (2018).
[23] "*Metro temporarily cancels 20 bus trips in Northern Virginia."* NBC Washington (2018).
[24] "*Metro announces June 25 date for changes in fares, services."* WMATA (2018).

Transportation Network Companies (TNCs) like Lyft and Uber have leveraged shared mobility platforms to capture a significant share of the national and regional transportation market. There were an estimated 4.2 billion TNC trips in the U.S. in 2018 versus 4.5 billion bus trips. In the Washington Metro Area in particular, there were an estimated 72 million TNC trips in 2018 vs. 110 million trips for Metrobus. If this trend continues, TNC ridership will surpass bus as early as 2019.[25]

Shared mobility poses two challenges for bus. First, the evolution of the TNC model suggests it will continue to erode bus market share. TNCs have shifted towards pooled and express services, driving down per trip price, and making it more price-competitive with bus. Second, the proliferation of TNC vehicles increases road congestion, which could slow down bus services, and affect rider satisfaction.

However, mobility platforms also present opportunities for bus. Transit agencies can explore ways to leverage shared mobility platforms to improve transit service. In Duisburg, Germany, the regional transit authority is piloting a program that allows users to request services from five-seat transit vans using an interface similar to taxi-sharing applications.[26] The City of Los Angeles also created a multimodal platform for trip planning, which allows riders to choose from public and private transportations in one place.[27]

Connectivity-enabled Traffic Management

Connectivity-enabled traffic management involves leveraging big data and the Internet of Things (IoT) to reduce congestion and improve trip time. One example of connectivity-enabled traffic management is Transit Signal Priority (TSP) systems, which consist of technology-driven operational improvements that reduce bus wait times at traffic signals by holding green lights longer or shortening red light phases. Another example is the use of connected hardware to collect real-time traffic data and use to inform transit routes.

Regional jurisdictions are implementing TSP on a limited basis, but expanding and integrating connectivity-enabled traffic management systems could have a measurable impact on bus performance and potentially on the transportation system overall. Today, the agency predicts Metrobus arrival times and makes that information publicly available via its BusETA website.[28] Given the emerging technology in this space, there is potential for bus to further improve on-time performance using IoT infrastructure and big data. For example, San Francisco recently implemented a TSP, which optimizes traffic based on real-time and historical data and gives priority to certain bus lines. This effort has already decreased bus trip time in the area by 10 percent.[29]

Despite the opportunities in this space, implementing connectivity-enabled traffic management solutions on a larger scale could present some challenges. First, significant infrastructure investment is required to set up a robust traffic management system. Second, setting up systems such as TSP – which require changes to roadway infrastructure – would require a great deal of coordination. Because WMATA does not control the roadways or the traffic signals in any of the jurisdictions in

[25] "*The new automobility: Lyft, Uber and the future of American cities."* Schaller Consulting (2018); APTA bus ridership statistics; BCG Analysis.
[26] "*Pilot Project for peripheral areas in Duisburg."* Rundschau Online (2017); DVG myBus Application.
[27] *"This app hopes to help you outsmart LA traffic jams,"* CityLab (2016).
[28] BusETA.wmata.com.
[29] "*Transit Signal Priority Helping Speed San Francisco Buses through Intersections*." Global Traffic Technologies (2014). SFMTA.com.

which it operates, implementation would likely require buy-in from several agencies in the region that would all need to agree to prioritize bus.

User-centric Design

Advancements in technology have led to the emergence of a user-centric design philosophy focused on adapting tools to human needs and behaviors. Today, leading companies design products with the user's interests in mind and then develop solutions tailored to those interests.

The enhanced focus on human-centered design in the 21st century could pose challenges for bus. Given the emergence of user-centric technologies, customers in the region increasingly expect systems – including mass transit – to adapt to their individual needs and habits. It is difficult for mass transit to create tailored solutions for users, as these organizations are mandated to serve very diverse populations. At the same time, TNCs are developing user-focused tools at a rapid pace, potentially increasing the attractiveness of those transportation options.

Metrobus has taken some steps towards implementing user-centric design, but there are many more opportunities for bus to become more user-centric. For example, the agency's online Trip Planner tool allows users to identify routes nearest to their location or destination, and then plan a trip to or from the stop.[30] To become more user-centric, this tool could collect and share real-time seat information with users, leverage information on user preferences (e.g., route preferences) to plan trips, and allow for seamless application-based payment.

Automated Mobility

The widespread use of transportation modes that are capable of navigating their surroundings without human interaction is on the horizon. Automated vehicle exploration is already underway for multiple modes, including passenger vehicles, transit and shuttle buses, and freight services. In 2018 alone, Stockholm launched self-driving shuttle buses, BMW established a partnership with LiDAR company Innoviz to make self-driving cars, and Ford announced a $4 billion investment in a new self-driving vehicle unit.[31]

Despite these efforts, many open questions remain about automated vehicle penetration. Experts have not reached a clear consensus on when driverless vehicles will penetrate a significant portion of the new vehicle market. Similarly, it is unclear which markets will be early adopters of automated mobility options, and in what capacities and functions automated transport will be used.

Nevertheless, the Washington, DC region is already exploring potential future uses of automated vehicles. In 2015, Maryland launched the Connected & Automated Vehicles Working Group.[32] Last year, Virginia Tech began testing automated vehicles in Arlington, and the Virginia Department of Transportation released their Connected & Automated Vehicle Program Plan under the office of the Chief of Innovation and Technology.[33] Earlier this year, DC Mayor Muriel Bowser launched the

[30] wmata.com/schedules/trip-planner.
[31] *"Ugly but useful: Stockholm introduces first driverless buses."* Forbes (2018); *"BMW selects Innoviz solid-state LiDAR for 2021 Automated Driving."* Forbes (2018); *"Ford to invest four billion in self-driving vehicle unit."* Reuters (2018).
[32] www.mva.maryland.gov.
[33] www.vtti.vt.edu, www.virginiadot.org.

Interagency Autonomous Vehicle Working Group to proactively prepare the District for AV technologies.[34]

When automated vehicles penetrate the regional transportation market in the future, they could pose challenges and opportunities for bus. On one hand, the lower cost and increased convenience of automated transportation options could displace status quo mass transit options. On the other hand, bus systems could leverage driverless technologies to enhance the financial sustainability of their operations. In this case, bus would still have to contend with significant obstacles, including managing the potential employment impact of reduced operator needs.

Electric Propulsion

Today, the vast majority of global vehicle sales are for diesel or gasoline-powered vehicles. By 2030, diesel and gasoline-powered vehicles are expected to comprise only 50 percent of the market, while the other 50 percent will consist of electric or plug-in hybrids, which reduce CO_2 emissions.[35] Battery manufacturing capacity is expected to triple in the next three years, making electric cars as affordable as gasoline-powered cars by 2025.[36]

Metrobus and other regional bus operators have the potential to reduce carbon emissions by one-third by switching to hybrid or fully electric buses. One regional bus operator is already pioneering this approach. In 2017, the DC Circulator added 14 electric vehicles to its fleet. The use of these electric vehicles is expected to displace 88,900 gallons of diesel per year, eliminate more than 244,000 pounds of CO_2 emissions annually, and provide cost savings of more than $6 million during a 12-year lifetime.[37]

While significant energy efficiency opportunities are associated with electric propulsion technology, the rise of electric vehicles could pose two challenges for bus. First, electric-powered cars reduce the environmental advantage of current-state fuel-powered buses. Reduced environmental footprint is frequently cited as one of the key reasons for bus use, so the introduction of electric passenger vehicles could lead energy-conscious riders to switch from bus to that option. Second, to operate an electric bus system at scale, operators would need to invest in new infrastructure such as charging stations that allows battery-powered buses to be charged at the right times and in the right places.

A-4.3. Metrobus Business Model under Pressure

Metrobus covers operating expenses with an operating subsidy, which is comprised of financial contributions from state and local jurisdictions to fund the Metro operating budget. These contributions supplement revenues from fares, parking, advertising, and other sources.[38] The subsidy originates from the WMATA Compact, which includes a legislative mandate for DC, Maryland, and Virginia to finance the interstate transit system. Beginning with the FY2019 budget, WMATA is faced with a three percent operating subsidy growth cap for bus and rail imposed by state legislatures.[39]

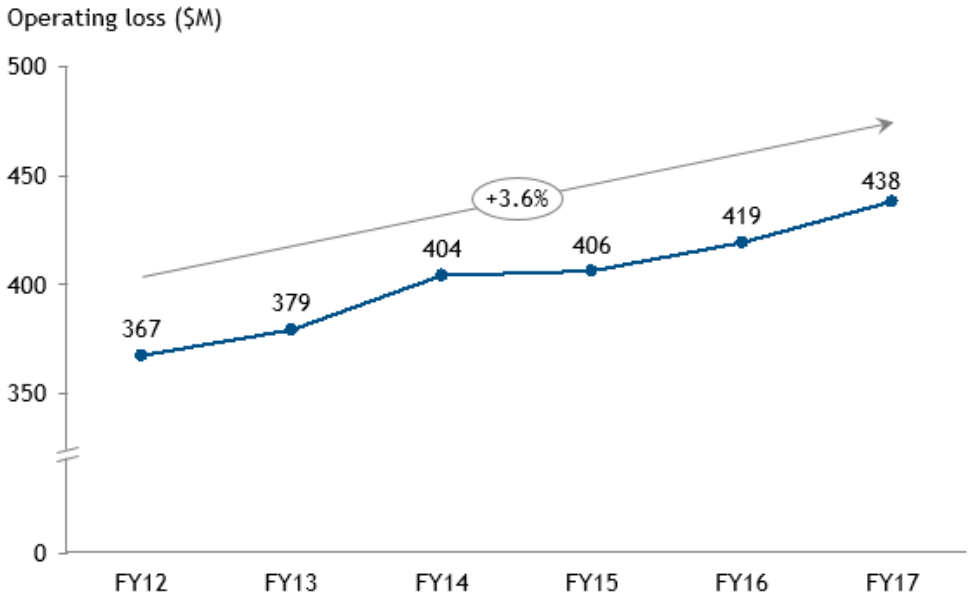
Metrobus cannot meet the subsidy cap with current passenger trends, costs, and service levels. From 2012 to 2017, the Metrobus operating loss (subsidy need) grew ~3.6 percent per year. Despite

[34] www.mayor.dc.gov
[35] BCG analysis.
[36] *"Pretty soon electric cars will cost less than gasoline ones."* Bloomberg (2018).
[37] *"14 electric vehicles will join DC Circulator Fleet May 1."* Curbed DC (2018); DCcirculator.com.
[38] "*How does metro's subsidy allocation work?"* PlanIt Metro (2012).
[39] WMATA FY19 Budget.

increasing fares over time, Metrobus has experienced declining revenue over the past five years, largely driven by declining passenger numbers.[40]

While fuel costs have fallen and service levels have remained constant, total Metrobus costs have risen 15 percent ($80 million) since FY12. Cost increases have mainly been driven by rising personnel costs, which make up 84 percent of total costs (up from 78 percent in FY12).[41]

WMATA Operating Losses over 5-year Period



Source: WMATA Budget FY12-17.

A-4.4. Complex Regional Roles and Responsibilities

WMATA is governed by a Board of Directors responsible for determining policy and overseeing funding, operations and expansion of transit facilities. The Board consists of two directors from each of the following political entities: (1) The Commonwealth of Virginia; (2) The State of Maryland; (3) The District of Columbia; and (4) The Federal Government. The Board of Directors and WMATA are responsible for developing and executing a Mass Transit Plan for the Washington Metropolitan Area Transit Zone.[42]

In addition to the Board, WMATA engages a number of stakeholders in decision-making processes. WMATA partners closely with city, county, and state and regional leadership in DC, Maryland, and Virginia. In addition to jurisdictional leadership, other key influencers typically have a seat at the decision-making table, including collective bargaining groups, community leaders, the business community, and subject matter experts.

[40] WMATA FY12-18 Budget.
[41] *ibid*.
[42] www.wmata.com.

Given the number of partners that are involved in transit decisions, a great deal of coordination is required to enact bus improvements, which can slow project progress. One example is the 16th Street Bus Lane Project. The responsibility for enacting bus lanes falls to the District Department of Transportation, as they own and operate the roads in the District. But the project involves the following stakeholders: WMATA, National Capital Planning Commission, National Park Service, DC Office of Planning, DC Historic Preservation Office, Maryland DOT, Maryland State Highway Agency, DC Advisory Neighborhood Commissions, and citizen advisory groups, among others.[43] Even though project planning began in 2002, implementation is not expected to occur until 2020, largely due to the complexities associated with enacting change led by a large and diverse stakeholder group.

A-4.5. Potential Need to the Refresh Approach to Deciding Who Pays

WMATA Compact jurisdictions in DC, Maryland, and Virginia split the cost of Metrobus funding by providing an annual contribution in the form of an operating subsidy. Metrobus has two types of subsidy allocations, one for regional routes and one for non-regional routes. For non-regional routes, subsidy calculations are simple – jurisdictions pay an hourly fee for bus service. For regional bus routes, a four-part formula is used, which takes into account population of the jurisdiction, number of riders in the jurisdiction, population density around bus routes, and number of miles in the jurisdiction.[44] The hourly cost used for non-regional routes is significantly lower than for regional routes because WMATA allocates more of its overhead expenses to the regional operation.

The funding formula has remained consistent over time, but there are stakeholder concerns with the formula that may warrant further exploration, including lack of clarity on how the allocation definitions work and are applied, and questions about whether the formula leads to equitable outcomes.

FY2018 Metrobus Operating Subsidy by Jurisdiction ($ millions)

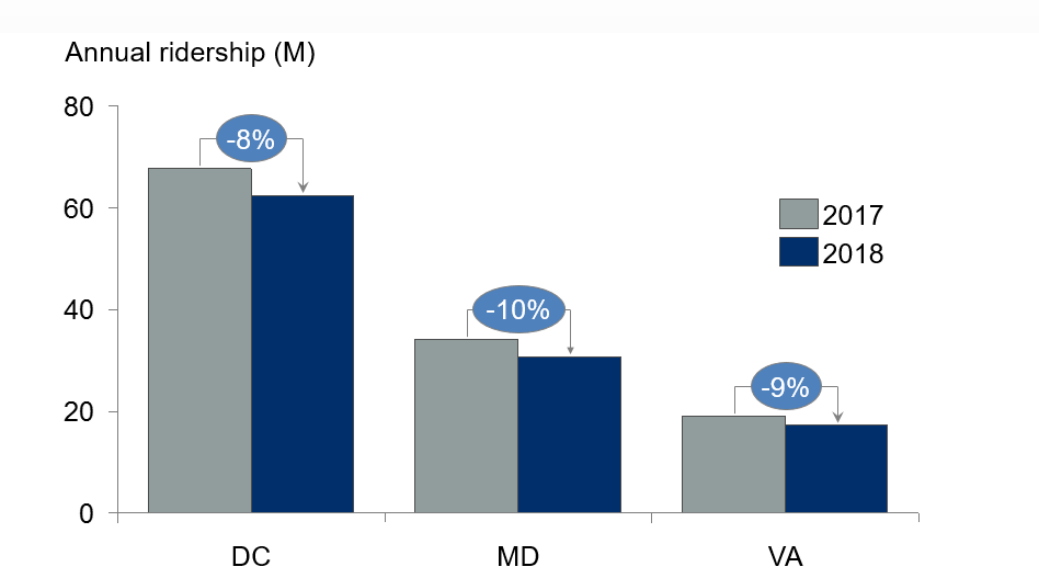
Jurisdiction	Metrobus	Regional	Non regional
District of Columbia	215.7	186.5	29.2
Montgomery County	70.7	63.1	7.6
Prince George's County	96.5	75.3	21.2
City of Alexandria	21.8	19	2.8
Arlington County	35.2	33.3	1.9
City of Fairfax	0.7	0.7	0
Fairfax County	61.9	56.8	5.1
City of Falls Church	1.6	1.6	0
Total	**504.1**	**436.3**	**67.8**

Source: WMATA FY18 Operating budget.

[43] WMATA Regional Bus Study (2003), 16th Street Lane Study (2009), 16th Street NW Safety & Mobility Study (2013), 16th Street Transit Priority Study (2016), 16th Street Bus Lanes Projects (2018).
[44] *"How jurisdictions share the cost of Metro, and what it means for riders,"* Greater Greater Washington (2009).

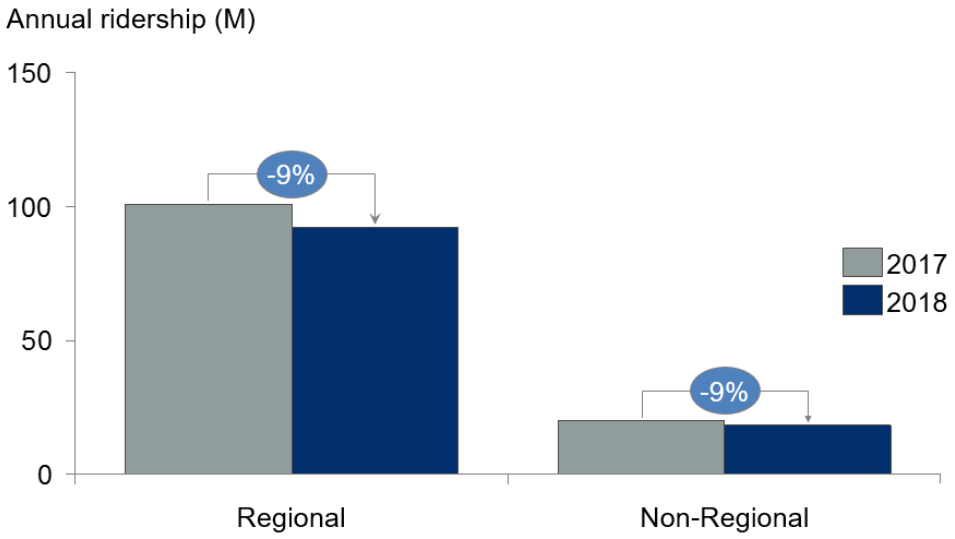
A-4.6. Ridership Trends

8 to 10 Percent Ridership Decline across DC, MD, and VA:



Source: JCC April 2018 Preliminary Ridership Report.

Similar Rate of Decline in Regional vs. Non-regional Lines:

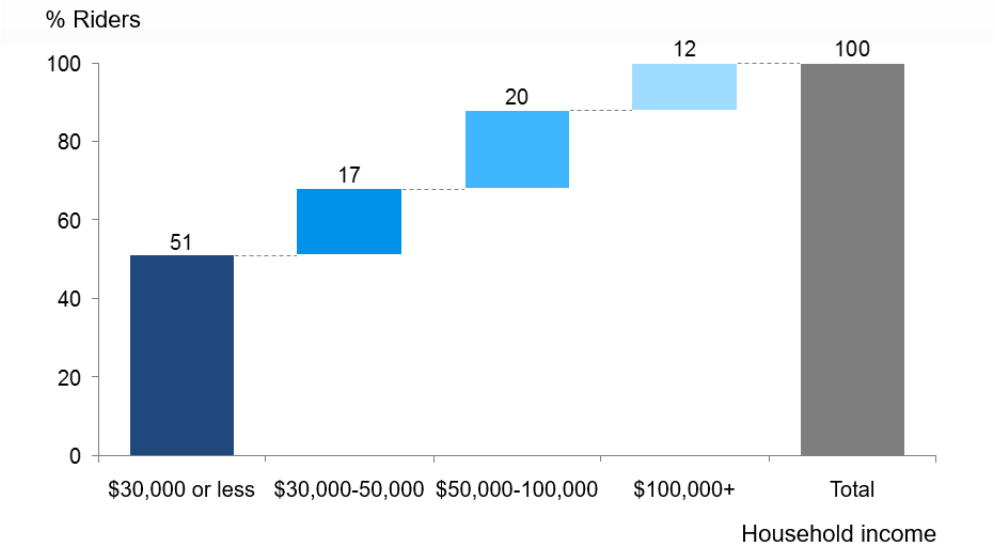


Source: JCC April 2018 Preliminary Ridership Report.

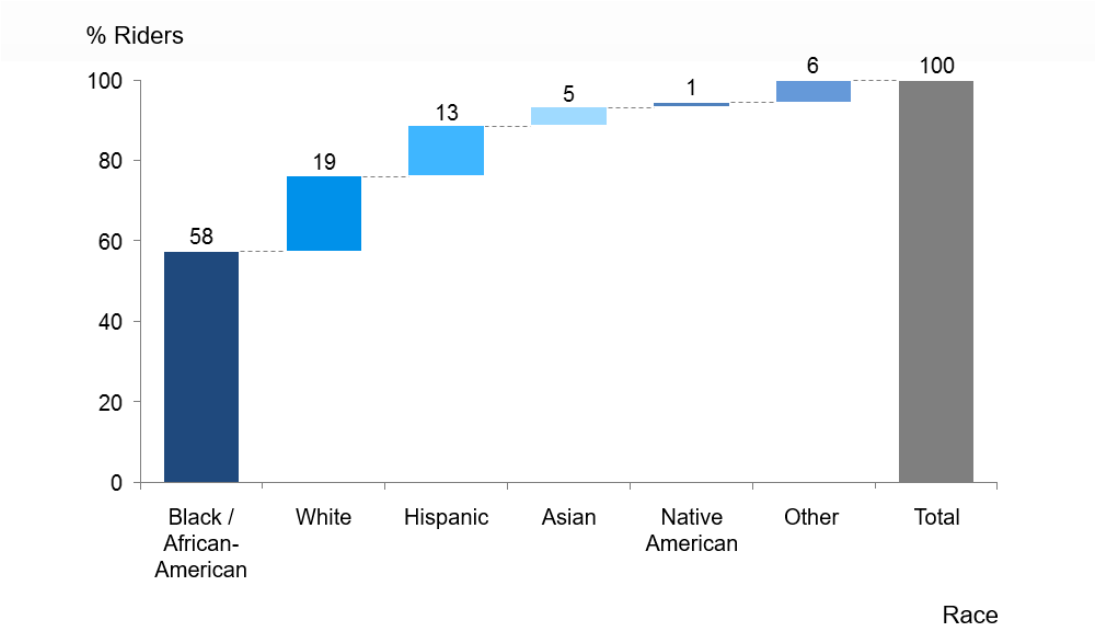
A-5. Further Details on Metrobus Operations

A-5.1. Rider Demographics

2014 Metrobus Rider Demographics:



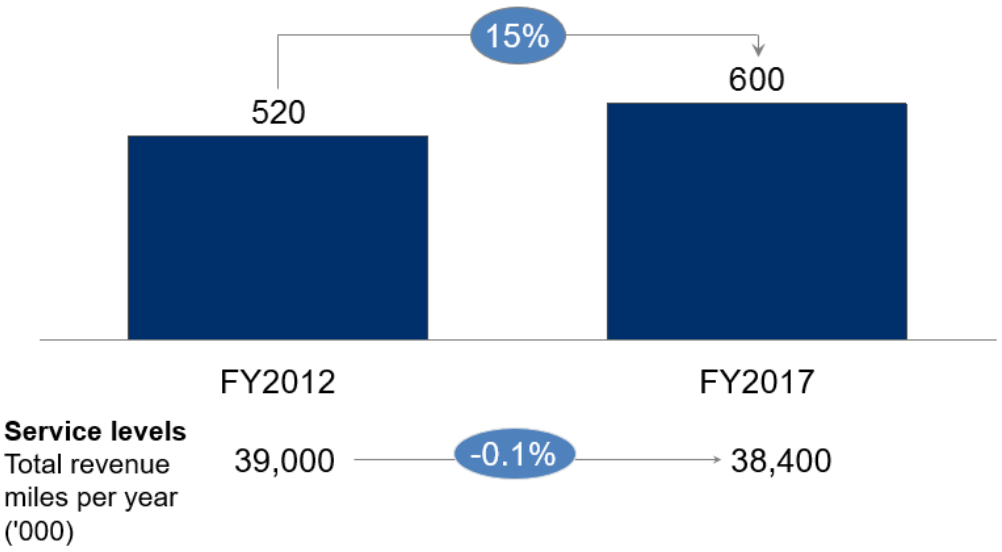
Source: WMATA 2014 Passenger Survey



Source: WMATA 2014 Passenger Survey

A-5.2. Cost Structure

Cost Increase of $80 million (15 percent) While Service Remains Constant:

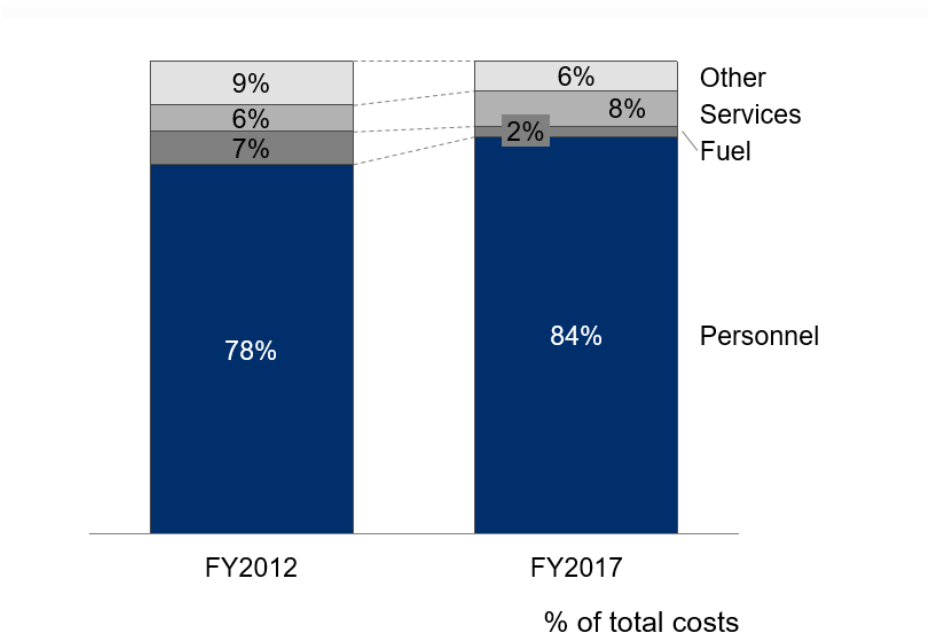


Source: WMATA FY12-18 Budget

Cost Increase Driven by $97 million Growth in Personnel Costs:

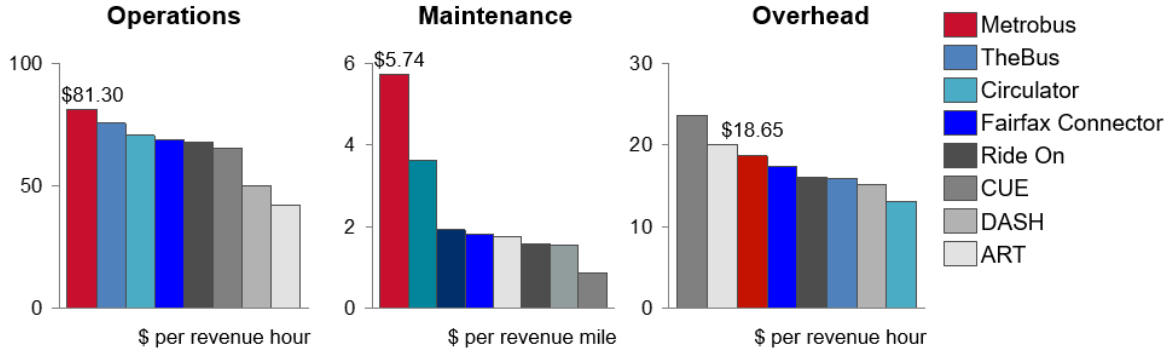
Source: WMATA FY2018 Budget

Personnel Costs Now 84 Percent, Up from 78 Percent in FY12:



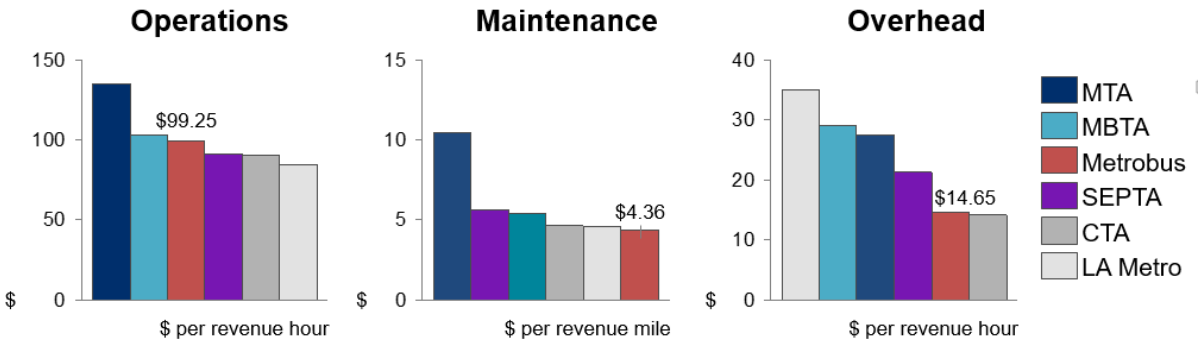
Source: WMATA FY2018 Budget

Metrobus Costs Higher than Regional Peers:



Source: National Transit Database 2017; MWCOG 2018 Regional Bus Service Provision Study.

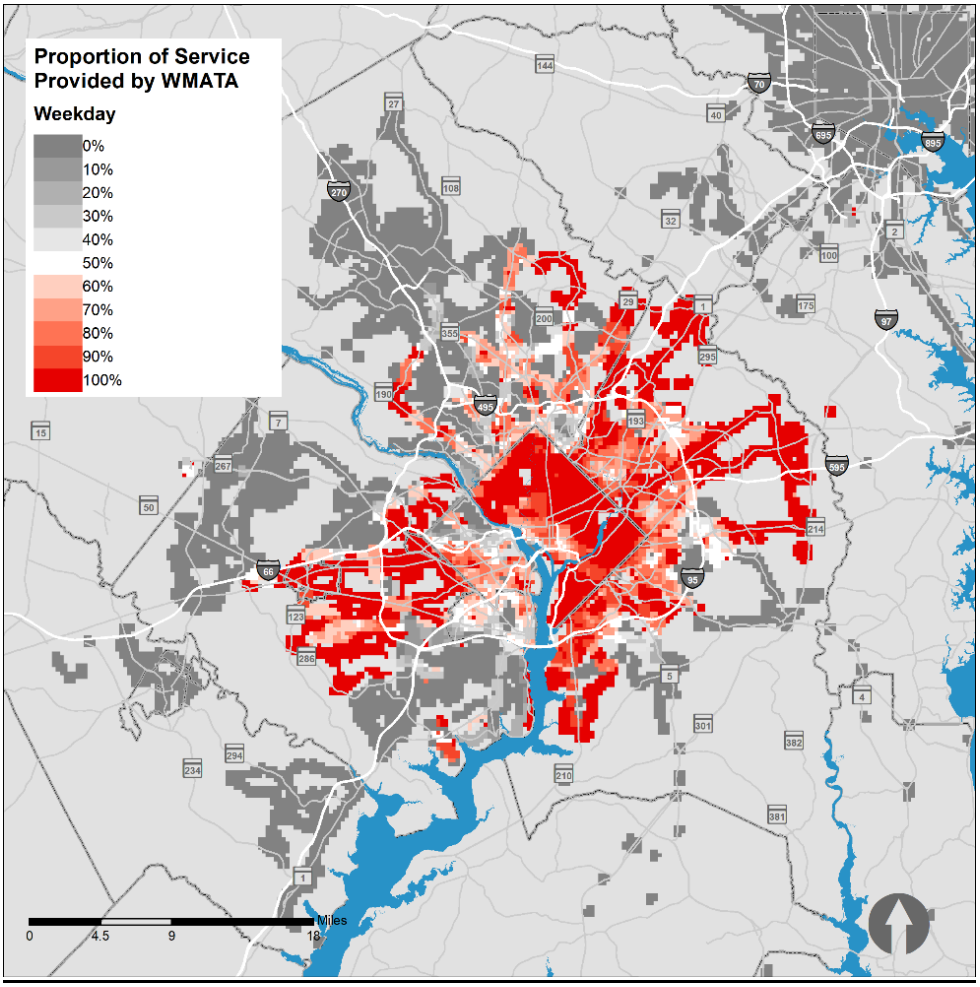
Metrobus Costs on Par with Other Agencies Nationwide:



Source: NTD Database (all figures from 2018)

A-5.3. Metrobus Service

Metrobus Coverage Area:



Source: Foursquare ITP analysis.