

Chapter 4:

Societal Topics

Visualize 2050 comes at a critical turning point in history. During the COVID-19 pandemic, the region saw drastic changes in economic activity and travel behavior. As the region enters a new chapter, post COVID-19, many societal topics related to transportation today and in the future are at the forefront of people's minds including the economy, environment, public health, and emerging technologies.

Economy

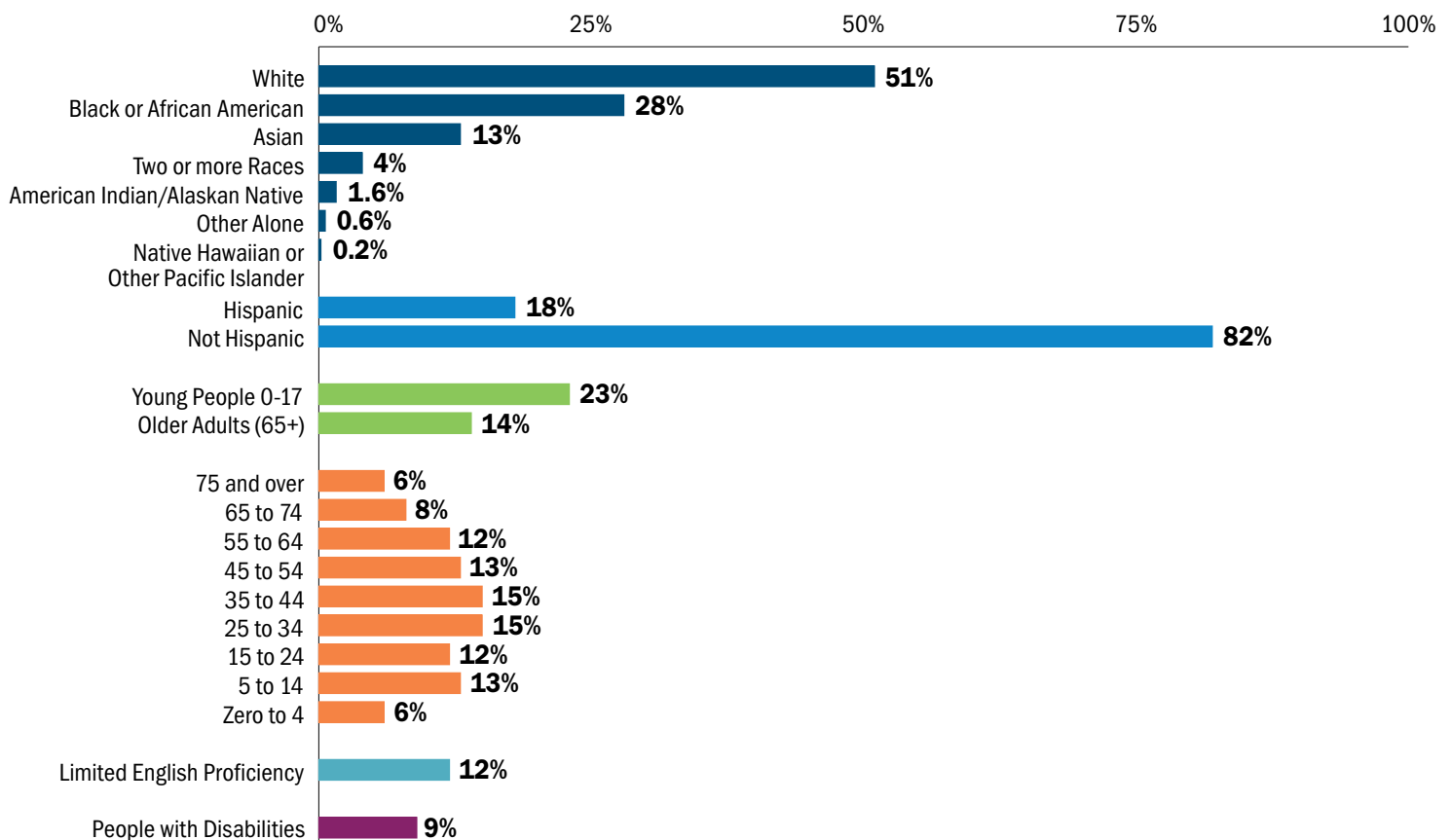
The people who live and work in the National Capital Region (see Chapter 1 for planning area) power an economy whose influence extends far beyond the region's borders—across the country and around the world. A comprehensive understanding of the

economy—including the population's characteristics, the region's housing market, and employment landscape—is essential for strategically planning the future transportation system.

Population and Demographics

Today, approximately 5.95 million people of all backgrounds, ages, and abilities live in a region spanning approximately 3,500 square miles across 22 jurisdictions. Figure 4.1 provides a summary of population demographics.¹ Young people 17 and under comprise 23 percent of the population while older adults 65+ make up 14 percent. Residents with limited English proficiency comprise 12 percent, and nine percent of people live with a disability.

Figure 4.1: Regional Demographics, Current Percent of Population



1 U.S. Census Bureau (2023). American Community Survey (ACS) 5-Year Estimates Data Profiles – Selected Social Characteristics. <https://data.census.gov/table/ACSDP5Y2023.DP02?q=dp02&g=010XX00US> and Demographic Characteristics. <https://data.census.gov/table/ACSDP5Y2023.DP05?q=dp05&g=010XX00US>

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Easterseals/NADTC



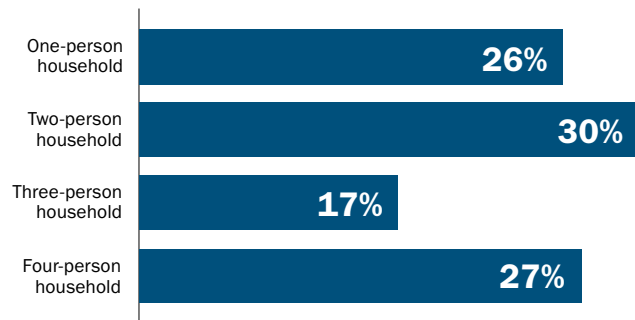
Although unforeseen disruptions, like COVID-19 or workforce reductions may occur, by 2050, the population is projected to reach nearly 7.2 million people, marking a 21 percent increase over 2025. Future growth will contribute to the region's quality of life and influence transportation options for both current and future residents. By 2050, Fairfax County (including City of Fairfax and City of Falls Church) and the District of Columbia are forecasted to gain the most community members, gaining 201 thousand and 147 thousand, respectively.²

Households and Housing



More than 2.25 million households call the National Capital Region home. As shown in Figure 4.2, two-person households are the most prevalent (30 percent), followed by households with four or more people (27 percent), one-person households (26 percent), and three-person households (17 percent).³ The number of households is expected to rise to 2.8 million by 2050, an increase of 24 percent.⁴

Figure 4.2: Regional Household Sizes



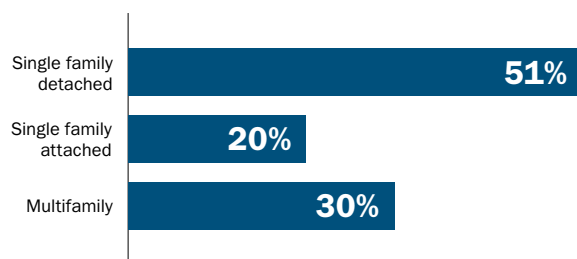
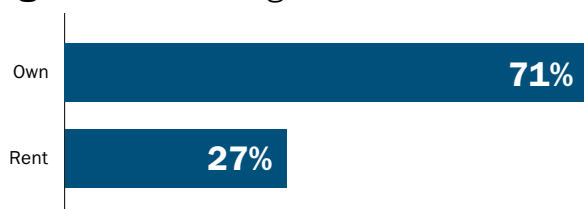
Seventy percent of households reside in single-family homes, with 51 percent in detached houses and 20 percent in attached homes like townhouses (Figure 4.3). The remaining 30 percent live in multifamily housing. As the region continues to add people, the resulting increase in housing demand will drive residential and household growth through 2050. Homeownership is prevalent as over two-thirds (71 percent) of households own their home, while just over a quarter (27 percent) are renters (Figure 4.4). The remaining 1.7 percent is categorized as other.⁵

2 National Capital Region Transportation Planning Board (November 3, 2023). Growth Trends: Cooperative Forecasting in Metropolitan Washington. <https://www.mwcog.org/documents/2023/11/03/growth-trends-cooperative-forecasting-in-metropolitan-washington-cooperative-forecast-featured-publications-growth--development/>

3 National Capital Region Transportation Planning Board (January 2021). 2017/2018 Regional Travel Survey. <https://www.mwcog.org/documents/2021/02/11/regional-travel-survey-technical-documentation/>

4 National Capital Region Transportation Planning Board (November 3, 2023). Growth Trends: Cooperative Forecasting in Metropolitan Washington. <https://www.mwcog.org/documents/2023/11/03/growth-trends-cooperative-forecasting-in-metropolitan-washington-cooperative-forecast-featured-publications-growth--development/> (Growth Trends Cooperative Forecast)

5 National Capital Region Transportation Planning Board (January 2021). 2017/2018 Regional Travel Survey. <https://www.mwcog.org/documents/2021/02/11/regional-travel-survey-technical-documentation/> (2017/2018 Regional Travel Survey)

Figure 4.3: Home Type**Figure 4.4: Housing Tenure**

More nuanced trends in household characteristics are seen when examining the difference between the region's core, inner suburban, and outer-suburban geographies. In the core, one-person households make up the majority, over half of all households reside in multifamily housing, and approximately half are renters. Two-person households are most prevalent in the inner and outer suburbs. Since 2007-2008, the share of people living in single-family detached housing has decreased, and the share of people living in multifamily and rental housing has increased in the core and inner suburbs.⁶

Housing Affordability

The region offers highly rated schools and access to jobs in a stable economy, making it an attractive place to call home. However, housing remains

unaffordable for many people, as rents in the region are high compared to the median income of renters. At the end of 2022, median rents in multifamily buildings were between 27 and 39 percent of median renter income.⁷ Moreover, the COG Fair Housing Plan survey found that 84 percent of respondents faced difficulties finding affordable housing that was also up to code.⁸ This financial burden is particularly severe for people with low incomes and/or with disabilities.

High costs to acquire land, escalating costs of construction materials, and prohibitive land use controls that hinder affordability and higher-density development are some of the many challenges to achieving more affordable housing in the region. Beyond rental affordability, home ownership is also difficult to attain for many people because of high costs and low supply of housing, forcing many into long commutes in search of affordable housing. Homeownership and access to affordable housing are also difficult due to a history of exclusionary zoning. Most of the region's residential land is zoned exclusively for single family homes, which artificially limits supply, creates barriers to opportunity, and increases housing costs for all.⁹ Without the additional construction of homes to purchase, many people lack the opportunity to build financial stability.

To improve access to code-compliant and affordable homes, many local governments in the region have increased funding for housing, pursued zoning changes to allow for more varied housing options, and added requirements for affordable housing in new developments. In 2017, the TPB determined that additional housing in Activity Centers and near

6 National Capital Region Transportation Planning Board (January 2021). *2017/2018 Regional Travel Survey*. <https://www.mwcog.org/documents/2021/02/11/regional-travel-survey-technical-documentation/> (2017/2018 Regional Travel Survey)

7 Percentage of median rents of median renter income vary depending on the number of bedrooms in a unit. See Metropolitan Washington Council of Governments (March 26, 2024). *Multifamily Rental Housing Construction Indicators Report*: <https://www.mwcog.org/documents/2024/03/26/multifamily-rental-housing-construction-indicators-report-housing-multifamily-rental-housing-featured-publications/>

8 Metropolitan Washington Council of Governments (November, 2023). *Metropolitan Washington Regional Fair Housing Plan*. <https://www.mwcog.org/documents/2023/11/15/metropolitan-washington-regional-fair-housing-plan-equity-fair-housing-housing/>

9 Pew Charitable Trusts (January 22, 2024). *How Restrictive Zoning in Virginia Has Hurt Housing Affordability*. <https://www.pew.org/en/research-and-analysis/articles/2024/01/22/how-restrictive-zoning-in-virginia-has-hurt-housing-affordability>

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HCT stations would improve transportation system performance.¹⁰ In 2019, COG endorsed a set of regional housing targets for 2030: increase the amount of units constructed, ensure 75 percent of all new housing is in RACs or HCT stations, and ensure 75 percent of new housing is affordable to low- and middle-income households. Progress toward this is being made; in 2022 about 40 percent of all multifamily rental units were built within a half-mile walk from a Metrorail station, and about 78 percent of new units were located within one of the 141 Insert Regional before Activity Centers or near a HCT station.¹¹

Employment and Income

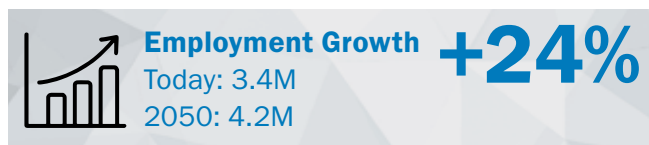
For the region's 3.4 million workers, commuting is a daily necessity that drives the economy forward. While the COVID-19 pandemic prompted unprecedented widespread remote work throughout the region, there has been an increasing trend of workers returning to their work location, which has brought about a return to significant commuting levels. The region has 3.4 million workers, many of whom commute on a regular basis. Although the region ranks among the most affluent in the nation—with a median household income nearing \$125,000 and a gross regional product exceeding \$679 billion annually—income disparities remain

significant.¹² Nearly one-fifth (18 percent) of the region's households earn less than \$50,000 a year.¹³ Ensuring access to a variety of transportation options is critical to connecting residents with employment opportunities to sustain the economic prosperity of the region and its residents.

The region sustains a robust economy, which is expected to add nearly 800,000 jobs by 2050, totaling 4.2 million employees. Key industries are professional and business services, the government sector, and educational and health services. Most of this growth is projected to occur in Fairfax County (including City of Fairfax and City of Falls Church) and the District of Columbia, with anticipated increases of 159,000 and 176,000 jobs, respectively. In terms of fastest growth, Frederick County would grow at a rate of 41 percent and Prince William County (including Manassas and Manassas Park) at a rate of 34 percent.¹⁴

Tourism

As the home to the nation's capital, tourism is one of the major sectors in the region's economy. The region's three major commercial airports, along with its intercity rail and bus networks, make it easily accessible for visitors traveling for business, tourism, or other purposes. Hundreds of national historic places, many world-class museums, and a variety of conferences attract millions of tourists to the region on an annual basis. In 2023, DC surpassed its pre-pandemic tourism record with nearly 26 million people visiting the city, a 17 percent increase from



- 10 Metropolitan Washington Council of Governments (December 20, 2017). *Long-Range Plan Task Force Reports*. <https://www.mwcog.org/documents/2017/12/20/long-range-plan-task-force-reports-projects-regional-transportation-priorities-plan-scenario-planning-tpb/>
- 11 Metropolitan Washington Council of Governments (March 2024). *Multifamily Rental Housing Construction Indicators Report*. <https://www.mwcog.org/documents/2024/03/26/multifamily-rental-housing-construction-indicators-report-housing-multifamily-rental-housing-featured-publications/>
- 12 Median household data comes from: U.S. Census Bureau (2023). *American Community Survey (ACS) 5-Year Estimates Data Profiles – Selected Economic Characteristics*. <https://data.census.gov/table/ACSDP5Y2023.DP03?q=dp03&g=010XX00US>. Gross regional product data comes from: MWCOC (2025). *Regional Economic Monitoring System (REMS) Dashboard*. <https://www.mwcog.org/community/data-and-tools/economic-dashboard/>
- 13 U.S. Census Bureau (2023). *American Community Survey (ACS) 5-Year Estimates Data Profiles – Selected Economic Characteristics*. <https://data.census.gov/table/ACSDP5Y2023.DP03?q=dp03&g=010XX00US>
- 14 National Capital Region Transportation Planning Board (November 3, 2023). *Growth Trends: Cooperative Forecasting in Metropolitan Washington*. <https://www.mwcog.org/documents/2023/11/03/growth-trends-cooperative-forecasting-in-metropolitan-washington-cooperative-forecast-featured-publications-growth-development/> (Growth Trends Cooperative Forecast)

2022. Over 10 billion dollars were also spent in 2023, supporting DC's hotels, restaurants, venues, and other destinations.¹⁵

Industries such as hospitality, retail, service-related sectors, and transportation are primarily supported by low-wage workers. Overall, the community members employed by the region's travel and tourism economy are among the most reliant on the public transportation system.



BWI Airport

Land Use and Development Patterns

As the region's population and employment grows, its transportation network will be challenged to meet the growing and changing needs that will come with future land-use developments. The region features a broad spectrum of development typologies, from natural areas that surround rural communities, to low-density, single-family subdivisions with adjacent commercial hubs, and dense, mixed-used urban centers.¹⁶ Density, zoning, infrastructure, transportation networks, and the spatial relationship between different land uses together define land development patterns. Where and how land develops within the region's communities shapes

the physical layout of communities and greatly influences people's practical mobility choices. When activities are far apart, travel options are limited, and reliance on vehicles to transport people becomes a necessity. This leads to more land dedicated to vehicle travel and undesired outcomes such as traffic congestion, crashes, and unfriendly environments for bicycles and pedestrians. Together, land use and transportation decisions impact travel distances, affect travel mode choice, and shape the accessibility of employment, goods, and services. Land use and transportation decisions have significant effects on the environment, public health, community character, and economic vitality.

Historically, the region has experienced significant job growth while housing supply has struggled to keep pace with demand. Recent forecasts of future employment and housing indicate this imbalance will continue, adversely affecting the area's affordability and undermining the region's appeal to new companies and talent. It also necessitates commuting to work from farther distances, which strains the transportation system, adds to the cost of living, and deteriorates the quality of life overall in the region.

To achieve a better balance between job growth and housing, a TPB task force determined that an optimal jobs-to-housing ratio of 1.54 would enhance competitiveness and improve future transportation system performance.¹⁷ Using this ratio, COG projected that by 2030, the region will need at least 75,000 additional households beyond what was forecasted at the time. This gap has been identified as the region's "housing shortfall" in COG's *The Future of Housing in Greater Washington* (2019),¹⁸

15 Destination DC (May 29, 2024). *Destination DC announces record visitation, economic impact*. [News Release]. <https://washington.org/press/destination-dc-announces-record-visitation-economic-impact>

16 TPB staff analysis of regional activity density of COG's Round 10.0 Cooperative Forecasts

17 ICF et al. (December 20, 2017). *An Assessment of Regional Initiatives for the National Capital Region: Technical Report on Phase II of the TPB Long-Range Plan Task Force*. <https://www.mwcog.org/documents/2017/12/20/long-range-plan-task-force-reports-projects-regional-transportation-priorities-plan-scenario-planning-tpb/>

18 Metropolitan Washington Council of Governments (September 4, 2019). *The Future of Housing in Greater Washington: A Regional Initiative to Create Housing Opportunities, Improve Transportation, and Support Economic Growth*. <https://www.mwcog.org/documents/2019/09/10/the-future-of-housing-in-greater-washington/>

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and it is expected to worsen without proactive intervention.

Activity Density

Analyzing activity density, measured by the number of people and jobs per acre, simplifies and standardizes comparisons of current and future development intensity across the region. Activity density can be categorized into similar groups, known as transects, describing the spectrum of built environments from natural, open space to dense urban core areas, as shown throughout the region in Figure 4.5.

growing activity. Roadways are designed to handle higher traffic volumes, and transit services expand to include Metrobus and other local providers. HCT options—such as Metrorail, bus-rapid transit (BRT), or commuter rail—become more prevalent, along with major interregional transit hubs like the Paul S. Sarbanes Transit Center in Silver Spring, Maryland, and the Springfield Community Business Center Commuter Parking Garage in Fairfax County, Virginia. Active transportation infrastructure also improves, with expanded bicycle and pedestrian networks, including Capital Bikeshare and various scooter-

Figure 4.5: Transects in the Region



Top street level photos come from Google Maps; Bottom overview photos come from Google Earth Pro

Every jurisdiction in the region is home to transects that range from natural zones, likely dedicated to open space and environmental preservation, to denser urban development supporting job centers and higher-intensity residential development. Traveling to, from, and within these various transects occurs on a variety of highway, transit, bicycle, and pedestrian transportation options tailored to the use and needs of each density type.

Natural and rural zones tend to be more automobile-oriented, though they may also feature commuter rail stations or long-distance trails. As development intensifies and the region becomes more urbanized and denser, a broader range of transportation options emerge to support the

share programs throughout the region's urbanized centers.

The region's densest transects are home to the region's urban cores, with established street networks, various HCT options, and regional transportation hubs that support global economic activity. Downtown DC includes an abundance of transportation options to support one of the country's largest central business districts (CBDs). Tysons Corner in Fairfax County, Virginia, and Silver Spring in Montgomery County, Maryland, are also home to bustling CBDs supported by high-frequency, HCT, dense street networks, and bicycle and pedestrian infrastructure.



As shown in the **Forecast Population and Employment Growth, Activity Centers, and Activity Density** map, most of the region will stay the same transect in 2050; few places will

increase by two or more transects, and those places with the greatest anticipated growth are located within or adjacent to currently active places.¹⁹

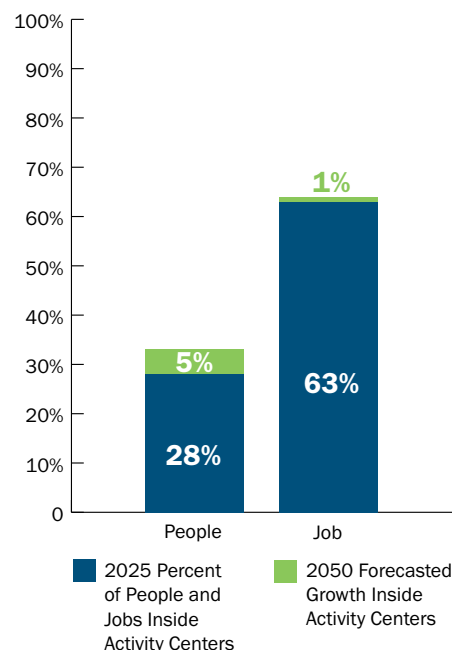
Regional Activity Centers (RACs)

RACs are COG-designated places with concentrations of employment or mixed uses, often dense transects now or planned for greater activity density in the future, that can support concentrating, connecting, and circulating travel to reduce congestion, emissions, and improve safety. As of 2025, 145 RACs are found throughout the region. Figure 4.6, as well as the Forecast Population and Employment Growth, Activity Centers, and Activity Density map, shows existing and predicted growth outside and inside of RACs by 2050, where currently, 28 percent of the region's population resides, and 63 percent of jobs are located.²⁰ By 2050, 33 percent of the regional population and 64 percent of jobs are forecasted to be in RACs.



Daniel Kelly/Flickr

Figure 4.6: Growth of People and Jobs Inside RACs, 2025 to 2050



Of the 145 RACs, 88, or 61 percent, are close to a HCT station. Building more residential, commercial, and employment developments in activity centers allows more community members to easily access public transportation, walking, and biking options to meet their daily needs without relying on a car. Connecting activity centers with multimodal options enhances convenience and efficiency for travel between these hubs.

Environment



Every aspect of transportation is deeply connected to the environment. Motor vehicle emissions contribute to air pollution, while natural hazards disrupt transportation systems and infrastructure. Additionally, certain activities associated with construction projects can negatively impact natural resources, disrupt ecosystem health, and affect nearby communities.

19 National Capital Region Transportation Planning Board (2025). *Forecast Job and Population Growth, Visualize 2050*. [Interactive Map]. www.mwcog.org/V50PopAndJobForecastMap

20 Metropolitan Washington Council of Governments (May 14, 2025). RACs. <https://www.mwcog.org/documents/2025/05/14/regional-activity-centers-maps-activity-centers-land-use-region-forward/>

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COG stock

In turn, the environment influences transportation, shaping decisions that affect both people and infrastructure. Environmental considerations, along with regulations, shape decisions on transportation project locations and the measures needed to protect the region's environmental resources and mitigate adverse transportation impacts.

Air Quality

The Clean Air Act Amendments (CAAA) of 1990 establish standards and procedures for reducing human and environmental exposure to a range of pollutants, referred to as “criteria pollutants,” generated by industry and transportation. The National Capital Region monitors the air quality in the region, specifically for criteria pollutants as defined in the CAAA. Monitoring helps to ensure that regional air quality achieves the National Ambient Air Quality Standards (NAAQS), resulting in pollutant levels that are considered acceptable for individuals and the natural environment. Historically, three criteria pollutants have been of concern in the region: carbon

monoxide (CO), fine particulate matter (PM_{2.5}),²¹ and ground-level ozone. Ground-level ozone is created when volatile organic compounds (VOC) combine with nitrogen oxide (NO_x) and sunlight. The region has achieved the CO and PM_{2.5} NAAQS and has done so long enough that analysis requirements under the CAAA no longer apply.

In April 2025, the U.S. Environmental Protection Agency (EPA) acknowledged that the region had also met the current NAAQS for ozone. This continues a decades-long trend of lower pollution levels in the region, mainly attributable to federal emissions control programs, although state and local emissions control programs and local transportation and land use planning have all played a role in emissions reductions. The Commuter Connections program, for example, which has existed in the region for more than 50 years, is estimated to have reduced daily NO_x by 0.4 tons and VOC by 0.3 tons in 2022, just as the region was emerging from the COVID-19 pandemic.²²

21 Fine particles, 2.5 micrometers in diameter and smaller.

22 Metropolitan Washington Council of Governments (November 21, 2023). *Commuter Connections Transportation Demand Management (TDM) Analysis Report FY 2021-2023*. <https://www.mwcog.org/documents/2023/11/21/commuter-connections-transportation-demand-management-tdm-analysis-report-carsharing-commuter-connections-commuting/>

Historical ozone levels are shown in Figures 4.7, highlighting the progress made. However, with the projected increases in people and jobs by 2050, strategic regional planning must remain focused on reducing vehicle emissions to preserve healthy air quality.

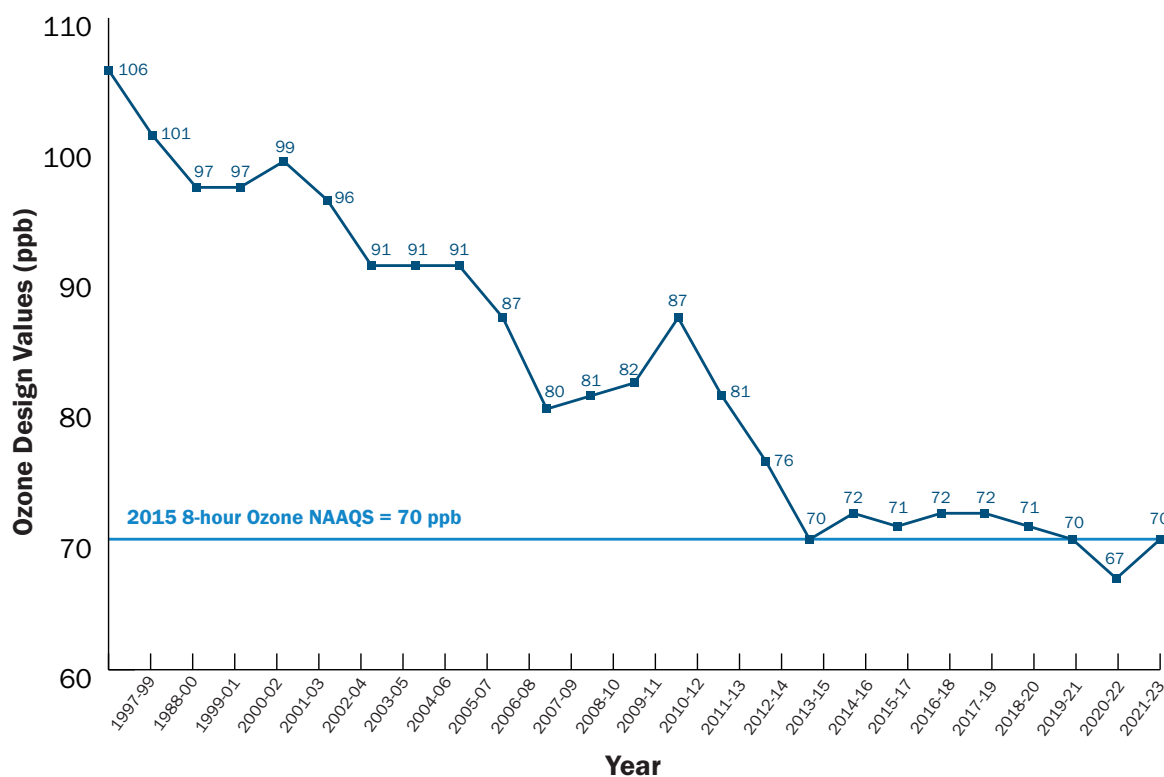
Natural Hazards Resiliency

The region has been adversely affected by natural hazards and weather events like extreme heat waves, severe wind, and flooding from coastal storms or heavy precipitation. Planning for and adapting to the impacts of these events is critical to ensuring the region's transportation system can operate efficiently and safely.



Credit: Elvert Barnes/Flickr

Figure 4.7: Trends in Ozone Pollutant Levels – DC-MA-VA Air Quality Region



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Projections suggest that by 2050, DC could experience between 29 and 38 days per year with temperatures exceeding 95°F—up sharply from the observed historical average (1961-1990) of just 4.4 days per year.²³ Precipitation is expected to become more variable each year, with heavy rainfall events expected to become more frequent and intense, leading to urban flooding. Sea levels are projected to rise by approximately 1.3-1.5 ft. by 2050 and 2.5-5.2 ft. by 2100, leading to nuisance flooding.²⁴ While the number of storms is expected to remain the same, storm intensity is projected to increase. Though projections are uncertain, the frequency of winter conditions (i.e., snow, ice) across the mid-Atlantic could decrease; however, winter storms that do occur may be more severe, with freeze-thaw cycles causing potholes and roadway cracking. Though average and high wind speeds are difficult to project, wind intensity during storms could increase, leading to downed trees on roads and rail lines.



The **Vulnerability of the Transportation System to Natural Hazards** map shows where the current transportation system is likely to be most impacted by these expected changes in extreme weather.²⁵

The NCR Transportation Resilience Improvement Plan (TRIP) (2024) and the associated risk-based vulnerability assessment found that many assets across the region—including roads and highways, public transit, and active transportation—are at high risk for impacts of these types of natural hazards. The assessment found 11.3 percent of rail lines and 4.8 percent of road and highway miles are at high risk of coastal and riverine flooding, while nearly 200 bus stops are at high risk of the impacts of extreme



Ted Eytan/Flickr

heat.²⁶ As the frequency and severity of weather events are expected to increase, the region must make resilience investments to minimize potential future impacts on transportation infrastructure and disruptions to services and operations.

A transportation system resilient to natural hazards is one that offers a range of mobility options and has infrastructure that can withstand, respond to, and recover rapidly from weather-related impacts while continuing to serve the needs of people traveling in and through the region.

Parks and Open Spaces

Throughout the region, there are many outstanding state and local parks, National Park Service and other federal public lands, and green spaces. These assets provide environmental benefits such as pollution mitigation, stormwater management, and temperature regulation. When a planned transportation project is found to have a negative impact on these assets, expanding or enhancing nearby green infrastructure can help to mitigate impacts. Within urban areas, incorporating bioswales

23 U.S. Federal Government (2025). *U.S. Climate Resilience Toolkit Climate Explorer*. https://crt-climate-explorer.nemac.org/climate_graphs/?city=Washington%2C+DC&county=District%2Bof%2BColumbia&area-id=11001&fips=11001&zoom=7&lat=38.9071923&lon=-77.0368707&id=days_tmax_gt_95f

24 National Capital Region Transportation Planning Board (June 20, 2024). *National Capital Region Transportation Resilience Improvement Plan*. <https://www.mwcog.org/documents/2024/06/20/national-capital-region-transportation-resilience-improvement-plan/>

25 National Capital Region Transportation Planning Board (2023). *TPB Transportation Resilience Study*. www.mwcog.org/V50NaturalHazardsVulnerabilityMap

26 National Capital Region Transportation Planning Board (April 10, 2024). *National Capital Region Transportation System Climate Vulnerability Assessment*. <https://www.mwcog.org/documents/2024/04/10/national-capital-region-transportation-system-climate-vulnerability-assessment/>



Virginia State Parks/Flickr

into street redesign projects contributes to stormwater management and water filtration. Less developed communities might benefit from restoring forested areas and erosion control. Table 4.1 outlines potential mitigation activities identified in environmental studies that can be used during the transportation planning process.

Community members also experience health and well-being benefits from the region's green infrastructure, which promotes active transportation along the National Capital Trail Network and within hundreds of parks. These active transportation facilities provide mental as well as physical health benefits. Making planning decisions that improve connectivity and access to parks is essential for enhancing the quality of life.

There are also cases where green infrastructure can help buffer noise from roadways, making nearby communities more pleasant. When transportation projects negatively impact green infrastructure, actions such as selective cutting and clearing, building sound barriers, and replacing or restoring forested areas can help mitigate environmental damage (Table 4.1).

Protected Lands

Protected lands include federal lands, agriculturally protected lands, easements and nature preserves, and lands protected at state and local levels. These lands provide the region with ecosystem services such as air and water purification, flood control, soil stabilization, and climate regulation. They also act as wildlife corridors that prevent habitat fragmentation, which can otherwise be disrupted by transportation infrastructure. Like green infrastructure, these lands offer recreational and mental health benefits for NCR communities and improving connectivity and access to them contributes to improved quality of life. Transportation projects can incorporate conservation easements, wildlife bridges, or buffer zones to reduce environmental impact (Table 4.1).

Wetlands

The region's wetlands are critical for many plants and animals and are valuable for flood protection, water quality improvement, erosion control, and recreation. As noted in the natural hazards resiliency section of this chapter, there are communities and transportation assets that face temporary and long-term flooding challenges. Wetlands absorb and store large amounts of water that help to protect transportation infrastructure from flood damage. At the same time, wetlands help to filter pollutants and sediments before reaching the region's rivers and lakes. Transportation planning efforts should avoid damage to wetlands to maintain these benefits for the community. In cases where damage does occur, mitigation efforts such as creating or restoring wetlands, submerging culverts, bridging roads over sensitive areas, and improving storm water management should be done.

The Visualize 2050 **Environmental Inventory** map highlights the region's environmental resources.²⁷



²⁷ National Capital Region Transportation Planning Board (2025). *Visualize 2050 Environmental Consultation Environmental Inventory Mapping*. [Interactive Map]. www.mwcog.org/V50EnviroInvMap

Table 4.1: Potential Mitigation Activities Identified in Environmental Studies

RESOURCE	POTENTIAL MITIGATION STRATEGY
Neighborhoods and Communities, Homes, and Businesses	■ Minimize noise impact with sound barriers ■ Prevent the spread of hazardous materials, fuels, and other contaminants with soil testing and treatment ■ New landscaping and revegetation to restore slopes ■ Design rail transit vehicles to reduce noise caused by the vehicles on the track ■ Adjust volume controls of transit public announcement system at specific sound levels in consideration of the surrounding community
Wetlands, Water Resources, and Floodplains	■ Replace or restore wetlands ■ Submerge or utilize bottomless culverts ■ Bridge sensitive areas instead of laying pavement directly onto the ground ■ Improve storm water management with continuous planting strips or rain gardens ■ Purchase wetland and stream restoration credits to compensate for potential impacts ■ Design drain structures to minimize potential increases in flood levels
Forested and Other Natural Areas	■ Use selective cutting and clearing ■ Replace or restore forested areas ■ Preserve existing vegetation ■ Provide invasive plant management for impacted areas ■ Forest mitigation banking ■ Implement soil stabilization techniques and erosion and sediment controls
Endangered and Threatened Species	■ Use selective cutting and clearing ■ Bridge sensitive areas instead of laying pavement directly onto the ground ■ Replace or restore forested areas ■ Design drainage structures to minimize obstructions to aquatic wildlife movements
Air Quality	■ Control loose exposed soils with watering or canvas sheets ■ Minimize idling of heavy construction vehicles ■ Implement dust control measures

Public Health

Transportation directly impacts public health. Air pollution from mobile sources weakens the immune system and fuels inflammation in the lungs and respiratory tract, adding to the risk of respiratory and cardiovascular diseases. With the region expecting an increase of over 20 percent more residents and jobs by 2050, air quality and emissions challenges will persist. Safety is also a significant public health challenge, with pedestrian deaths rising more rapidly than other traffic fatalities, and both the number and rate of motorist fatalities also increasing (See Safety in Chapter 3).



John Brighenti/Flickr

Physical Health

Transportation and physical health are closely connected in several ways:

- Death or serious injury possibilities due to safety or security issues while traveling
- Respiratory health concerns from automobile and truck impacts on air quality
- Active mobility options reducing obesity and other health issues
- Access to physical fitness destinations and healthy food options

Neighborhoods closer to congested or high-traffic roadways are more likely to experience negative impacts from vehicle emissions. In the National Capital Region, communities closer to the region's core, interstates, or major highways experience greater exposure than those in outer suburban or rural areas. The proximity to major roadways contributes to this disparity, leading to higher rates of asthma, cancer, heart disease, and overall lower life expectancies. Because property values are often lower in these vulnerable areas, lower-income individuals and families disproportionately bear the burden of transportation-related public health impacts.

Walking and biking are often not viable transportation options when distances to destinations are long. When personal automobiles are the primary or most efficient means of getting around, there is an increased risk of obesity and other health issues.²⁸ Accessing healthy foods, green spaces, healthcare, and recreational areas is more challenging where multimodal options are limited, and vehicle ownership is essential.

Mental Health

The region's transportation systems influence mental health through factors like commute times, access to social services, and opportunities for social interaction. People with limited incomes may struggle to afford a car, public transit fares, or highway tolls. They may also lack easy access to bus stops or Metrorail stations, often facing long, stressful commutes with multiple transfers. The resulting stress and sedentary time can harm people's mental health, regardless of socioeconomic status.

Emerging Technologies

Every day, many people and businesses depend on transportation-related information technology. With ongoing advancements, new technologies are increasingly integrated, enabling phones, infrastructure, and all types of vehicles to connect,

28 Frank, L. D., Andresen, M. A., & Schmid, T. L. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *American journal of preventive medicine*, 27(2), 87–96. <https://doi.org/10.1016/j.amepre.2004.04.011>

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monitor, and communicate about the transportation system. Understanding these trends is crucial for future planning, ensuring that regional infrastructure and operations can adapt and leverage new opportunities for improved safety, efficiency, and user experience.

Regional Intelligent Transportation System Architecture

The Regional Intelligent Transportation System Architecture (RITSA) serves as a vital framework for the integration of emerging technologies within the transportation sector. By establishing standards for communication and data exchange, RITSA facilitates enhanced coordination among transportation and public safety agencies, particularly in addressing incidents that have multi-jurisdictional or regional impacts. This collaboration is essential for improving data-sharing systems, streamlining operational procedures, and developing effective incident response strategies.

Key components such as transit signal priority (TSP), connected and automated vehicles (CAVs), autonomous vehicles, and on-demand transportation services rely on RITSA for vehicle-to-everything (V2X) communication, data exchange, security protocols, and infrastructure integration. RITSA provides the necessary structure for data warehousing and access, which are foundational for advanced analytics. It acts as the essential blueprint that ensures emerging technologies can communicate and function cohesively across the region, thereby supporting initiatives such as congestion management, emergency response, and the preparation for new mobility options.

Autonomous Driving, Connected and Automated Vehicles (CAVs)

Autonomous driving and connected and automated vehicles (CAVs) are rapidly transforming the landscape of urban mobility and reshaping the ways regions approach transportation planning. The six levels of vehicle automation, defined by SAE International's J3016 standard²⁹ and adopted by the U.S. Department of Transportation³⁰ range from Level 0 (no automation) to Level 5 (full automation with no human intervention). Intermediate levels, such as Level 3, still require some degree of driver engagement, while Levels 4 and 5 represent high to full autonomy. Since 2020, Level 5 autonomous ride-hailing services have been operating in Phoenix, Arizona, and have expanded to major cities including Austin, Los Angeles, and San Francisco. As these services continue to scale, they have the potential to improve safety, reduce congestion, and increase transportation accessibility which align with TPB's goals.

As autonomous driving becomes more prevalent, it will be important to consider their effects on driver and vehicle behavior, safety, traffic flow, infrastructure requirements, and regulatory policies to ensure their smooth integration into the existing system. Additionally, the deployment of autonomous



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29 SAE International (July 1, 2019). *J3016 Levels of Driving Automation*. <https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic>

30 National Highway Traffic Safety Administration (March 2022). *Levels of Automation*. https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-03/Levels_of_Automation_Static_022822-v4-tag.pdf

ride-hailing services may influence public transit connectivity, curbside management, and access to transportation, requiring proactive strategies to maximize benefits while addressing potential challenges. As the region prepares for this transition, transportation agencies and policymakers will continue to play a crucial role in shaping the future of autonomous mobility.

Alongside autonomous driving services are CAVs, which are transforming transportation through advanced technologies that enable seamless vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. The transition to CAVs may have significant impacts for mobility, traffic safety, emergency preparedness, vehicle ownership, public transit, and/or regional development. Preparing for ongoing deployment of CAVs into society will be crucial for achieving regional goals related to safety, congestion management, and system efficiency.

To support these vehicles and driving advancements, agencies in the region are investing in smart infrastructure technology. The City of Alexandria, in collaboration with Virginia Tech, is studying smart intersections to enhance road safety through data collection.³¹ In Arlington County, the Intelligent Transportation System (ITS) program is improving traffic operations and paving the way for future CAV integration.³² Streetlights in Washington, DC, are being upgraded with functionality for the streetlight system to provide public Wi-Fi access.³³ As these innovations and others unfold, anticipating their impact and ongoing technological advancements will be important to maximize their benefits.



Intelligent Transportation Systems, U.S. Department of Transportation

Electric Vehicles/Zero-Emission Vehicles

Transitioning from internal combustion engine vehicles to EVs and zero-emission vehicles (ZEVs) is essential to substantially reduce emissions and become a more resilient region. There are challenges to adopting light-duty EVs, including vehicle cost, limited number of models available, long charging times, and a lack of reliable, publicly available charging infrastructure.

The Regional Electric Vehicle Infrastructure Implementation (REVII) Strategy **Electric Vehicle Charger Siting** map is a regional tool that guides decision-makers in prioritizing where to place charging stations to overcome these challenges.³⁴ Electrification of medium- and heavy-duty vehicles, aside from buses, remains in early phases of technological advancements. As of December 2023, the 110,000 registered light-duty EVs in the region are supported by 4,276 EV plugs across 1,586 publicly available charging stations.³⁵



31 City of Alexandria (2024). *Virginia Tech Smart Intersections Pilot: Potomac Yard Metro Station*. <https://www.alexandriava.gov/mobility/virginia-tech-smart-intersections-pilot-potomac-yard-metro-station>

32 Arlington County (2024). *Intelligent Transportation Systems*. <https://www.arlingtonva.us/Government/Projects/Project-Types/Uncategorised/Intelligent-Transportation-Systems>

33 District Department of Transportation (2022). *Project Profile: D.C. Smart Street Lighting*. <https://ddot.dc.gov/page/streetlights>

34 National Capital Region Transportation Planning Board (Sep 4, 2024). *REVII Strategy EV Siting Parcel Review*. www.mwcog.org/V50EVSitingMap

35 National Capital Region Transportation Planning Board (Sep 4, 2024). *Regional Electric Vehicle Infrastructure Implementation (REVII) Strategy*. <https://www.mwcog.org/documents/2024/09/04/regional-electric-vehicle-infrastructure-implementation-revii-strategy-climate-energy-climate-change-electric-vehicles/>

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As the number of EVs in the region increases, there are potential factors for planners and policy makers to address. For example, roadway maintenance needs may increase because of the increase in average vehicle weight. As fewer drivers fill up tanks at the gas stations, there will be a reduction in gas tax revenue, which is currently a primary source of roadway maintenance funds. Strategically locating charging stations in a convenient manner for drivers throughout the region, especially for people living in multifamily buildings or who do not have parking available at their homes, will also be an important consideration.

Maryland, Virginia, and DC are all taking actions to encourage EV adoption and develop a publicly available network of EV charging infrastructure. DC and Maryland have adopted ambitious EV registration goals. All three jurisdictions joined Mid-Atlantic Electrification Partnership (MAEP), along with West Virginia, to support the deployment of EVs and a regional network of EV chargers that will make it possible to seamlessly drive and charge light-, medium-, and heavy-duty EVs across transportation corridors and underserved communities.³⁶



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At the regional level, COG published the region's first EV-readiness plan in 2012. Within COG's EV Deployment Clearinghouse³⁷ is the Regional Electric Vehicle Infrastructure Implementation (REVII) Strategy. This strategy was published in August 2024 as a joint effort by TPB and COG to support the implementation of the findings from the TPB's Climate Change Mitigation Study of 2021 (CCMS) by developing a blueprint for a robust regional network of EV chargers as a major element of the region's commitment to reducing emissions from motor vehicles.³⁸

Electric vehicles/zero-emission vehicles are used by many people traveling throughout the region and more widespread adoption is anticipated. Continued planning for supportive infrastructure as well as consideration of other societal implications will be important.

Artificial Intelligence

Artificial Intelligence (AI) is making its way into the landscape of transportation planning as computers are used for more tasks traditionally done by people. By integrating AI into processes, planners can explore innovative approaches to budget and cost estimation, enhance asset management, optimize transit routes and schedules, gain deeper insights into traffic mobility, and pinpoint areas requiring safety improvements.

The Virginia Department of Transportation is launching a pilot project that will leverage AI to address the growing financial strain of roadway maintenance. By providing deeper insights into pavement lifecycles, this initiative aims to enhance decision-making and optimize long-term maintenance strategies. Outside the region, the Texas Department of Transportation has released its AI Strategic Plan,

36 Virginia Clean Cities (2024). *Mid-Atlantic Electrification Partnership*. <https://vacleancities.org/projects-and-accomplishments/mid-atlantic-electrification-partnership/>

37 Metropolitan Council of Governments (2025). *Electric Vehicle (EV) Deployment Clearinghouse*. <https://www.mwcog.org/about-us/cog-board-and-priorities/ev-clearinghouse/>

38 National Capital Region Transportation Planning Board (Sep 4, 2024). *Regional Electric Vehicle Infrastructure Implementation (REVII) Strategy*. <https://www.mwcog.org/documents/2024/09/04/regional-electric-vehicle-infrastructure-implementation-revii-strategy-climate-energy-climate-change-electric-vehicles/>

serving as a roadmap for rolling out AI over the next three years. The plan foreshadows activities that AI may assist with in the NCR, including infrastructure and traffic analysis, strategic project prioritization and optimization, dynamic traffic signal adjustments, and the review of bid documents, among other advancements.

Drone/Automated Vehicle Deliveries

E-commerce has expanded the level of access consumers have to retailers and products, and the increased demand for goods means that new modes of freight delivery may be required. Goods delivery by drone and automated vehicles, such as the Starship robots on George Mason University's Fairfax campus, are two potential methods that may be deployed to meet delivery needs. The use of these technologies could have policy implications in various areas such as public safety. Also, the federal airspace in certain parts of the region is currently restricted, which affects drone operations. As the timeline for the deployment of these technologies is unknown, continued monitoring of the development of these and similar freight delivery technologies is important.

The concept of using drones and similar aircraft technologies is part of a larger emerging air transportation system known as Advanced Air Mobility (AAM), which is focused on moving people and cargo from point to point using innovative aircraft, technology, and air operations. AAM can generally refer to local, regional, and intraregional operations, and Urban Air Mobility (UAM) is a subset of AAM focused primarily on flight operations within urban areas. AAM/UAM rely on aircraft, predominantly drones, with electric vertical takeoff and landing (eVTOL) capabilities. As this new system matures, consideration will be needed for supporting infrastructure on the ground including siting vertiport facilities, ground access, transportation planning, and community engagement.³⁹



Rob Pegoraro/Flickr

Automated Traffic Enforcement

Automated Traffic Enforcement (ATE) generally involves use of an electronic camera to enforce traffic laws by assisting with the detection of infractions and providing photo documentation of the vehicle or driver violating the traffic law. The two most common types of automated enforcement systems are red-light cameras and automated speed enforcement cameras.

ATE systems that cite red light runners and speeders are deployed across the region, although their use varies because of differences in state laws.

The TPB has attempted to shape ATE policy to improve regional roadways. In 2021, the TPB submitted a letter to the governors of Maryland and Virginia and the mayor of DC urging that they work to establish interjurisdictional reciprocity for citations issued by ATE. The letter stated that the existing Driver License Compact between all three jurisdictions allows for reciprocity across state boundaries for citations issued by law enforcement personnel but not for citations issued by automated traffic enforcement. It called on the three states to

³⁹ U.S. Department of Transportation Federal Aviation Administration (April 26, 2023). *Urban Air Mobility (UAM) Concept of Operations v2.0: Foundational Principles, Roles and Responsibilities, Scenarios and Operational Threads*. https://www.faa.gov/sites/faa.gov/files/Urban%20Air%20Mobility%20%28UAM%29%20Concept%20of%20Operations%202.0_1.pdf



User Vmzp85/Wikipedia

The AeroTrain automated train system at Washington Dulles International Airport has been moving passengers between the Terminal station and gates since 2010.

“...work collaboratively to create a multijurisdictional safety taskforce to work toward an agreement on reciprocity for automated traffic enforcement citations...”⁴⁰

The TPB renewed its interest in establishing automated traffic reciprocity at its October 2024 Regional Roadway Safety Summit, where attendees recommended that the TPB partner with COG to explore a multijurisdictional arrangement for reciprocity of automated enforcement. This recommendation was affirmed by the TPB in November 2024, and the TPB continues to pursue this action.

Automatic Train Operation

Automatic Train Operation (ATO) is recognized globally as an industry standard and best practice for transit operations worldwide due to its energy-saving benefits, optimized acceleration and braking, and

enhanced operator efficiency. The WMATA Metrorail system was designed in the 1970s with then state-of-the-art automatic operation, but technological capabilities and the aging of the system limited effectiveness. In recent years, WMATA has pursued the phased reintroduction of semi-automated ATO, including Automatic Door Operation, which reduces dwell time by 10-15 seconds at each stop. As a semi-automatic system, ATO assists train operators by managing key functions, allowing them to focus more on monitoring safety concerns and their surroundings, including track conditions, train status, and door operations. A system with ATO is more efficient and better equipped to handle higher passenger capacities.

The current ATO system still relies on obsolescent technology and its modernization is a priority for WMATA. The DMVMoves transit initiative is facilitating regional discussions to identify funding for advanced,

⁴⁰ National Capital Region Transportation Planning Board (Dec 15, 2021). *Letter in Support of Establishing Interjurisdictional Reciprocity of automated Enforcement Citations*. <https://www.mwcog.org/documents/2021/12/15/letter-in-support-of-establishing-interjurisdictional-reciprocity-of-automated-enforcement-citations-traffic-safety/>

fully automated ATO in use elsewhere globally, which could lead to driverless trains in the future. An upgraded ATO system would feature improved train operation technology and platform screen doors in all stations, which would improve the safety, speed, and reliability of the Metrorail system, improving the traveler experience as well as providing operational and cost efficiencies.

On-Demand Transit/Microtransit

A modern form of demand response transit, microtransit offers customers the opportunity to book a shared ride between dynamic pickup and drop-off points that are set based on the needs of multiple riders on a route. Typically, microtransit operates within designated service zones, uses small vehicles, and primarily uses a mobile app to schedule and manage rides. What makes these services unique is the technological convenience of booking trips through an app, with options available within minutes, hours, or even days. This contrasts to how many Dial-A-Ride services have operated traditionally where customers would perhaps need to schedule the trip at least 24 hours in advance.

Microtransit has become increasingly popular because customers have more control over the routes and lengths of their trips. For transit agencies, microtransit offers a cost-effective way to provide service in areas with low fixed-route ridership, requiring less capital investment, and potentially lower operating costs than traditional fixed-route services. However, microtransit is generally not the most efficient way of moving people due to the limited seating capacity per vehicle. This also means that the operating costs per vehicle revenue mile or hour will likely be higher than that of a fixed-route bus service. As a result, microtransit may be more effective as a strategic coverage solution or in specific contexts, rather than as a replacement for traditional transit in densely populated areas with high ridership potential.

The region features three microtransit services across Virginia and Maryland: Montgomery County's Ride On Flex, OmniRide Connect in Prince William County, and Prince George's County's Link. As of spring 2025, Arlington and Loudoun counties also have microtransit services planned.



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