2050 MTP

Conditions, Trends, and Challenges Technical Memo

January 2024

MARYLAND DEPARTMENT OF TRANSPORTATION

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Purpose

The Maryland Transportation Plan (MTP) creates a framework for addressing the State's transportation priorities and investments and meets various federal and State requirements related to long range planning. The MTP has a twenty-year horizon and is updated every five years.

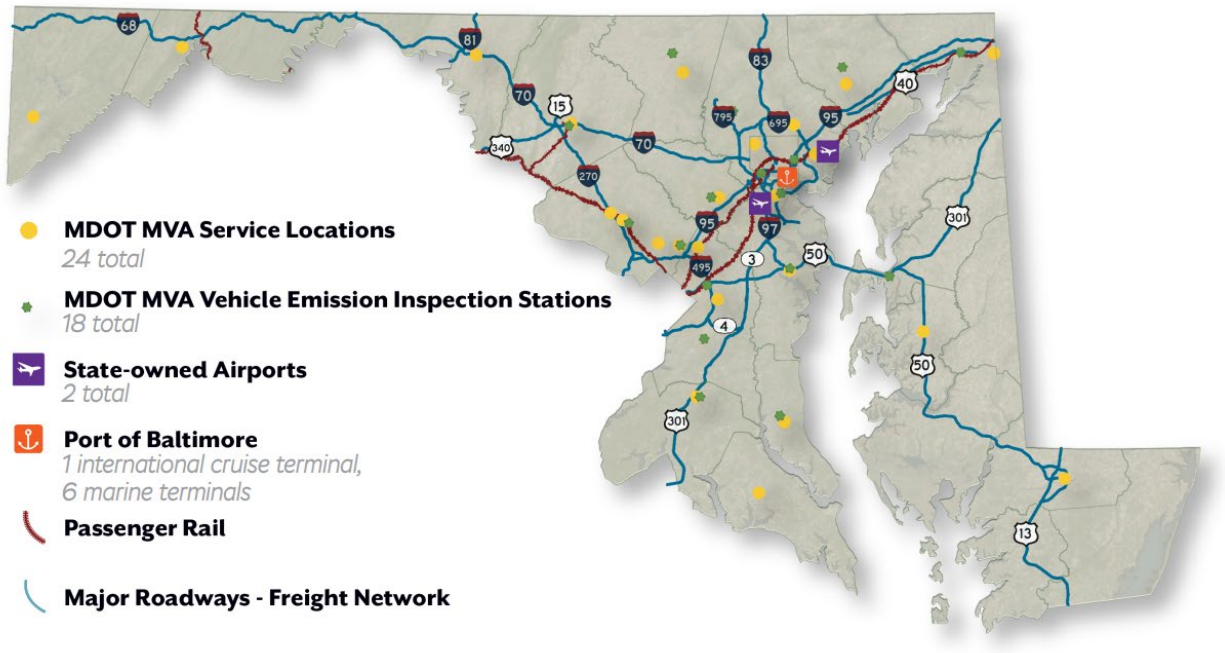
The Conditions, Trends, and Challenges Technical Memorandum provides background information that will guide and support development of the MTP including plan goals, objectives, and strategies. The memorandum has five sections:

- Transportation system extent, which describes Maryland's transportation system;
- Factors that influence transportation in Maryland, which discusses geography, population, and economy;
- Travel characteristics, which describes Maryland's travel trends;
- Environment, which outlines the steps the Maryland Department of Transportation (MDOT) is taking to minimize the impact of transportation on the environment; and
- Maryland's emerging transportation trends, which outlines important issues deserving consideration as part of the MTP development process.

Transportation System Extent

MDOT is a multimodal organization that comprises five transportation business units (TBUs) and one Authority including the MDOT State Highway Administration (MDOT SHA), the Maryland Transportation Authority (MDTA), the MDOT Maryland Port Administration (MDOT MPA), the MDOT Maryland Aviation Administration (MDOT MAA), the MDOT Maryland Transit Administration (MDOT MTA), the MDOT Motor Vehicle Administration (MDOT MVA), and The Secretary's Office (TSO). Figure 1 shows a map of the transportation network that each of the TBUs and MDTA collectively oversee as described in the following sub-sections.

Figure 1. Maryland's Major Statewide Transportation System



Source: Maryland Department of Transportation, Maryland Consolidated Transportation Program FY2023-FY2028

State-owned Highways and Bridges

MDOT SHA owns, operates, and manages the State's highway network, while MDTA owns, operates, and maintains the State's eight tolled facilities.[i] Together MDOT SHA and MDTA are responsible for an estimated 15,600 lane miles of roadways, including Maryland's Interstate System segments, its National Highway System (NHS) routes, and other non-NHS State routes.[ii] Table 1 shows total lane miles by system. Across the highway system, MDOT is responsible for maintaining 2,966 bridges out of a total of more than 5,000 bridges in Maryland.[iii] MDOT MTA and MDTA are also responsible for maintaining two tunnels each.

Table 1. MDOT SHA and MDTA Roadway Lane Miles[iv]

Roadway	Lane Miles
Total Interstate	2,779
Urban Interstate	2,106
Rural Interstate	673
Non-Interstate NHS	5,523
Non-NHS State roadways	7,344

Maryland Truck Route System

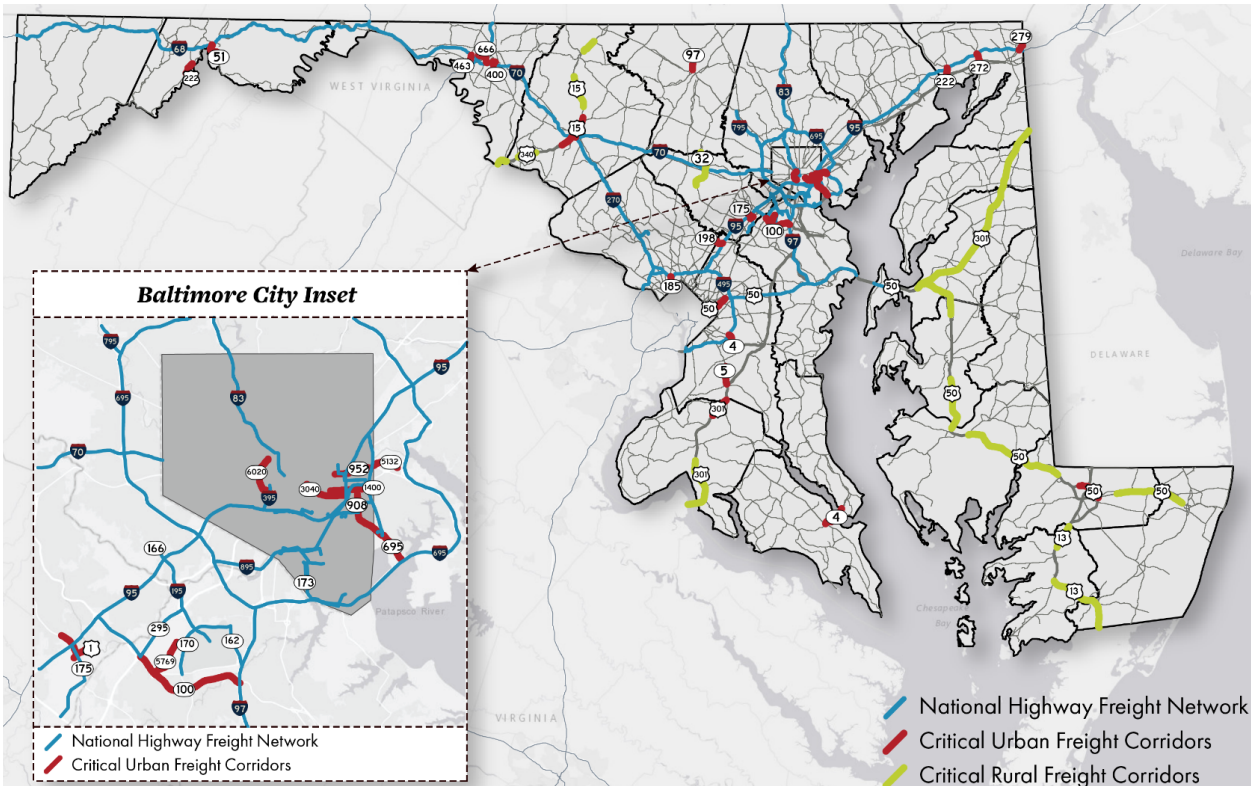
The Maryland Truck Route System, which is part of the State's highway network, contains approximately 900 roadway miles and includes all 478 miles Interstate System segments in the State, as well as 320 miles of the State's non-Interstate NHS, and 99 miles of the non-NHS State roadway network.

The Fixing America's Surface Transportation (FAST) Act led to designation of selected highways across the country as part of the National Highway Freight Network (NHFN). Maryland's highway network features 548 roadway miles within the NHFN including:

- 375 miles of federally designated Primary Highway Freight System (PHFS) routes and 29 miles of PHFS intermodal connectors that are considered most critical to freight transportation.
- 143 miles of non-PHFS Interstates.

The NHFN also includes 150 miles of Critical Rural Freight Corridors (CRFCs) and 75 miles of Critical Urban Freight Corridors (CUFCs) that provide access to the PHFS in Maryland. MDOT, through coordination with its freight stakeholders, selects the CRFCs and coordinates with metropolitan planning organizations (MPOs) to designate the CUFCs. The 2021 Infrastructure Investment and Jobs Act (IIJA) doubles the state's mileage caps to 300 CRFC miles and 150 CUFC miles, so MDOT will be able to expand the network as resources become available.[v] The NHFN, CRFC, and CUFC routes are show in Figure 2.

Figure 2. National Highway Freight Network, Critical Urban Freight Corridors, Critical Rural Freight Corridors

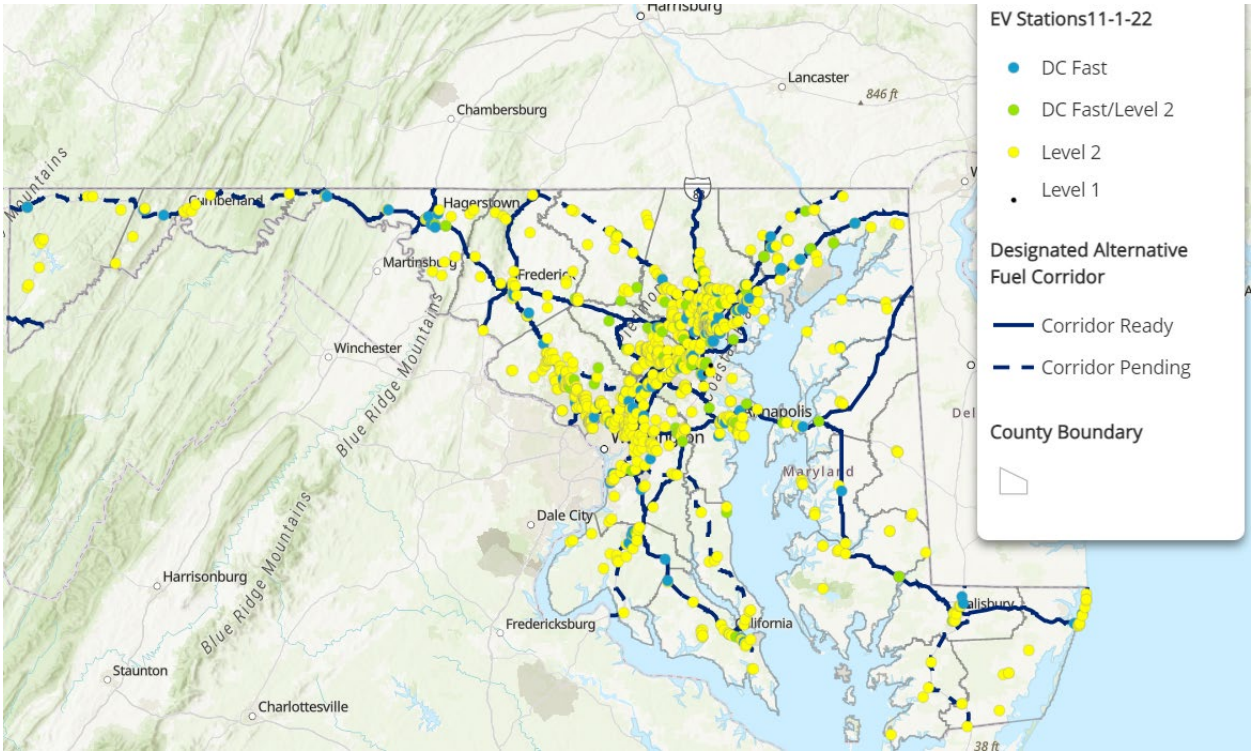


Source: Maryland Department of Transportation

Electric Vehicle Infrastructure

There are over 50,000 electric vehicles (EVs) registered in Maryland, including about 32,000 battery electric vehicles (BEVs) and 18,000 plug-in hybrid electric vehicles (PHEVs) registered in Maryland. MDOT has designated 23 Alternative Fuel Corridors (AFCs). These corridors have about 1,200 charging stations featuring about 3,350 charging ports. The highest concentrations of EV charging stations are in the Baltimore and Washington Metro regions, along the I-95 and I-270 corridors. Figure 3 shows designated Alternative Fuel Corridors and EV charging stations.

Figure 3. Alternative Fuel Corridors and Electric Vehicle Charging Stations (2022)

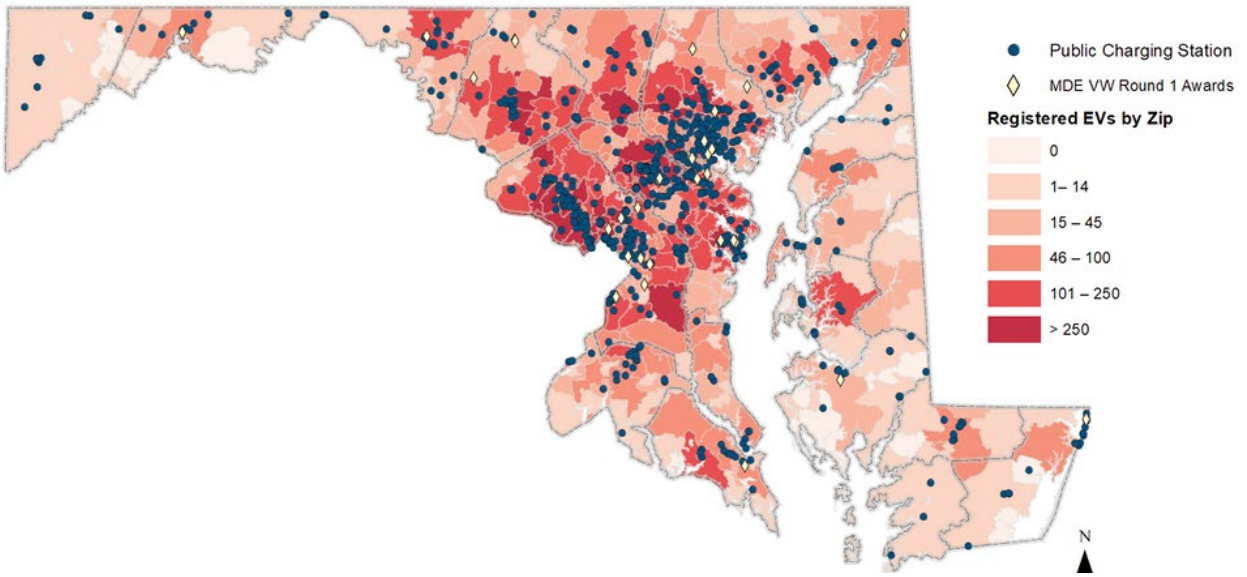


Source: Maryland Department of Transportation ZEEVIC Map Viewer

Between 2009 and 2016, Volkswagen (VW) sold diesel vehicles with defeat devices that allowed them to emit multiple times more nitrogen oxide (NOx) emissions than were legally allowed. In September 2015, the Environmental Protection Agency (EPA) and California Air Resources Board (CARB) notified VW of their violations of the Clean Air Act, resulting in a settlement agreement that created an Environmental Mitigation Trust fund to remediate the excess NOx emissions from the affected vehicles. Maryland is eligible to receive approximately $75.7 million to use on projects that would reduce diesel emissions from the transportation sector. The Maryland Department of the Environment (MDE) developed a VW Mitigation Plan, which included a call for project proposals that would install Level 2 electric vehicle stations and Level 3 electric vehicle direct current Fast Charging stations throughout Maryland. Figure 4 shows the number of registered EVs by zip code, the locations of public charging stations, and the locations of MDE VW Mitigation Plan Round 1 Award winners. Both public charging stations and MDE VW Round 1 Award winners are clustered around the middle of the state. This is in line with the higher number of registered EVs per zip code in the middle of the state.

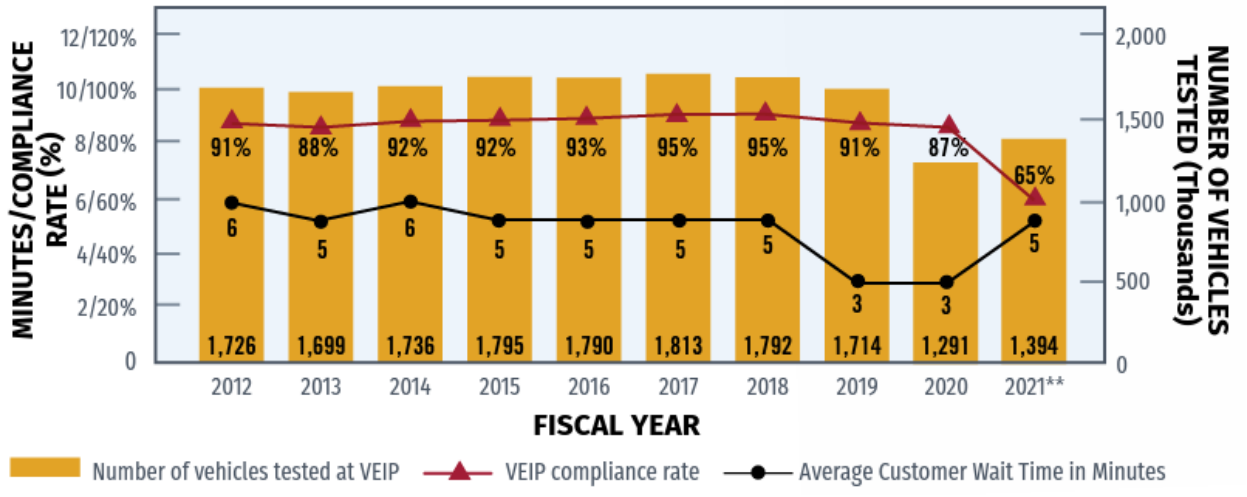
In addition to installing charging stations, Maryland offers credits of up to $3000 for the purchase or lease of plug-in electric or fuel electric vehicle through 2027.[vi]

Figure 4. Number of Registered EVs by Zip Code, Public Charging Stations, and MDE VW Round 1 Awardees (2022)



Source: Maryland's ZEV Policy Scorecard

Figure 5. Compliance Rate and Number of Vehicles Tested for Vehicle Emissions Inspection Program (VEIP) versus Customer Wait Time (2012 – 2021)



** 14 counties offer VEIP tests: Anne Arundel, Baltimore, Baltimore City, Carroll, Harford, Howard, Queen Anne's, Cecil, Washington, Calvert, Charles, Frederick, Montgomery, and Prince George's.*

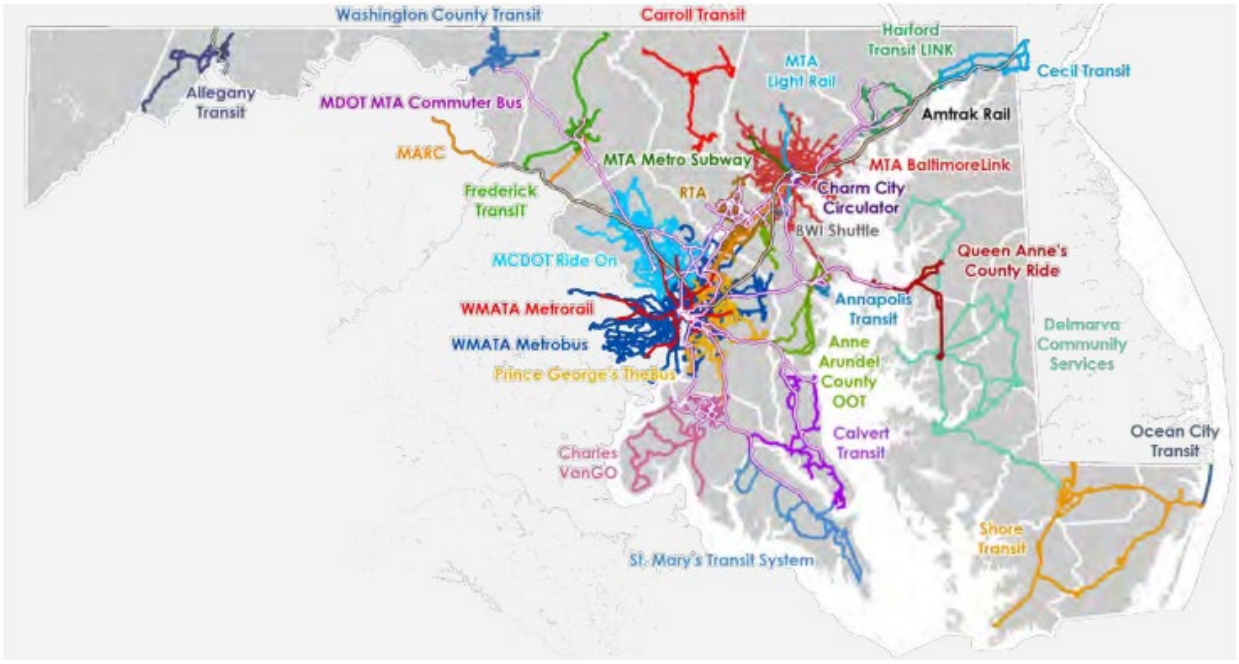
*** 2021 data is preliminary and subject to change.*

Source: 2022 Attainment Report on Transportation System Performance

Transit

There are more than 20 public transit service providers in Maryland, offering fixed-route service in every part of the state except the westernmost Garrett County, which has only demand response service. The two largest providers are MDOT MTA and Washington Metropolitan Area Transit Authority (WMATA). Figure 6 shows all fixed-route transit in Maryland.

Figure 6. Fixed-Route Transit in Maryland



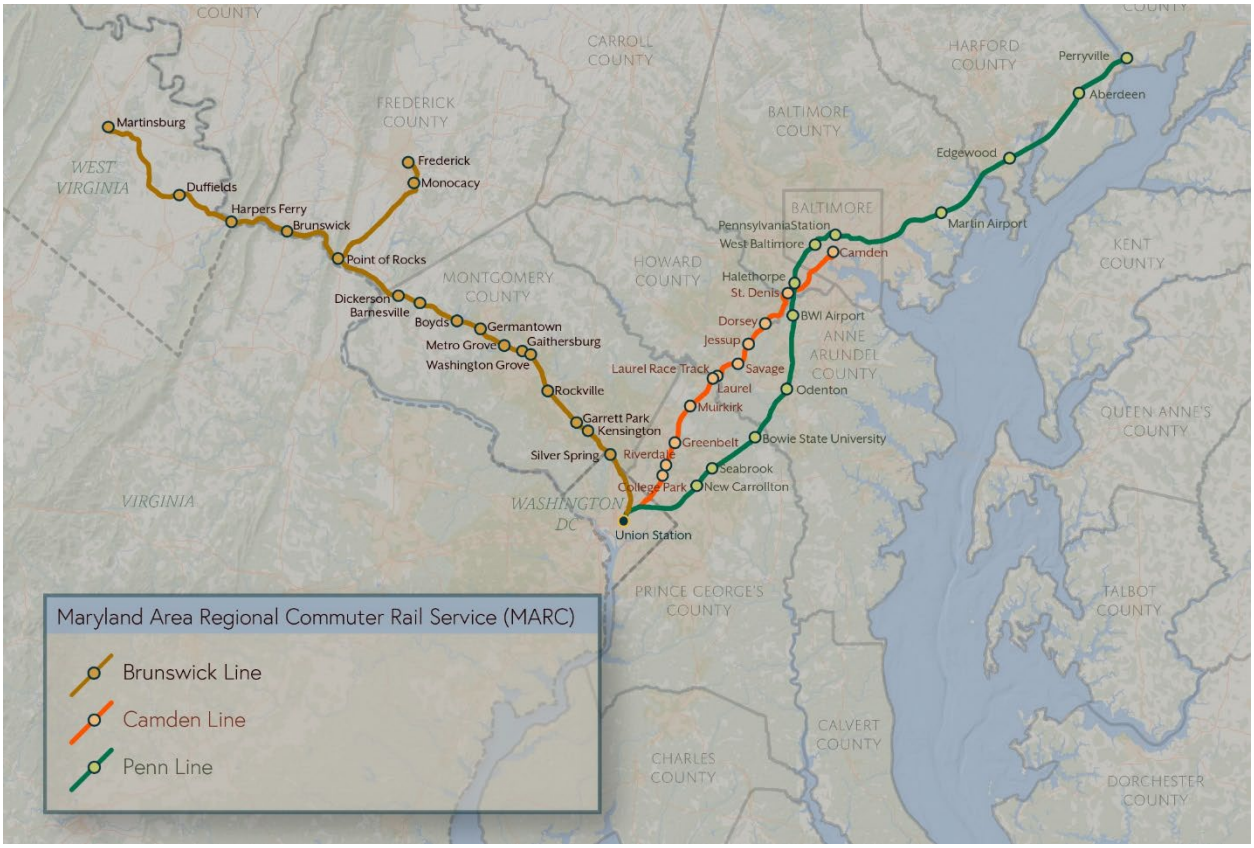
Source: Maryland Statewide Transit Plan (January 2022 Draft)

MDOT Maryland Transit Administration

MDOT MTA operates 65 local bus routes (CityLink, LocalLink, and Express BusLink) throughout the Baltimore area; 36 commuter bus routes; light rail (Light RailLink); Metro SubwayLink; and the Maryland Area Regional Commuter (MARC) train service.[vii] MARC service areas are shown in Figure 7 and include:

- Anne Arundel County
- Baltimore City
- Baltimore County
- Frederick County
- Harford County
- Howard County
- Montgomery County
- Prince George's County
- Washington County
- Washington, D.C.

Figure 7. MARC Service Area



Source: Maryland Department of Transportation

Light RailLink trains provide service to portions of the Baltimore Metro Region operating between Hunt Valley in the north and Baltimore/Washington International Thurgood Marshal (BWI) Airport and Glen Burnie (formerly Cromwell Station) in the South. In addition, MDOT MTA operates Maryland paratransit for citizens unable to use fixed route services (MobilityLink). MDOT MTA also directs funding and provides technical assistance for transit systems in each of Maryland's 23 counties. MDOT MTA's revenue-producing vehicle fleet includes:

- 1,058 buses
- 443 vans
- 309 rail cars (98 Metro, 53 Light Rail, and 158 MARC)
- 48 locomotives[viii]

The agency also maintains 30 miles of light rail track, 17 miles of Metro subway,[ix] and 14 Metro SubwayLink stations.

Washington Metropolitan Area Transit Authority

WMATA is funded and governed through a regional compact between the District of Columbia, Maryland, and Virginia with a Board that represents each jurisdiction, as well as the federal government. MDOT is a funding partner of WMATA and coordinates with WMATA and the Washington Suburban Transit Commission (Montgomery and Prince George's

Counties) to provide planning and oversight of transit and paratransit service in the Washington metropolitan region.

Locally and Regionally Operated Transit Service

A majority of transit agencies in Maryland are governed at the county or city level, known as Locally Operated Transit Service (LOTS). Some jurisdictions have extensive fixed-route service, many have both fixed-route and demand-response service, and one rural jurisdiction offers demand-response service exclusively. These local services typically operate within jurisdictional boundaries, though some county-based providers travel across city, county, or state lines.

Several transit operators in Maryland reach beyond jurisdictional boundaries to provide greater regional connectivity. The Regional Transportation Agency (RTA) of Central Maryland is funded and governed by Howard, Anne Arundel, and Prince George's Counties and the City of Laurel. Shore Transit, on the southern end of Maryland's Eastern Shore, serves as a regional provider with service across Somerset, Wicomico, and Worcester Counties. [x]

Intercity Bus

Intercity bus service provides connections between rural Maryland and the State's economic hubs. MDOT MTA administers the Intercity Bus (ICB) Program, which distributes federal Section 5311(f) grants for rural intercity service. Grants last two years and are provided through the Office of Local Transit Support (OLTS).[xi] MDOT MTA's ICB Program sponsors intercity bus services in the following corridors:

- Greyhound operates one roundtrip per day along U.S. 1 and U.S. 40 between Washington, D.C. and Wilmington, DE, with. MDOT MTA funds costs for operating the Maryland portion of the route.
- BayRunner Shuttle operates two daily roundtrips between Baltimore and Grantsville, MD with intermediate stops.[xii]

Intercity bus service connections to the Baltimore and Washington metropolitan areas allow passengers to access other modes of transportation available in these cities as well as access jobs, educational institutions, and health care. Outside of the metropolitan areas, local transit operations provide long distance transportation that connects with the larger/national intercity bus network.

Ports

Maryland's Port of Baltimore

The Helen Delich Bentley Port of Baltimore includes seven state-owned public cargo terminals and an international cruise terminal that are managed by the MDOT MPA.[xiii] MDOT MPA's tenants handled 10.3 million tons of cargo in FY 2020.[xiv] The Port also includes many privately-owned terminals. Maryland's Port of Baltimore is the largest roll-on/roll-off (RoRo) port in the U.S. and handles the largest volume of cars and trucks of any U.S. port.[xv]

Maryland's Port of Baltimore is also one of the busiest cruise ports on the eastern seaboard and is a home port for Carnival and Royal Caribbean cruise lines. Together, the lines had 94 sailings in each of FY 2018 and FY 2019, before dropping to 69 in FY 2020 due to the COVID-19 pandemic.[xvi] Cruises resumed from the Port in September 2021, with a total of 67 sailings in FY 2022.[xvii]

Airports

There are 36 public use airports in Maryland. MDOT MAA operates two airports, Baltimore/Washington International Thurgood Marshall Airport (BWI) and the Martin State Airport which is a general aviation/reliever airport northeast of Baltimore. MDOT MAA also oversees federal grants for the public-use airports in the State.[xviii]

Maryland continues its distinction as the only state in the continental U.S. that owns and operates its primary commercial airports. Commercial air traffic fell during the COVID-19 pandemic, from 13.3 million passengers in 2019 to 5.5 million passengers in 2020, before recovering to 9.3 million passengers in 2021. During this period BWI remained the nation's 22nd busiest airport[xix] and currently serves 70 domestic and 16 international nonstop markets.[xx] Southwest is the largest airline by market share at BWI, using the airport as its East Coast hub for its international flights to Central America and the Caribbean.

BWI is also the largest cargo airport in the state and the only airport with a Foreign Trade Zone. BWI handled 619 million tons of freight and mail cargo in 2021, an increase from 595 million tons in 2020 and 500 tons in 2019. Amazon – ATI is BWI's largest carrier, with 42 percent of total freight volume in 2021, followed by FedEx (20%) and UPS (9%).[xxi]

Passenger and Freight Rail

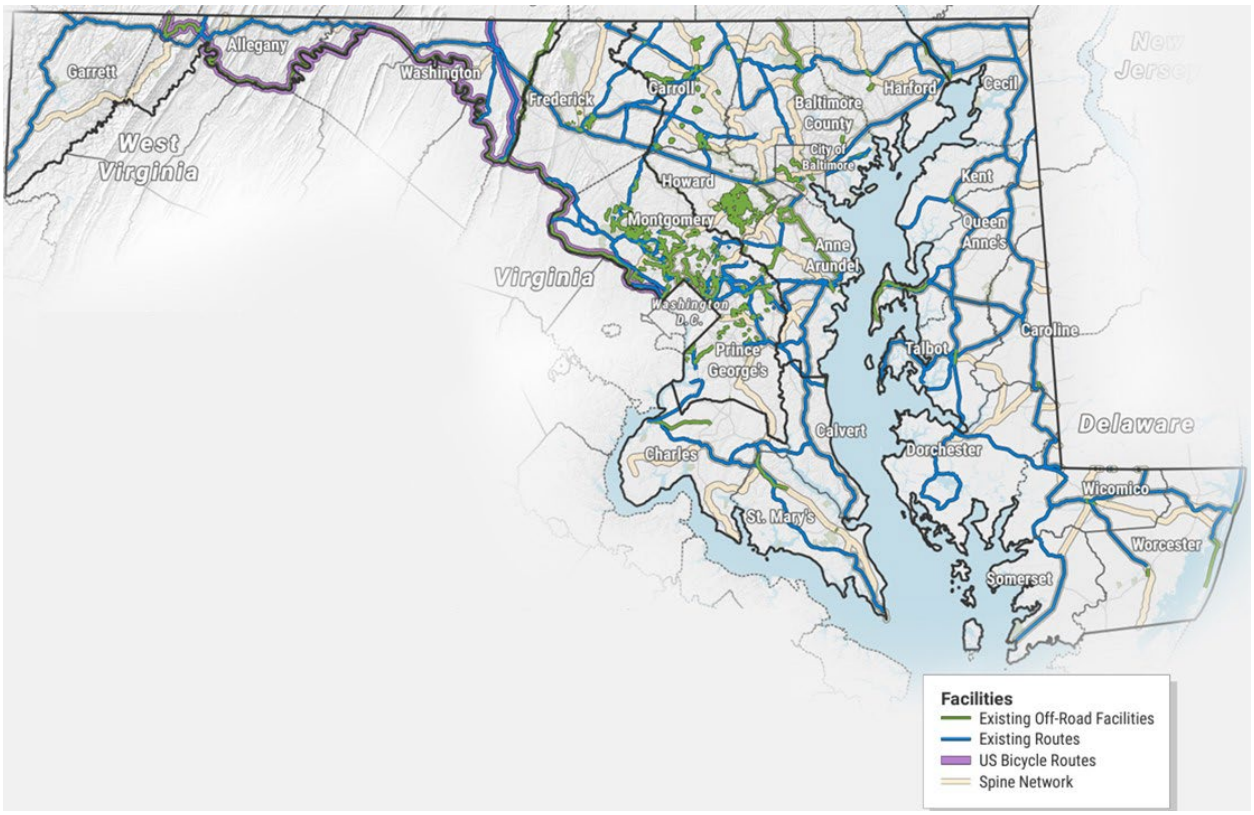
Maryland's rail network consists of 1,152 miles of track, of which 886 miles is active track.[xxii] The network includes two Class I freight railroads, seven Class III short line freight carriers, MARC, Amtrak, and several small tourist railroads.[xxiii] These companies do not necessarily own the tracks on which they operate. The two Class I railroads, CSX Transportation and Norfolk Southern Railway, own 63 percent of the network, while Class III operators own an additional 13 percent. The remainder of the rail network consists of short lines, rail operating within ports, and track banked by MDOT for future use. Other freight and passenger rail carriers, such as MARC, operate via trackage rights. [xxiv]

Non-motorized

Maryland's State highway network has more than 700 miles of sidewalks, two thirds of which are compliant with the Americans with Disabilities Act (ADA). Twenty percent of State-owned roadway miles within urban areas have sidewalks.[xxv]

The state also has 1,148 miles of road-separated bicycle routes including the 190-mile Chesapeake & Ohio Canal National Historical Park Trail. A majority of the bicycle routes are in the Washington metropolitan region (346 miles in Montgomery County and 152 miles Prince George's County) or in Howard County, particularly Columbia (131 miles).[xxvi] Half of Maryland's rail transit stations are within one-half mile of a trail, and all MDOT MTA buses have bicycle racks.[xxvii] Figure 8 shows the State's bicycle network, which is comprised of existing off-road facilities, existing routes, U.S. bicycle routes, and the Spine Network. MDOT has developed the Spine Network to promote regional connectivity across the State and paired it with atlases to promote biking tourism.[xxviii]

Figure 8. Maryland's Bicycle Network



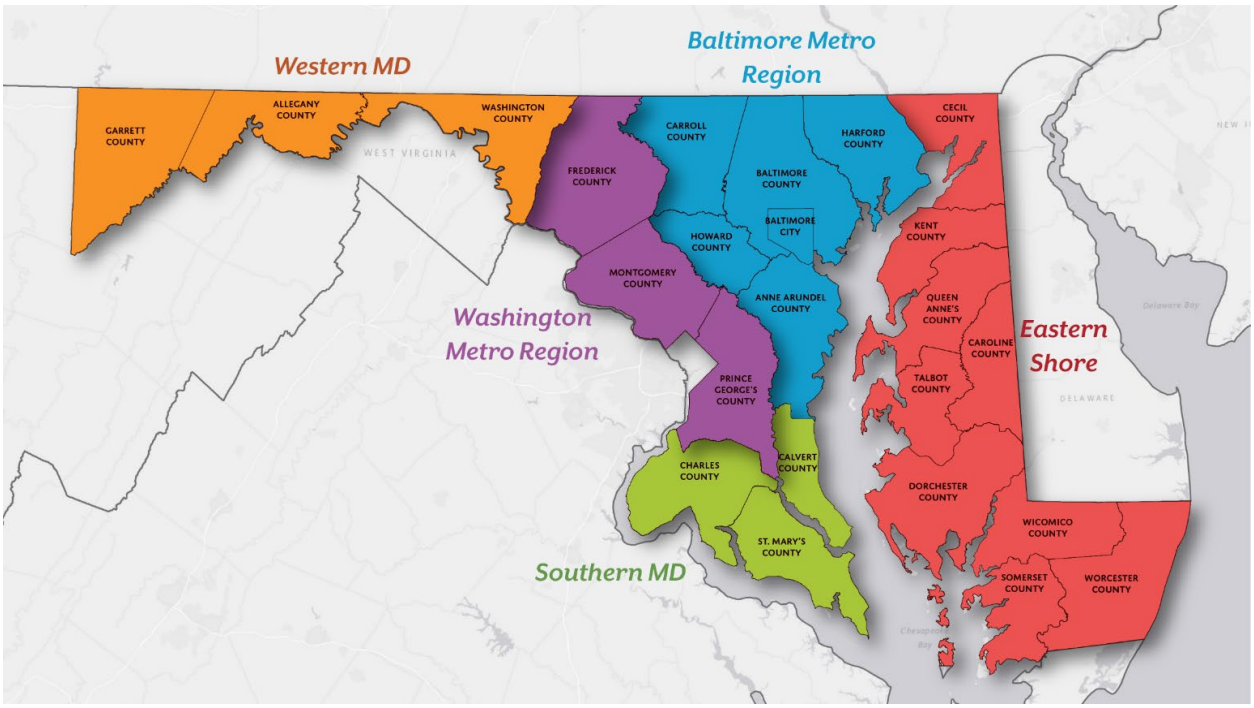
Source: 2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update

Factors that Influence Transportation in Maryland

Maryland's Geography

Though Maryland is the ninth smallest state, it is geographically diverse. As shown in Figure 9, the State's defining geographic feature is the Chesapeake Bay, which nearly divides the State. The Bay's 7,000 miles of shoreline affords numerous natural harbors for ships large and small; of which the most prominent is the Port of Baltimore, one of the nation's busiest ports.[xxix] Figure 9 also depicts Maryland's five regions – the Eastern Shore, the Baltimore Metro Region, the Washington Metro Region, Southern Maryland, and Western Maryland. Each of the regions has its own distinct needs and associated transportation system.

Figure 9. Maryland's Five Regions



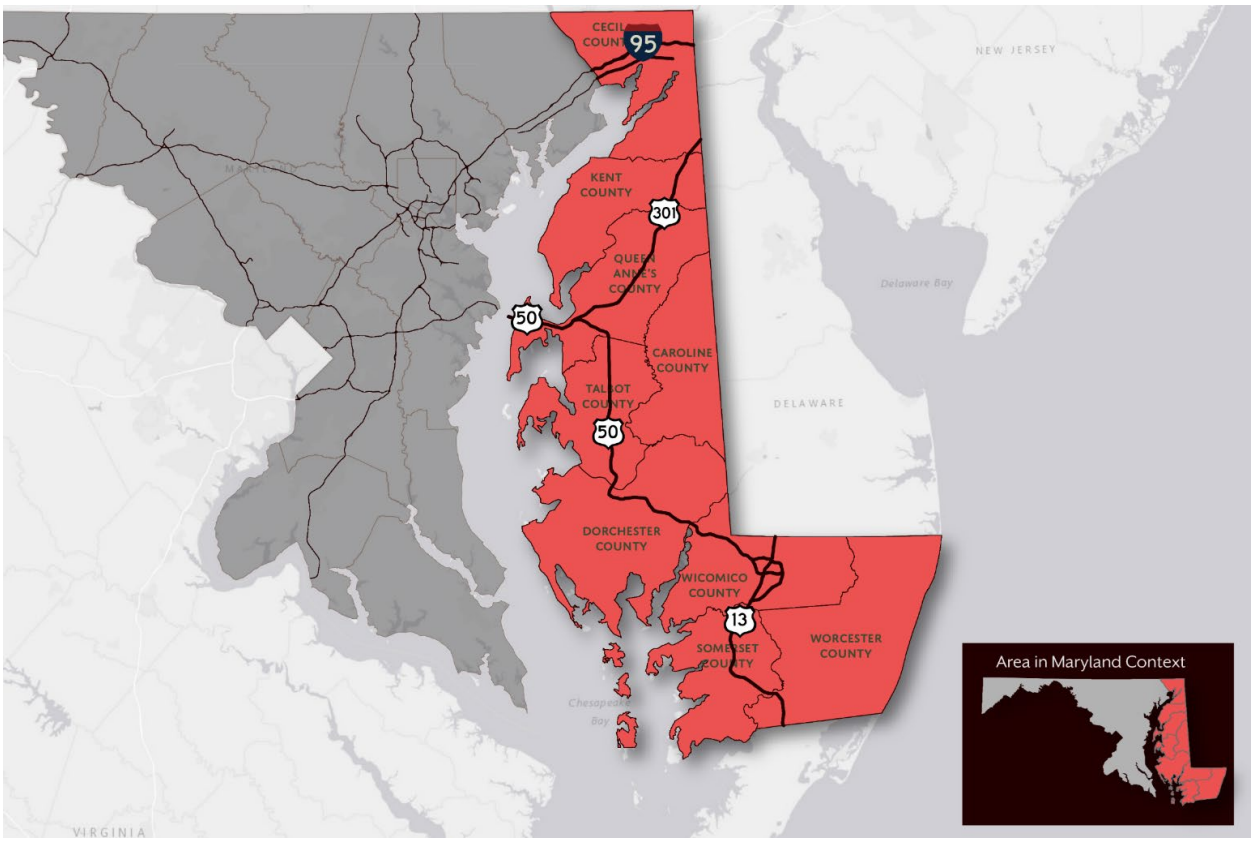
Source: Maryland Department of Transportation

Eastern Shore

The east side of the Chesapeake Bay on the Delmarva Peninsula is the Eastern Shore of Maryland. It has a population of approximately 450,000 residents, or 7.4 percent of the State's population. The region's population grew 1.7 percent from 2010 to 2020, though this was slower than the State's overall growth rate of 7 percent.

It is relatively flat and mostly rural with a thriving agriculture industry including large poultry farms. The small city of Salisbury is a center of this industry, especially with respect to chicken processing.[xxx] Tourism is also important on the Eastern Shore, especially for the coastal beach town of Ocean City. The counties that make up the Eastern Shore from north to south are Cecil, Kent, Queen Anne's, Caroline, Talbot, Dorchester, Wicomico, Worcester, and Somerset, shown in Figure 10.

Figure 10. Eastern Shore Region



Source: Maryland Department of Transportation

The Eastern Shore's transportation system is primarily highway oriented. Key routes include:

- Interstate 95, the main highway connecting major cities on the East Coast, which runs across Cecil County at the far northern end of the region. It is tolled in the northbound direction.
- U.S. 40, which runs approximately parallel to Interstate 95 across Cecil County and includes the tolled Thomas J. Hatem Bridge.
- U.S. 50, which crosses the tolled Chesapeake Bay Bridge and provides a link between the Eastern Shore and the rest of the State; it is also a key route for tourist traffic heading to and from Ocean City and the Delaware Beaches.

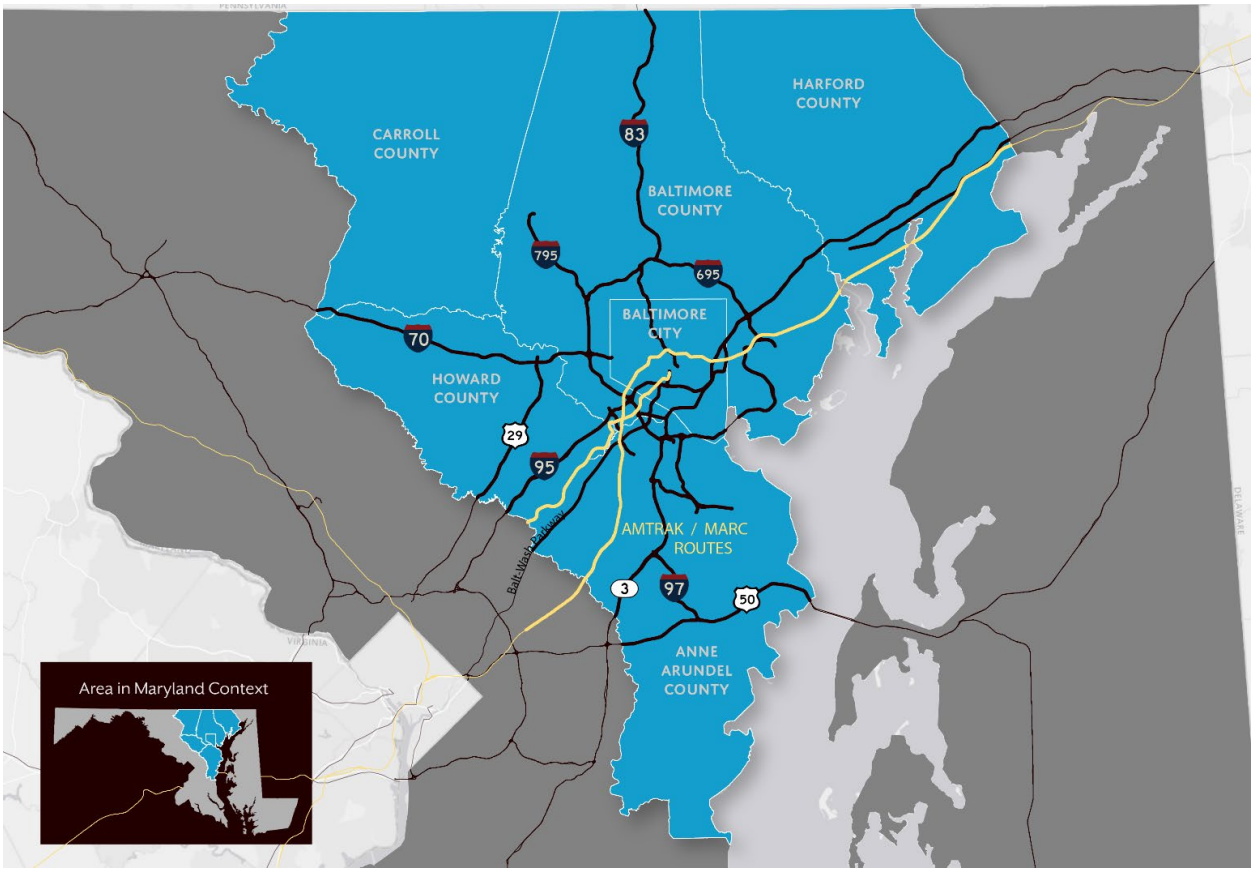
- U.S. 301, which provides access to the northern portion of the eastern shore near Chestertown
- U.S. 13, which traverses the length of the Eastern Shore and connects Wilmington, Delaware with the eastern shore of tidewater Virginia.

Shore Transit, Ocean City Transit, Delmarva Community Services, Queen Anne's County Ride, and Cecil Transit operate transit services in the region.

Baltimore Metro Region

The Baltimore Metro Region comprises Baltimore City and its surrounding counties – Carroll, Baltimore, Harford, Howard, and Anne Arundel, shown in Figure 11. The region is the most populous in Maryland, with 2.79 million people, or 45 percent of the State's population. The region's population grew 5 percent from 2010 to 2020, slower than the State's overall growth of 7 percent. Included in this region is Annapolis, which is the State capital, in Anne Arundel County.

Figure 11. Baltimore Metro Region



Source: Maryland Department of Transportation

Land use in the region is varied with dense and historic urban cores in Baltimore and Annapolis transitioning to medium and low-density suburban areas in southern Baltimore, northern Harford, eastern Howard, and northern Anne Arundel Counties. The landscape becomes progressively more rural as one moves towards the periphery of the Baltimore Metro Region. This region has experienced outward suburban expansion with low density housing development consuming agricultural lands (particularly in Howard, Carroll, and Harford Counties). A wide variety of multimodal transportation options are available in this region. Key highways include:

- Interstate 95, which provides a vital connection along the nation's East Coast and links Baltimore with Washington, D.C. It includes the tolled Fort McHenry Tunnel below Baltimore Harbor.

- Interstate 70, which provides an important connection between Baltimore and Frederick (in the Washington Region) and points west.
- Interstate 83, which provides access from Baltimore City to central Pennsylvania and points north.
- Interstate 97, which links Baltimore and Annapolis.
- U.S. 50, which links Washington, D.C., Annapolis, and the Eastern Shore.
- Baltimore-Washington Parkway, which provides an alternate route to Interstate 95 between Baltimore and Washington.
- Interstate 695, the Baltimore Beltway, which is a circumferential highway around Baltimore City. It includes the tolled Francis Scott Key Bridge.
- Interstate 895, the Harbor Tunnel Throughway, which runs parallel to Interstate 95 south of Downtown Baltimore. It includes the tolled Baltimore Harbor Tunnel.

Intercity train service along the U.S.'s East Coast is provided by Amtrak along the Northeast Corridor. Within the Baltimore Metro Region, Amtrak trains stop at Aberdeen in Harford County, Pennsylvania Station in Baltimore City, and the BWI rail station in Anne Arundel County.[xxxi] Regional commuter rail service within the region is provided by the MDOT MTA's MARC service. The Baltimore Metro Region has two MARC commuter lines – the Camden Line and the Penn Line. The Camden Line travels between Baltimore City and Washington, D.C. The Penn Line travels between Washington, D.C., Baltimore City, and northeastward to Perryville. In addition to servicing the urban stations, MARC trains also stop at suburban locations along the route.[xxxii]

MDOT MTA operates the Baltimore Metro Region's transit which includes bus service in Baltimore City and Baltimore County; Metro subway between Owings Mills in northwest Baltimore and downtown Baltimore City; Light Rail between Hunt Valley in northern Baltimore County and Cromwell and BWI Airport in Anne Arundel County; and commuter buses between suburban locations and downtown Baltimore, Fort Meade, and from Howard and Anne Arundel Counties to downtown Washington.[xxxiii] The counties also operate their own county-based bus systems, show in Figure 6.

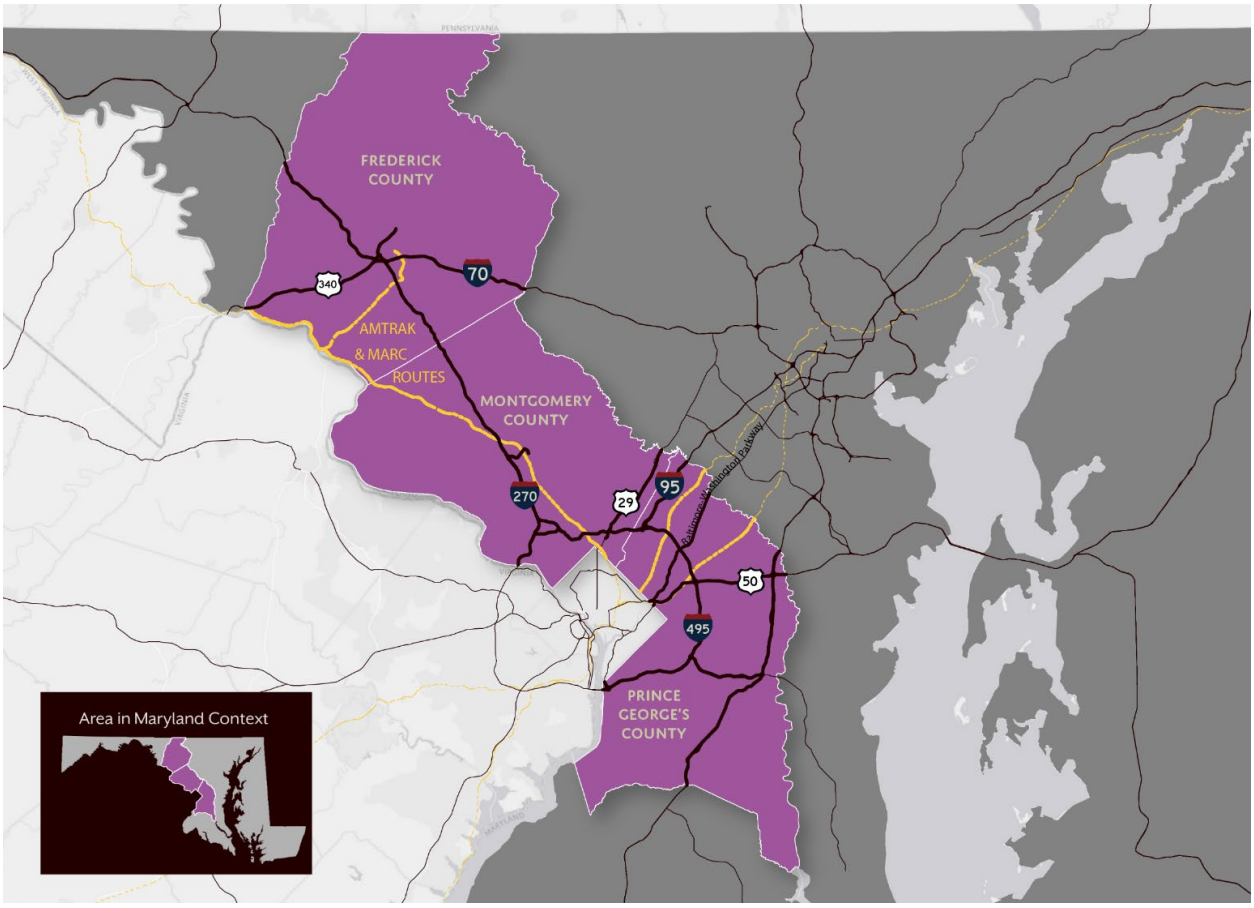
The Baltimore Metro Region is home to the Port of Baltimore, BWI Thurgood Marshall Airport, and Martin State Airport.

Washington Metro Region

The Washington Metro Region is made up of the suburban counties surrounding Washington, D.C. – Montgomery and Prince George's Counties – and Frederick County, which is just north of Montgomery County. These counties are shown in Figure 12. After the Baltimore Metro Region, it is the second most populous, with 2.30 million people, 37 percent of the State's population. It was also the fastest growing region from 2010 to 2020, with an increase of 11.2 percent, compared to 7 percent for the state as a whole.

Land use in the Washington Metro Region is primarily suburban or rural with newer dense urban nodes. The City of Frederick has a moderately dense historic town center. Rapid suburban growth is occurring along the I-270 corridor in Frederick and Montgomery Counties;[xxxiv] some of this growth is moderately dense (3.5 to 8 dwelling units per acre), but low-density housing is being built on former farmlands in both Frederick and Prince George's Counties.

Figure 12. Washington Metro Region



Source: Maryland Department of Transportation

The highway system in the Washington Metro Region is highly radial with the focal point being Interstate 495, the Capital Beltway.

- From the Beltway, Interstate 270 extends to the north and west linking Washington with suburban Montgomery County, Frederick, and points west.

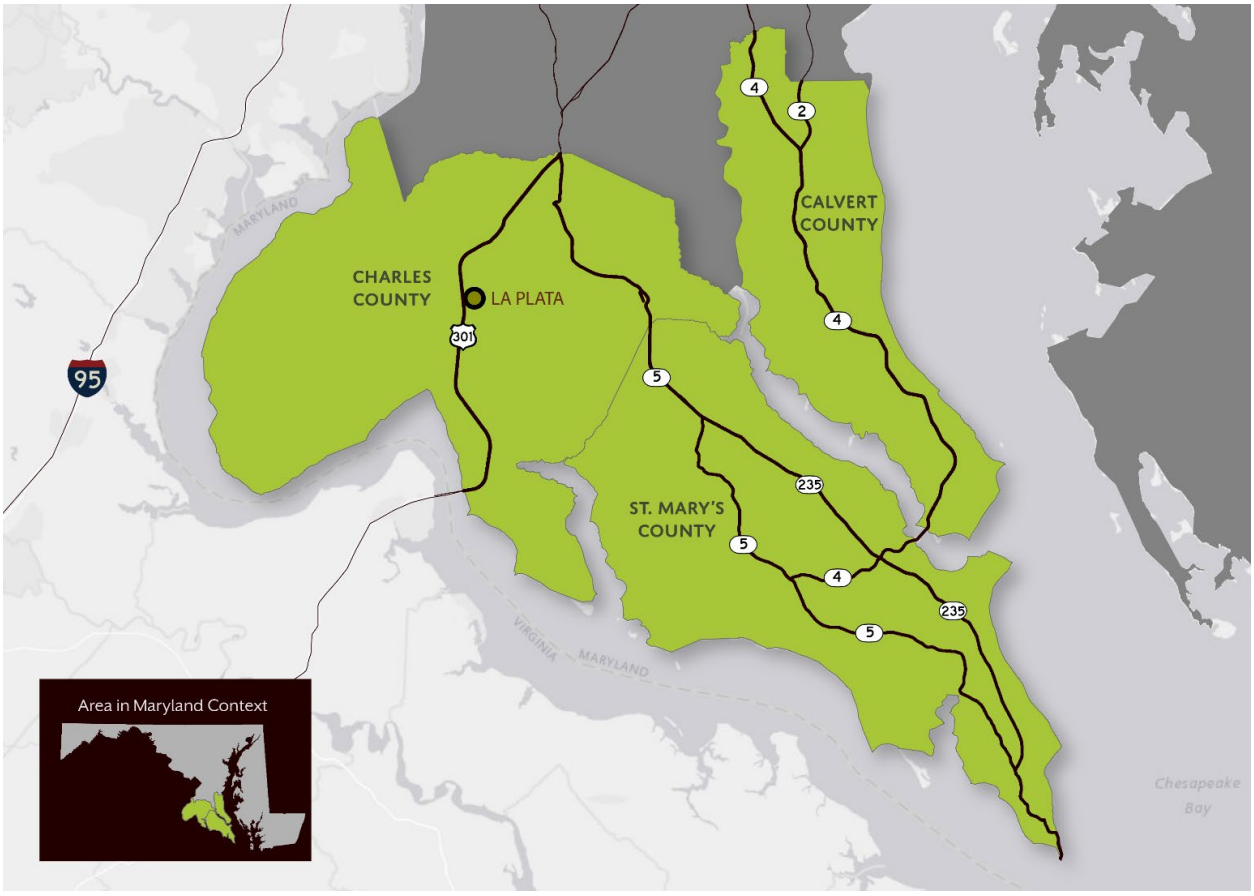
- Interstate 95 follows the east side of the Capital Beltway before heading northeast towards Baltimore, Philadelphia, and New York; the Baltimore-Washington Parkway and U.S. 29 run parallel to this portion of I-95 providing important alternate routes and, in the case of the Parkway, a freeway connection to downtown Washington, D.C.
- U.S. 50 heads east from the Washington, D.C. boundary line providing a direct highway connection to Annapolis and the Eastern Shore.
- Maryland Route 200, the Intercounty Connector, from Gaithersburg in Montgomery County to Laurel in Prince George's County, is a toll road with variable pricing based on the time of day.

The Washington Metro Region has an extensive and busy transit network. WMATA's Metro subway connects downtown Washington with inner Montgomery and Prince George's Counties; WMATA also operates an extensive core bus service throughout these counties. Each county in the Washington Metro Region also has its own bus system to provide for local travel and regional connections, shown in Figure 6. Augmenting these transit services, MDOT MTA provides MARC service along three corridors - northwestward from Washington, D.C. through Montgomery County to Frederick and Brunswick (Brunswick Line), northward from Union Station paralleling I-95 to downtown Baltimore at Camden Station (Camden Line), and a more easterly route which connects Union Station and Baltimore's Penn Station (Penn Line) on the same alignment traveled by Amtrak service.[xxxv] The Purple Line is a 16-mile light rail line, scheduled to begin operation in 2026, that will extend from Bethesda in Montgomery County to New Carrollton in Prince George's County. It will provide a direct connection to the Metrorail Red, Green and Yellow Lines at Bethesda, Silver Spring, College Park, and New Carrollton. The Purple Line will also connect to MARC, Amtrak, and local bus services.[xxxvi] Amtrak's busy Northeast Corridor service is available in New Carrollton (Prince George's County). Another Amtrak station in Rockville (Montgomery County) provides links to Washington, D.C. and to Pittsburgh and points west.

Southern Maryland

Southern Maryland comprises the counties to the south and east of Washington, D.C. on the western shore of the Chesapeake Bay, shown in Figure 13. It has about 373,000 people, or 6 percent of Maryland's population. From 2010 to 2020 it was the second fastest growing region, with a growth rate of 9.6 percent, compared to 7 percent for the State as a whole. Rapid, low-density suburbanization is a key land use feature of this region of the State, which is being driven both by expansion of employment opportunities (most notably by job growth associated with Patuxent Naval Air Station) and an influx of people who work in the Washington, D.C. region.[xxxvii]

Figure 13. Southern Maryland Region



Source: Maryland Department of Transportation

Important transportation facilities include the Governor Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge, which connects Charles County, MD with King George County, VA on U.S. 301 and the Governor Thomas Johnson Memorial Bridge, which joins Calvert and St. Mary's Counties.

The transportation network in Southern Maryland is highway oriented, but there are few limited access expressways in the region. Key four-lane arterials include:

- MD 4, which connects Calvert County to the Washington Metro Region.
- MD 5, which connects St. Mary's County to Charles County and Prince George's County.

- MD 235, which provides access along the length of St. Mary's County.
- U.S. 301, which traverses Charles County north to south and is the only route in the region that crosses the Potomac River into Virginia. It crosses the tolled Governor Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge, which opened in October 2022.

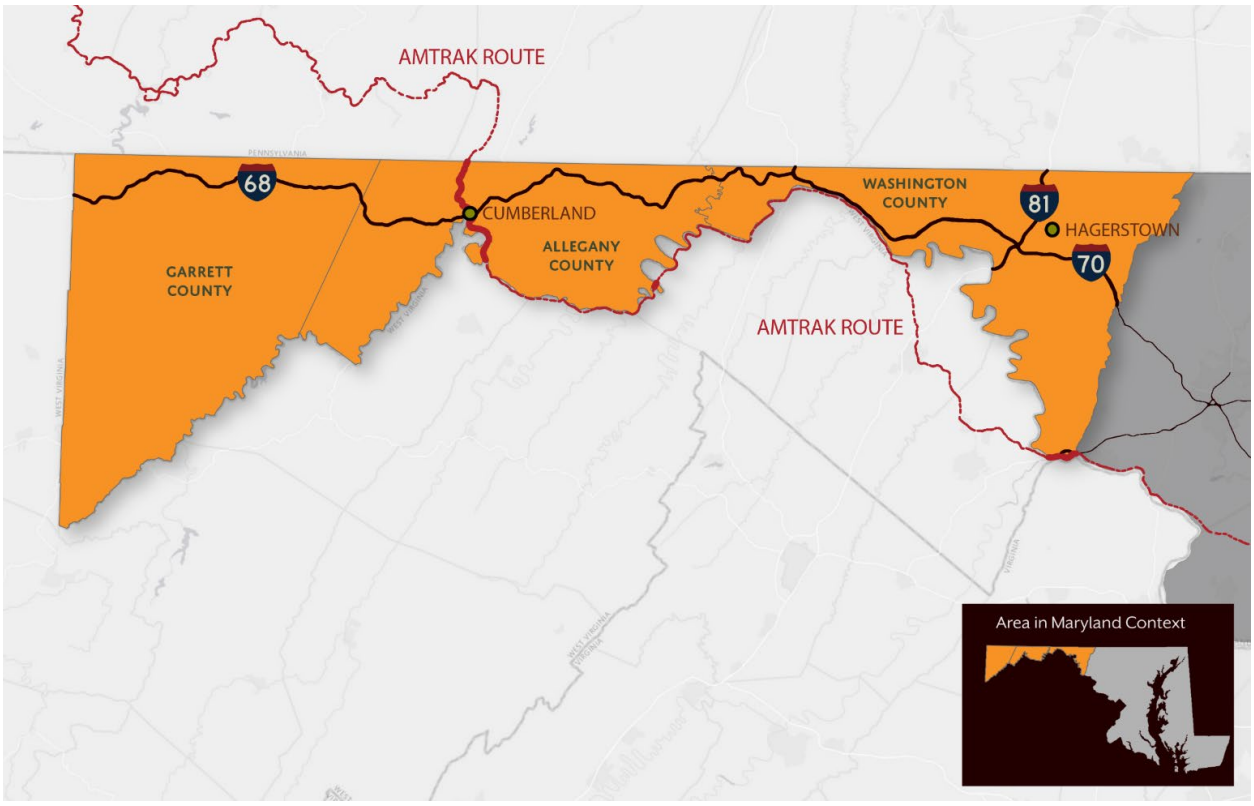
MDOT MTA operates several commuter bus routes from points within the Southern Maryland region's counties to downtown Washington, D.C.[xxxviii] In addition, each county operates its own county-based fixed-route bus systems.

Western Maryland

Western Maryland is in Maryland's panhandle and, west to east, comprises Garrett, Allegany, and Washington Counties, shown in Figure 14. It is Maryland's least populous region, with about 251 thousand residents, or 4.1 percent of the State's population. It was also the only region to see a decline in population from 2010 to 2020, losing about 1,000 residents or 0.4 percent of its population.

The region is mostly rural and characterized by forested mountain ridges, some agriculture, small towns, and the cities of Hagerstown in Washington County and Cumberland in Allegany County. Western Maryland is the State's least populous region. The counties in the Western Maryland Region are part of the Appalachian Regional Commission, a federal economic development agency that includes 13 states and 423 counties.

Figure 14. Western Maryland Region



Source: Maryland Department of Transportation

As on the Eastern Shore, the transportation system in this region is primarily highway oriented. Key roadways include:

- Interstates 70 and 68, which traverse the Appalachian Mountains and connect Maryland with the Midwest.
- Interstate 81, which traverses a short distance through Maryland, is another critical roadway, especially for freight; it links the Northeast with destinations to the South and Southwest.

- U.S. 219 bisects Garrett County and provides connections between Oakland and West Virginia and Pennsylvania.
- U.S. 220 is the primary north-south route in central Allegany County and connects Cumberland to West Virginia and Pennsylvania.

Locally operated fixed-route bus services are provided in Cumberland and Hagerstown. Amtrak also makes a station stop in Cumberland on its route between Washington, D.C. and Chicago.

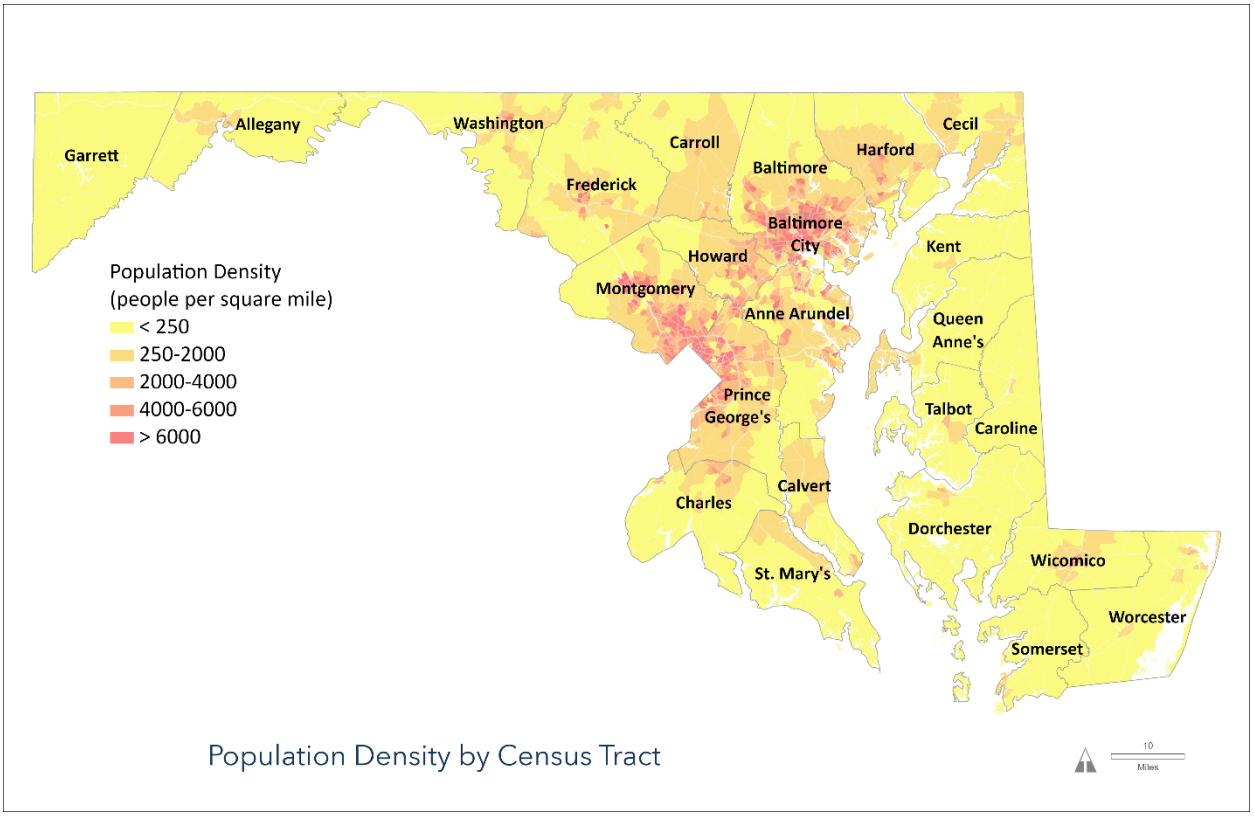
The eastern portion of Western Maryland faces development pressures radiating from residents in Frederick, Washington, D.C., and Baltimore, who are searching for more affordable housing.[xxxix] The western portion of the region is dominated primarily by highway travel, linking lower density development with various commercial developments and towns including Cumberland and Frostburg (both in Allegany County).[xl]

Maryland's Population

Population Growth

Maryland's population is estimated at 6.2 million, making it the 18th most populous state. However, the State ranks 42nd in land area, making it the fifth most-densely populated state. As shown in Figure 15, population and population density are primarily concentrated in central Maryland along the I-95 corridor between Washington, D.C. and Baltimore, and along I-270 extending from Washington, D.C. into Montgomery County. Baltimore, Silver Spring, Bethesda, and Towson are key high-density population and employment nodes within this broader area. Outside of these areas, land uses become more suburban in character before transitioning into more rural land uses.

Figure 15. Maryland Population Density by Census Tract (2021)



Source: ACS 2021 5-Year Estimates

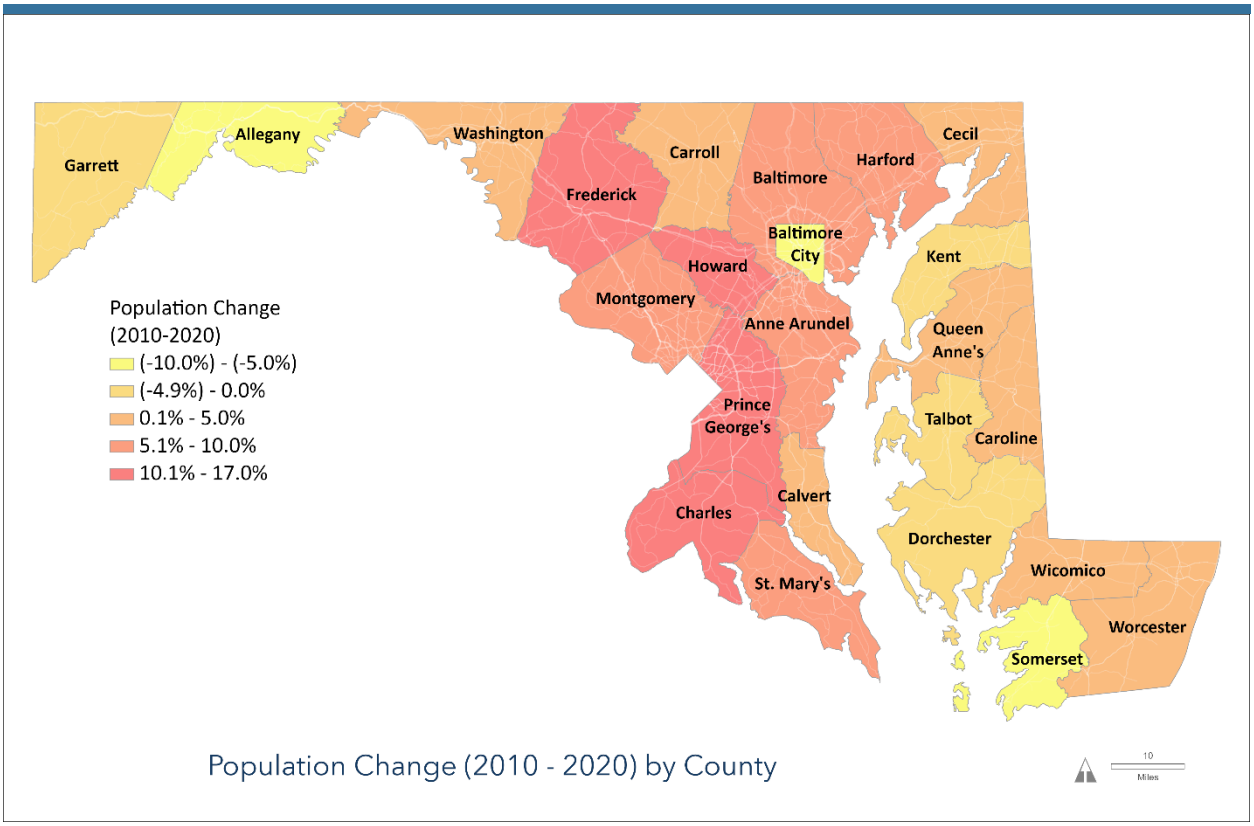
Maryland's population is growing. Between 2010 and 2020, the State's population grew 7.0 percent, just below the national average of 7.4 percent. As Table 2 shows, population has grown most rapidly in the Washington Metro Region (11.2%) and Southern Maryland (9.6%) during this time. The Eastern Shore region, on the other hand, saw growth of only 1.7 percent during this period, and Western Maryland experienced a population decline of 0.4 percent. As shown in Table 2 and Figure 16, though Baltimore County population continues to grow, Baltimore City has experienced population loss between 2010 and 2020.

Table 2. Population Trends by Region and County

	2010 Census	2020 Census	Percent Growth	Share of State Population (2020)
Baltimore Metro Region	**2,662,691**	**2,794,636**	**4.96%**	**45.24%**
Anne Arundel	537,656	588,261	9.41%	9.52%
Baltimore	805,029	854,535	6.15%	13.83%
Carroll	537,656	588,261	3.44%	2.80%
Harford	805,029	854,535	6.58%	4.22%
Howard	537,656	588,261	15.76%	5.38%
Baltimore City	620,961	585,708	-5.68%	9.48%
Washington Metro Region	**2,068,582**	**2,300,979**	**11.23%**	**37.25%**
Frederick	233,385	271,717	16.42%	4.40%
Montgomery	971,777	1,062,061	9.29%	17.19%
Prince George's	863,420	967,201	12.02%	15.66%
Southern Maryland Region	**340,439**	**373,177**	**9.62%**	**6.04%**
Calvert	88,737	92,783	4.56%	1.50%
Charles	146,551	166,617	13.69%	2.70%
St. Mary's	105,151	113,777	8.20%	1.84%
Western Maryland Region	**252,614**	**251,617**	**-0.39%**	**4.07%**
Allegany	75,087	68,106	-9.30%	1.10%
Garrett	30,097	28,806	-4.29%	0.47%
Washington	147,430	154,705	4.93%	2.50%
Eastern Shore Region	**449,226**	**456,815**	**1.69%**	**7.40%**
Caroline	33,066	33,293	0.69%	0.54%
Cecil	101,108	103,725	2.59%	1.68%
Dorchester	32,618	32,531	-0.27%	0.53%
Kent	20,197	19,198	-4.95%	0.31%
Queen Anne's	47,798	49,874	4.34%	0.81%
Somerset	26,470	24,620	-6.99%	0.40%
Talbot	37,782	37,526	-0.68%	0.61%
Wicomico	98,733	103,588	4.92%	1.68%
Worcester	51,454	52,460	1.96%	0.85%
Maryland	**5,773,552**	**6,177,224**	**6.99%**	**100.0%**

Source: Decennial Census (2010 and 2020)

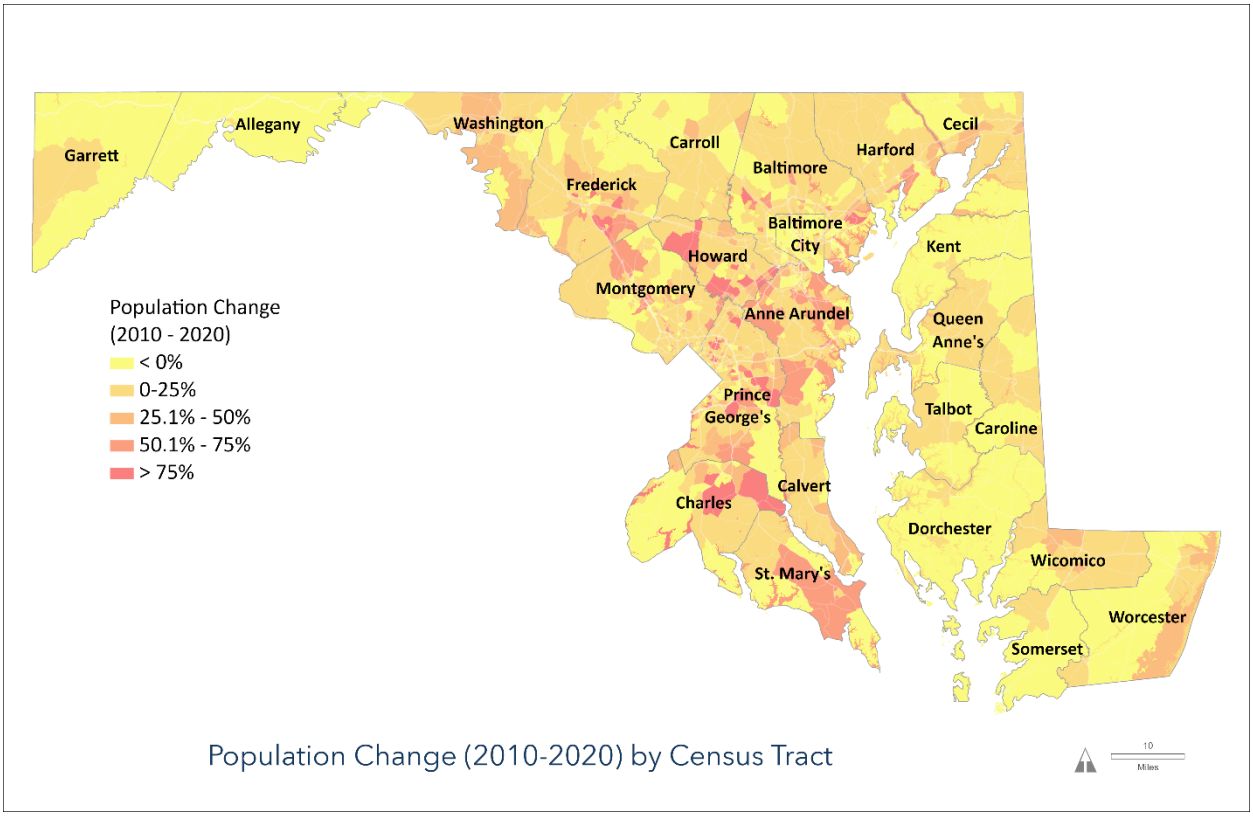
Figure 16. Population Change by County (2010-2020)



Source: Decennial Census (2010 and 2020)

Figure 17 shows geographic variation in population growth at a more granular level – by Census tract. Continued suburban growth occurring further around Washington, D.C. and Baltimore puts great pressure on the transportation system in central Maryland. In addition, the Eastern Shore in Maryland is experiencing population growth along the eastern edge of Worcester County, along the Atlantic Ocean. This area of Maryland has limited roadway infrastructure and experiences high volumes of seasonal, tourist traffic.

Figure 17. Maryland Population Growth by Census Tract



Source: Decennial Census (2010 and 2020)

Future population growth is expected in Maryland (Table 3). By 2045, the State is projected to add just under 800,000 new residents, representing an 11.3 percent increase in population. Population in Southern Maryland is expected to grow over 25.8 percent, the fastest among the five regions. This will put further strain on the transportation system.

Table 3. Population Forecasts by Region

	2020 Census	2050 Projection	% Growth
Baltimore Metro Region	2,794,636	3,150,530	12.73%
Washington Metro Region	2,300,979	2,690,860	16.94%
Southern Maryland Region	373,177	490,480	31.43%
Western Maryland Region	251,617	297,490	18.23%
Eastern Shore Region	456,815	553,660	21.20%
Maryland	6,177,224	7,183,020	16.28%

Source: Decennial Census (2020) and MSDC (Preliminary Historical and Projected Total Population for Maryland's Jurisdictions)

Population Age Distribution

Maryland has also experienced an aging population in line with national trends. As shown in Table 4, the 65- to 74-year-old population cohort grew 49.7 percent between 2010 and 2020, while the 75 and older population grew 27.2 percent. The former group grew at a rate ten times the State's overall population growth rate of 4.9%, while the latter grew at a rate five and a half times the overall rate. In 2020, the population age 65 and over equaled 16.3 percent of the total population, compared to just 12.3 percent in 2010. This growth is expected to continue as the Baby Boomer generation ages, presenting new transportation challenges for Maryland. These challenges are not unique to the State, since the percentage of older residents in Maryland corresponds to national averages of 12.8 percent in 2010 and 16.0 percent in 2020.

Table 4. Maryland's Population Age Distribution[xli]

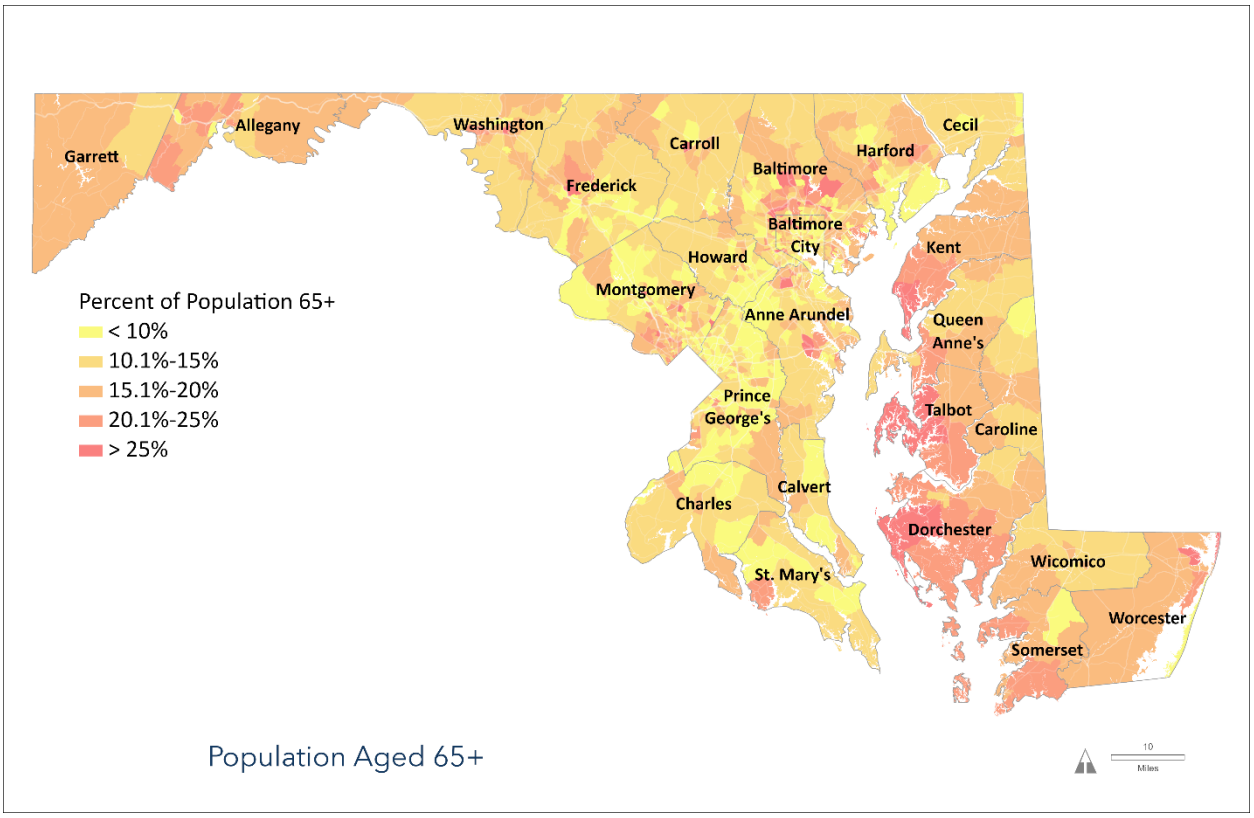
	2010 Census	2020 Census	% Growth
0-15	1,189,455	1,183,304	-0.5%
16-24	720.894	670,998	-6.9%
25-34	762,083	826,201	8.4%
35-44	795,603	792,009	-0.5%
45-54	902,245	776,744	-13.9%
55-64	695,806	819,194	17.7%
65-74	386,387	578,509	49.7%
75+	321,321	408,843	27.2%
Total	5,773,794	6,055,802	4.9%

Source: MDP Maryland State Data Center, U.S. Census Bureau Population Estimates by Age (2010 and 2020)

Aging residents often require alternative modes of transportation to help meet their needs. Improved pedestrian infrastructure and transit service are two ways the State can address this challenge. Figure 18 shows where concentrations of older populations occur in Maryland; many are in low density rural areas of the State, which presents additional challenges to ensuring access to transportation choices. These include coastal areas of the Eastern Shore, in Kent, Queen Anne's, Talbot, Dorchester, and Worcester Counties; suburban areas in Baltimore County; and Allegany County in Western Maryland. It should be noted, however, that this map highlights relative concentrations of elderly residents, while the absolute number of aging residents may be higher in areas of more dense population.

While Maryland's population is getting older, the implications of this change are uncertain. A higher proportion of seniors relative to the general population exhibit safe driving habits, such as wearing seatbelts, but many seniors who drive face age-related vulnerabilities such as arthritis, that increase safety risks. As seniors live longer and awareness grows about age-related impacts on driving ability, the number of licensed drivers and registered vehicles may be affected. The need to provide expanded transportation services for older Marylanders who no longer drive could also impact public transportation agencies, non-profit transportation providers, and/or private providers.

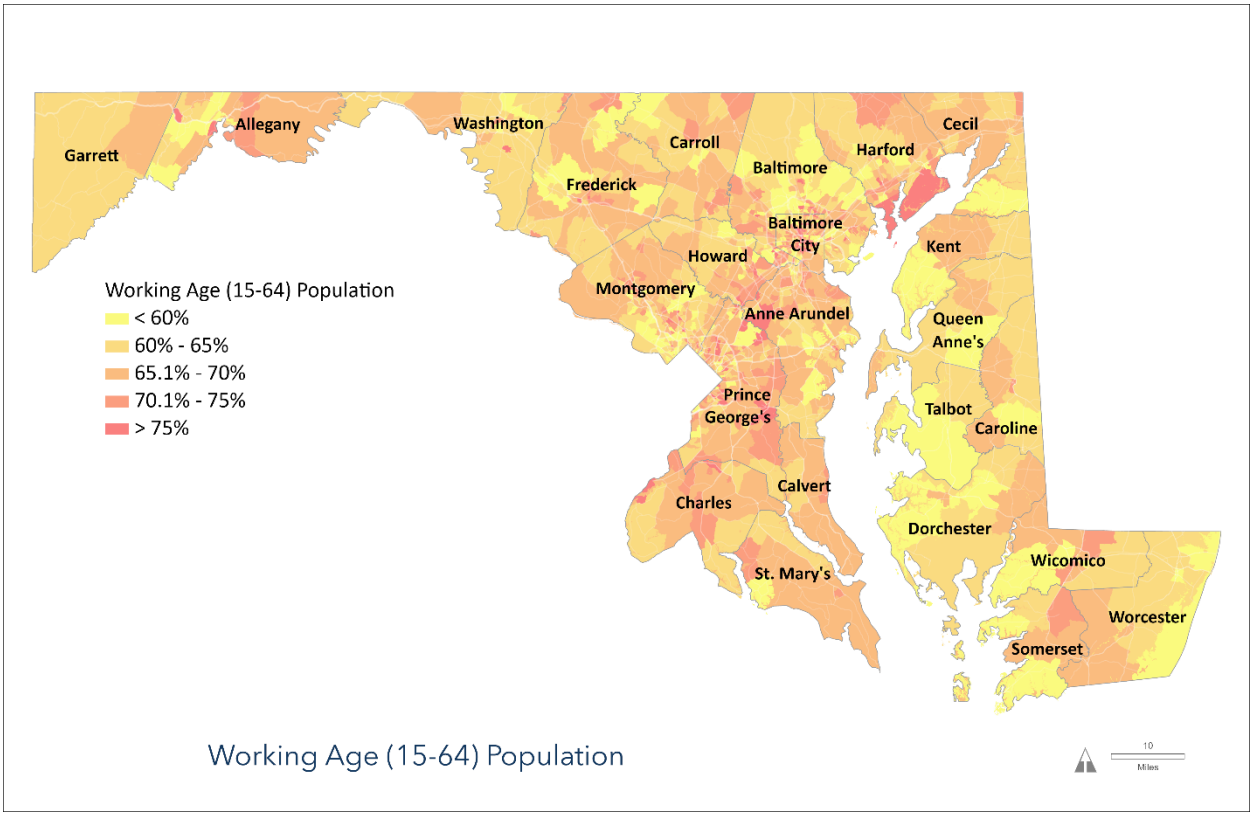
Figure 18. 65 and Older Population by Census Tract



Source: U.S. Census Bureau, ACS 5-Year Estimates (2021)

The working age population shows a less clear pattern but are concentrated in areas of high employment density in and around the Baltimore and Washington D.C. metropolitan areas. Working age populations are least concentrated on the Eastern Shore and in Western Maryland, as shown in Figure 19. It is worth noting that the U.S. Department of Housing and Urban Development (HUD) defines the Working Age Population as 16-64, but Census data is segmented from 15-64. As a result, this paper uses two working age population age groups, depending on the data source.

Figure 19. Working Age Population by Census Tract

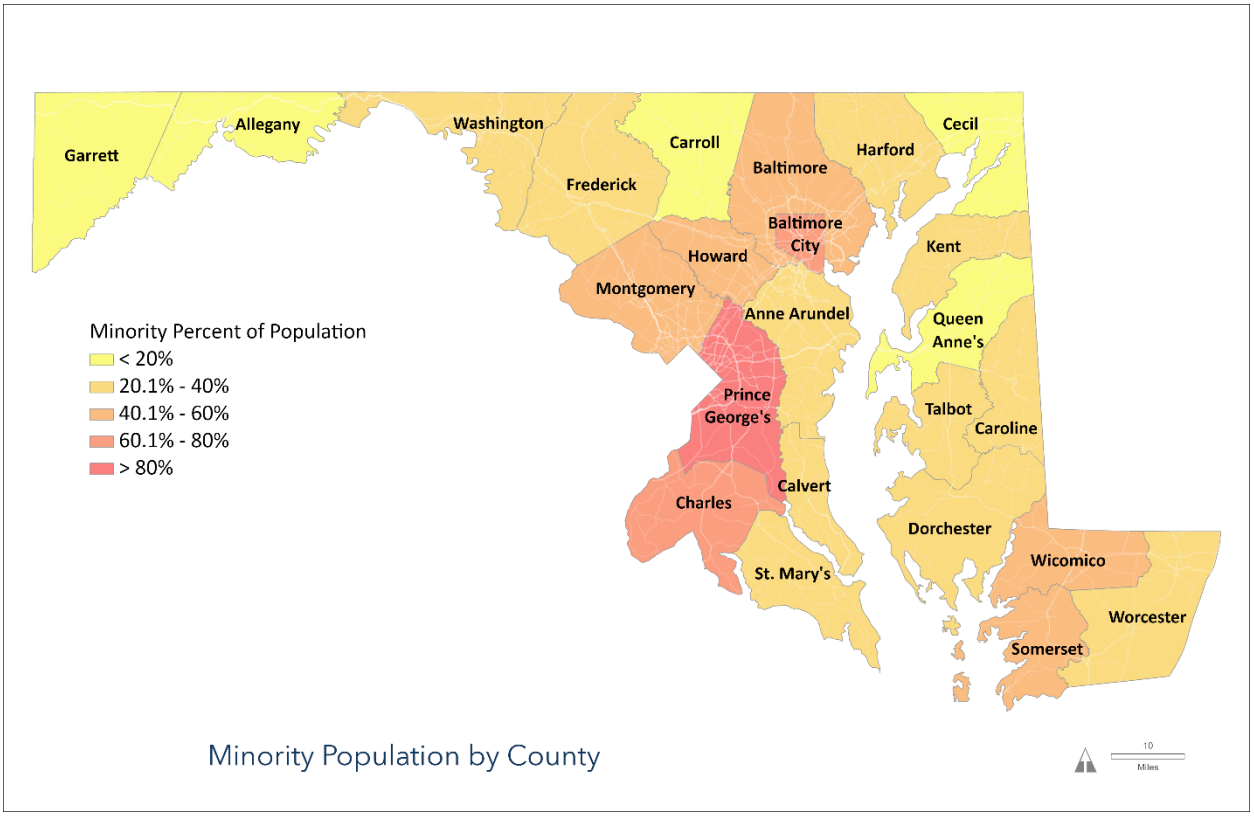


Source: U.S. Census Bureau, ACS 5-Year Estimates (2021)

Minority Population

Maryland is diverse in both its geographic regions and its population. Based on U.S. Census race data, less than half (or about 49%) of Maryland's population identifies as 'white alone'. The highest percent of minority populations in Maryland is in Prince George's County, followed by Baltimore City and Charles County. The concentration of minority population is lowest in the Western Maryland region. Understanding where minority populations are located, along with other socioeconomic factors such as income and age, help to identify the unique transportation needs of the regions. Figure 20 illustrates the concentration of minority populations in Maryland.

Figure 20. Minority Population by County (2020)

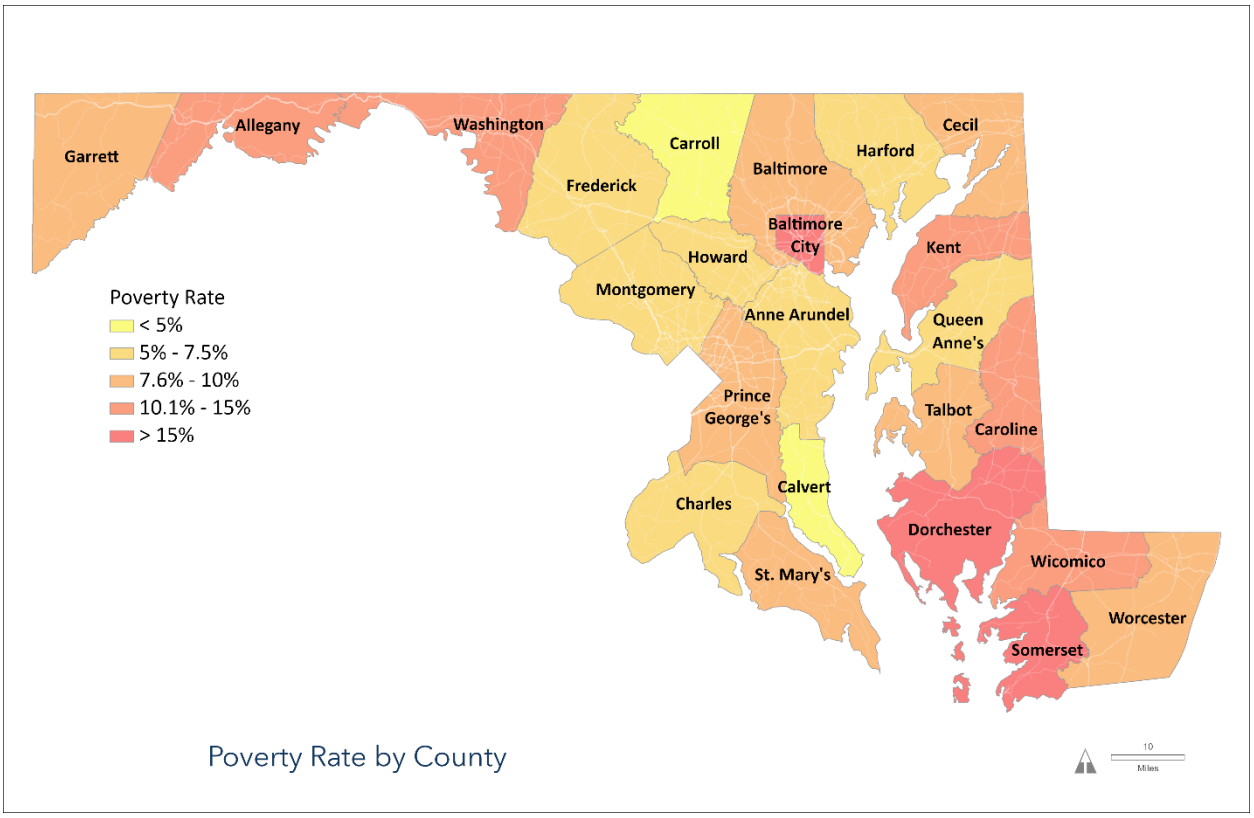


Source: U.S. Census Bureau, ACS 5-Year Estimates (2021)

Poverty

Baltimore City faces a poverty rate (20.0%) more than double the statewide average of 9.0 percent. Outside of Baltimore City, poverty in Maryland tends to be concentrated in Western Maryland and the Eastern Shore. Eleven of the twelve counties in these regions have a poverty rate higher than the State average. Figure 21 displays poverty rates by county in Maryland.

Figure 21. Poverty Rate by County in Maryland, 2021



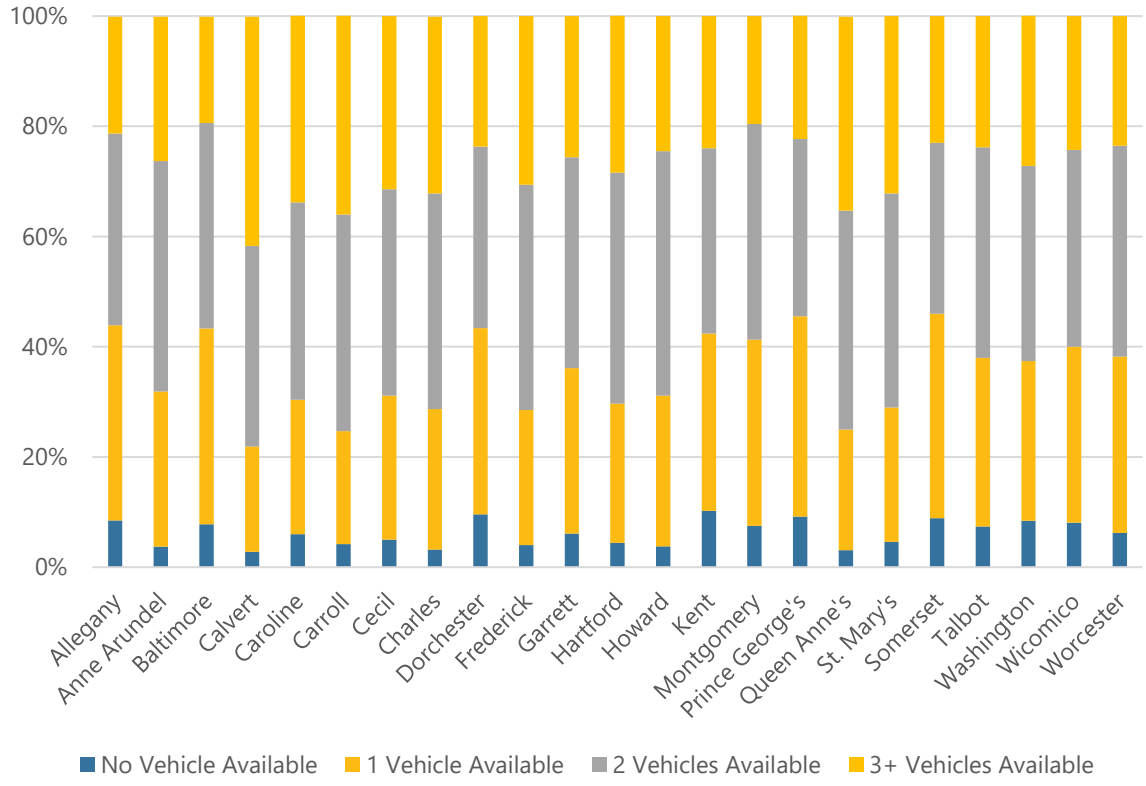
Source: U.S. Census Bureau, ACS 5-Year Estimates Poverty Status in the Last 12 Months (2021)

Vehicle Availability

Of the 2,230,527 households in Maryland, 8.8 percent (or 196,074) do not have a car, some by choice and others who cannot afford a vehicle. Households without vehicles rely on upon public transportation to get to and from work, visit family, purchase groceries, and go to the doctor.

Figure 22 shows the number of vehicles per house varies greatly by county. The counties with a highest rate of households with no vehicles are Prince George's (9.2%), Dorchester (9.6%), and Kent (10.2%). Prince George's County likely has a high rate of households with no vehicles because it is part of the Washington Metro area and is served by WMATA. Dorchester County and Kent County, while two of Maryland's least populous counties, are served by the Maryland Upper Shore Transit (MUST).

Figure 22. Household Vehicle Availability by County



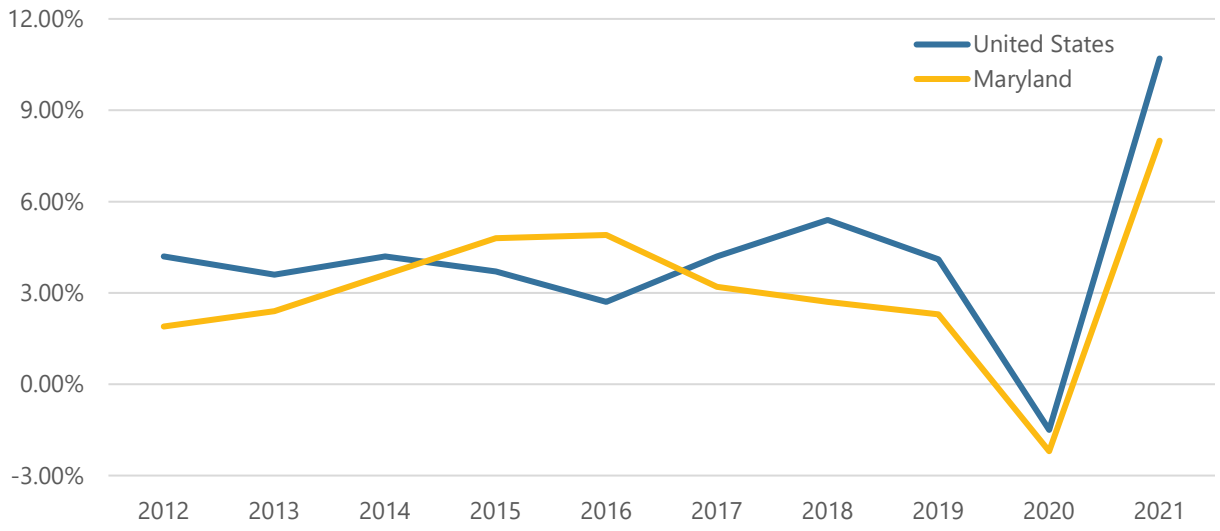
Source: U.S. Census Bureau, 2015-2020 American Community Survey 5-Year Estimates

Maryland's Economy

Maryland's Gross State Product (GSP), a measure of overall economic activity in the state, increased from $387.7 billion in 2016 to $443.9 billion in 2021. A well-functioning transportation system is critical to Maryland's economic competitiveness and provides access to life's opportunities for residents and visitors alike. Maryland residents rely on the transportation system every day to commute to work, to attend business meetings, to visit stores, and to reach key destinations and attractions, including key tourist attractions throughout the State. Businesses rely on the transportation system to receive raw materials for manufacturing and to ship finished products. Transportation – including the highway and rail systems, air freight, and the Port of Baltimore – links Maryland's businesses to regional, national, and international markets, allowing them to grow and prosper. Businesses seeking to relocate or open new facilities will often consider transportation opportunities as well as congestion hindrances as factors to ensure goods can be shipped on time and that employees can enjoy a high quality of life. A well-functioning transportation system will allow Maryland residents and businesses to complete activities in a timely and efficient manner and will make the State attractive to new businesses, boosting economic growth. This section discusses trends in economic output, employment, industry composition, and freight movement in Maryland that could affect the need for transportation system improvements in Maryland.

Figure 23 shows the year-over-year real GSP growth for Maryland relative to the United States. The decline in GSP in 2020 and return in 2021 is likely attributable to the economic impact of the COVID-19 pandemic in 2020.

Figure 23. Year-over-Year real GSP Growth – Maryland vs. United States (2012-2021)

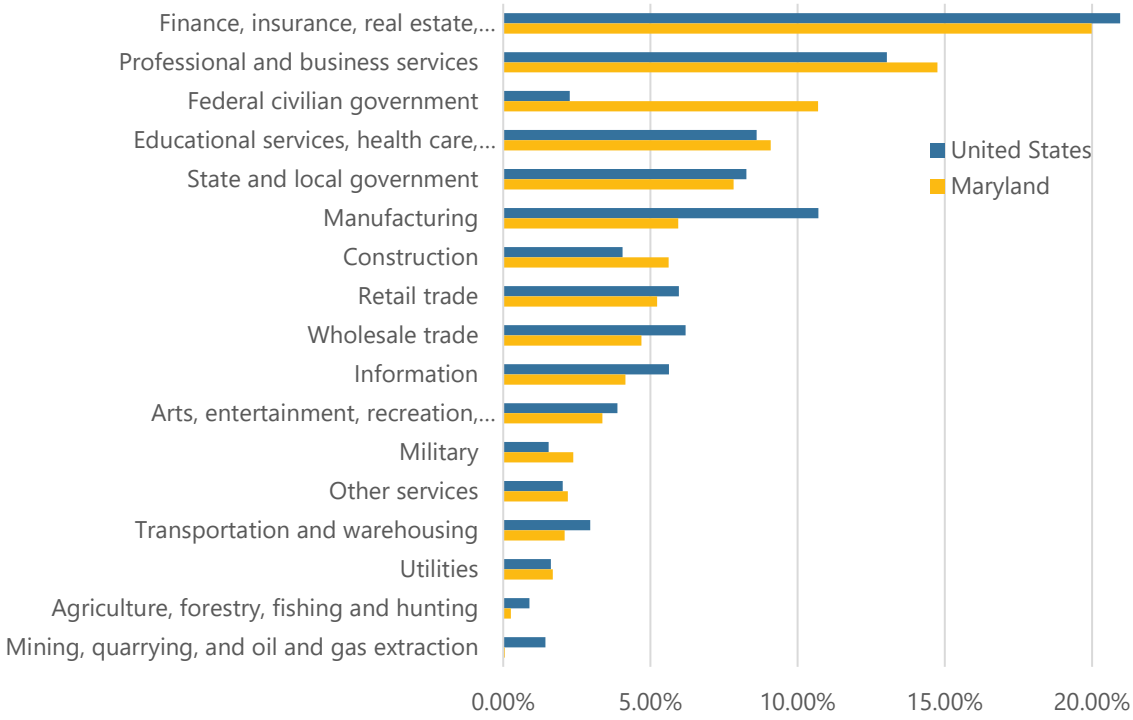


Source: U.S. Bureau of Economic Analysis, Real GDP by State – Interactive Data Tool

Economic Sectors

Maryland's largest sector by share of GSP is finance, insurance, and real estate, which contributes 19.99 percent of GSP, compared to 20.95 percent nationally. Two sectors, federal civilian government and professional and business services, have a substantially stronger presence in Maryland relative to the United States overall. This is due to the concentration of federal government offices and support services located in the State. Conversely, manufacturing is underrepresented in the Maryland economy, contributing to only 5.95 percent of GSP, compared to 10.71 percent nationally. Figure 24 shows Maryland's sector by sector share of real GSP relative to the United States overall.

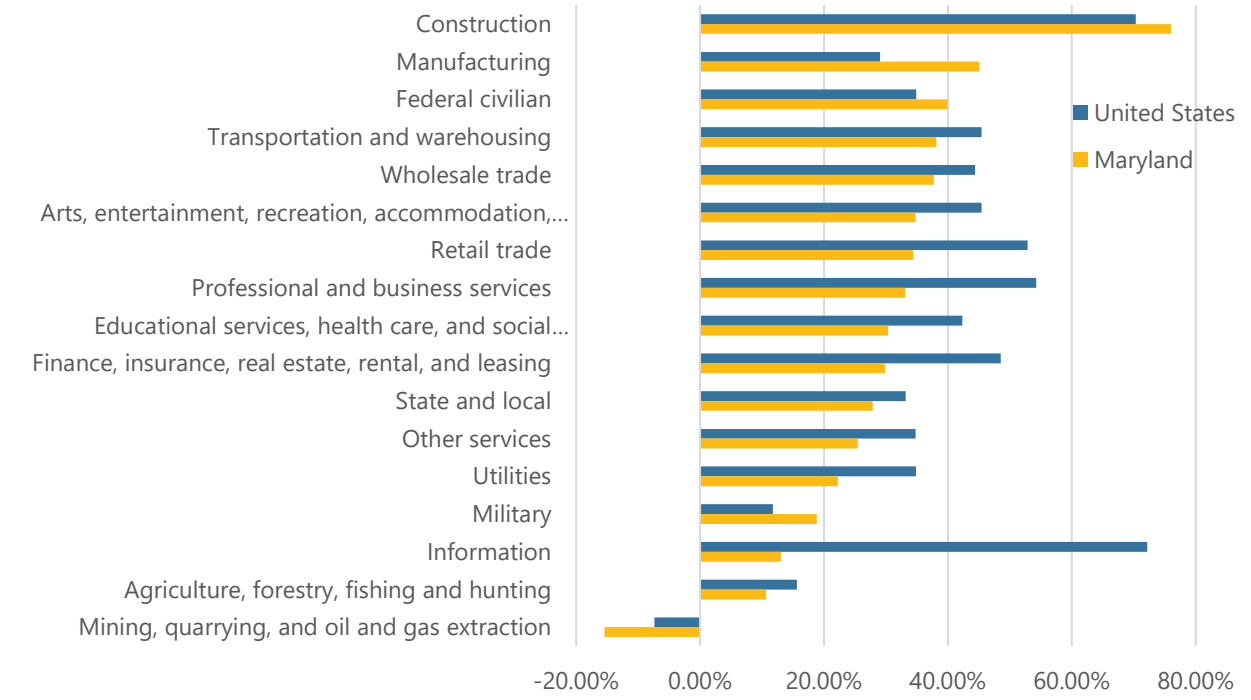
Figure 24. Sectors by Share of Real GSP – Maryland vs. United States (2021)



Source: U.S. Bureau of Economic Analysis, Real GDP by State

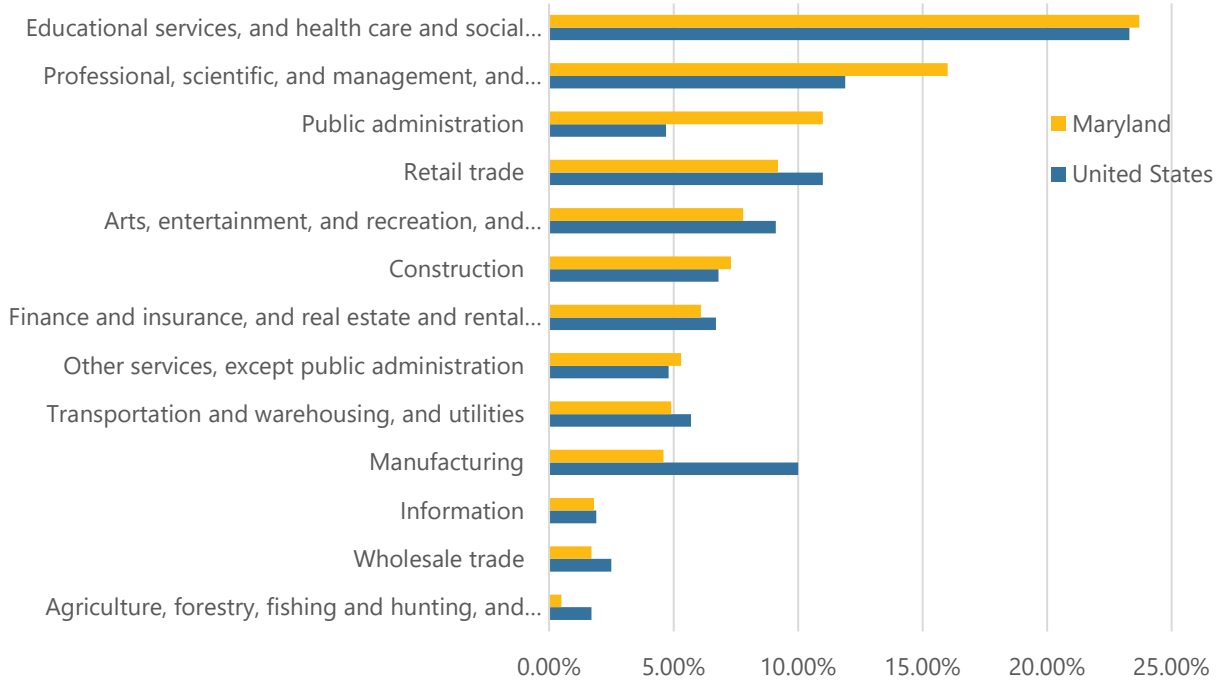
Between 2012 and 2021, Maryland's fastest growing industries by GSP were construction, manufacturing, and federal civilian government. These industries grew at a faster rate than the national average. The only sector that shrank in the last decade was mining, quarrying, and oil and gas extraction. This sector shrank both nationally and in Maryland, though it shrank by nearly double the rate in Maryland. Figure 25 shows Maryland's sector growth by share of real GSP relative to the United States. Figure 26 shows Maryland's employment by sector relative to the United States.

Figure 25. Real GSP Growth by Sector - Maryland vs U.S. (2012-2021)



Source: U.S. Bureau of Economic Analysis, Real GDP by State – Interactive Data Tool

Figure 26. Employment by Sector – Maryland vs. United States (2021)



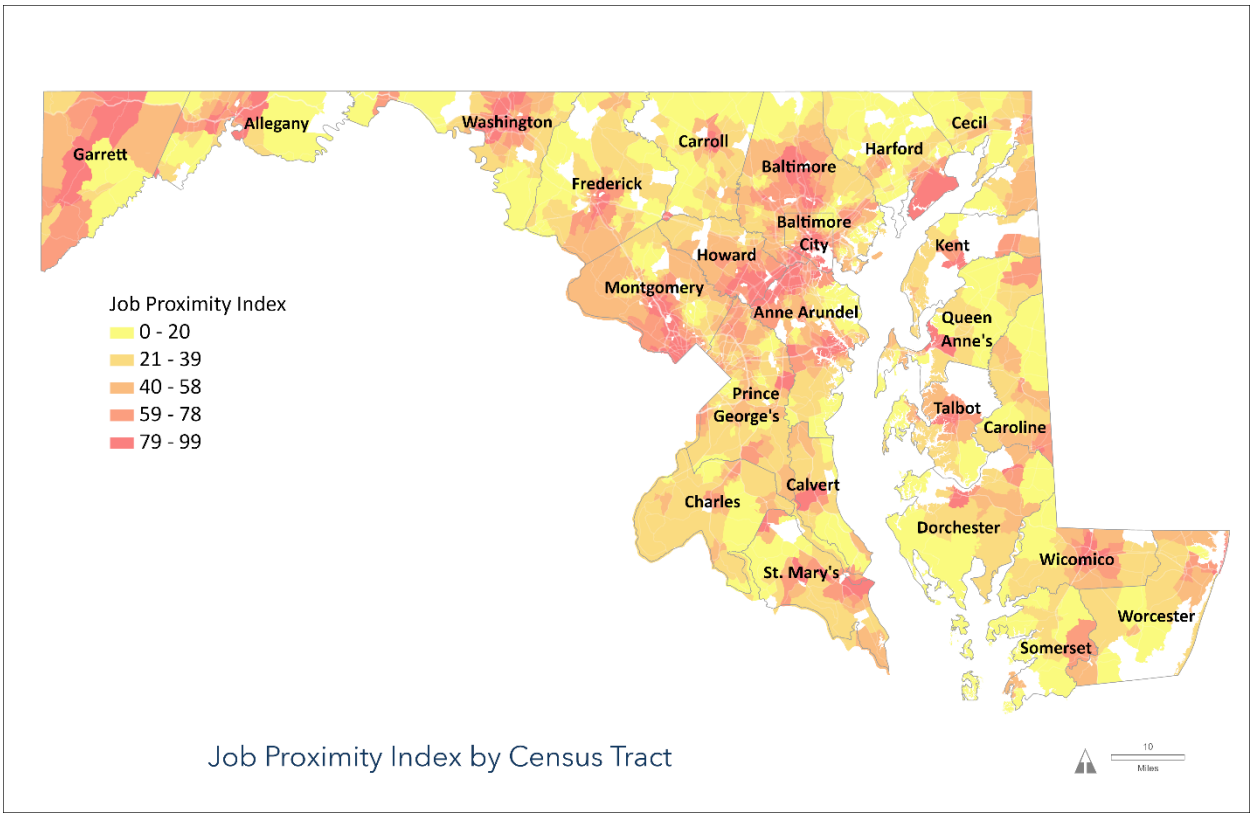
Source: United States Census Bureau – ACS 5 Year Estimates (2021) Select Economic Characteristics

Employment

Geographically, Maryland's employment is concentrated in a few key locations near major cities and transportation arteries. Employment density is highest in the urban and suburban spine of central Maryland from Bethesda and Silver Spring northeastward to Baltimore and Towson. People living near these employment centers tend to drive less because of their proximity to work destinations and because of higher access to non-auto modes which work well at high population densities. This jobs-housing imbalance, combined with the auto-oriented design of many employment centers in Maryland, increases long-distance commuting by car, which contributes to peak hour congestion along corridors providing access to job centers.

The Jobs Proximity Index, developed by the U.S. Department of Housing and Urban Development (HUD), measures the accessibility of each Census Block Group as a function of its distance to all job locations in the region, with larger employment centers weighted more heavily. Analysis of job proximity, shown in Figure 27, shows that every county except Cecil County has at least one area with scores in the highest quintile. Outside of the Baltimore and Washington D.C. metropolitan areas, these areas include regional cities like Frederick, Hagerstown, or Salisbury, as well as areas surrounding large employers like the Naval Air Station Patuxent River in St. Mary's County.

Figure 27. Job Proximity Index (2021)

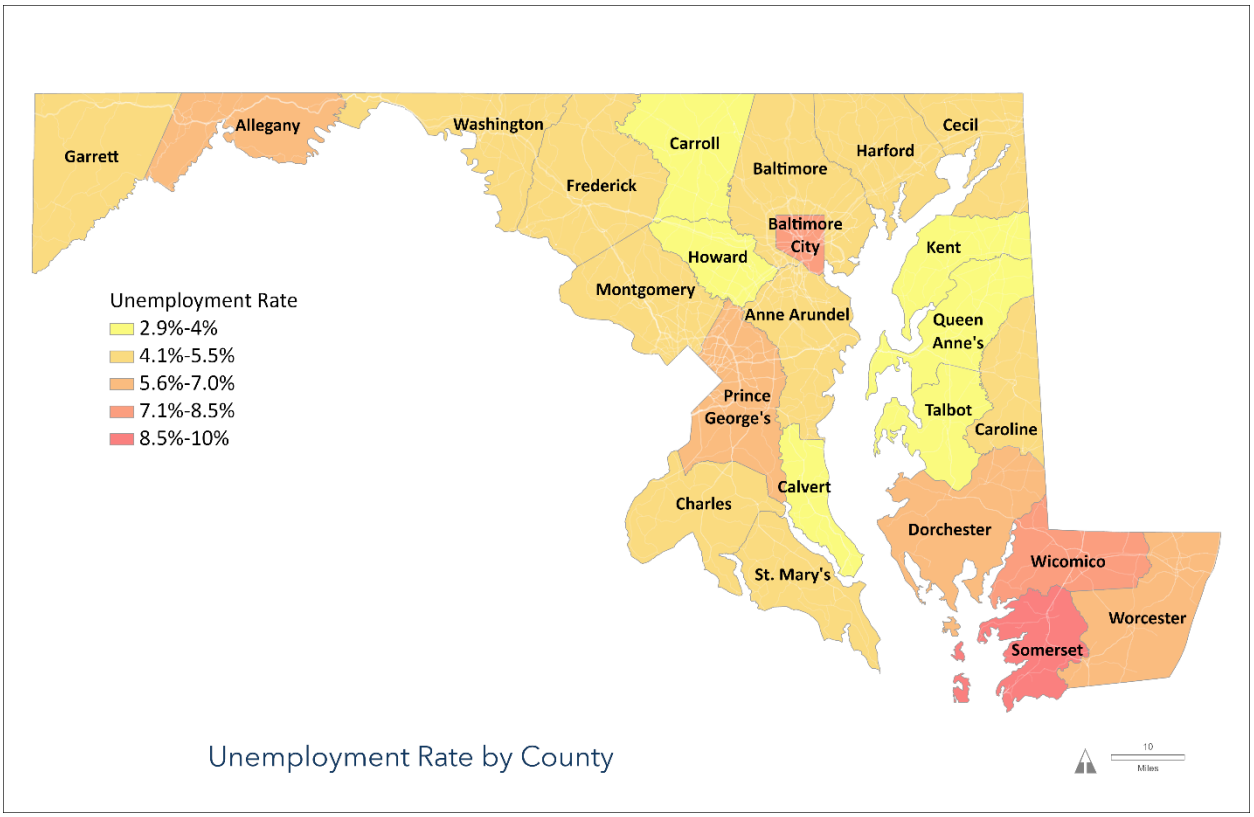


Source: HUD Job Proximity Index

The unemployment rate in Maryland in Maryland in October 2022 according to the Bureau of Labor Statistics (BLS) was 4.1 percent, down from 5.2 percent in 2021 and moving close to the pre-pandemic unemployment rate of 3.4 percent in October 2019. Maryland's unemployment

rate is slightly higher than the national unemployment rate of 3.7 percent in October 2022. Figure 28 illustrates the unemployment rates by county based on 2021 American Community Survey 5-year estimates. Unemployment rates are highest in Somerset County. Other parts of the Eastern Shore experienced low unemployment rates in the same time period. Providing economic opportunities for these areas of low unemployment and access to jobs is an important transportation consideration.

Figure 28. Unemployment Rate



Source: U.S. Census Bureau, ACS 5 Year Estimates (2021)

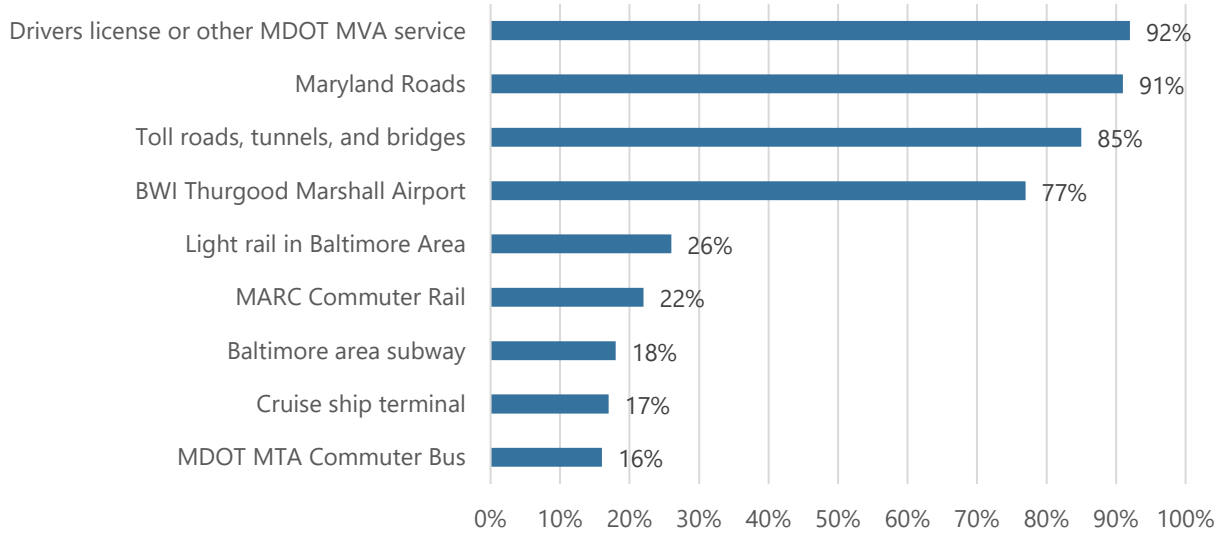
Maryland's transportation infrastructure also helps facilitate freight movement, which is essential to the State's economy. Maryland lies within the Washington, D.C.-Virginia megaregion, which covers most of Maryland; all of Delaware and Washington, D.C.; and much of northern and eastern Virginia. The I-95 corridor in Maryland – stretching from Wilmington, Delaware to Washington, D.C. – plays a key part in facilitating regional freight flows throughout this megaregion. Other high value freight flows can be found on the Eastern Shore from Wilmington to Salisbury and from Washington, D.C. to the Eastern Shore and western Maryland.

Travel Characteristics

Maryland's transportation system is interconnected, complex, and critical to the State's success. Residents and employers have made decisions about where to live and locate their businesses based on their transportation needs and how well the system meets their needs. Future decisions made by residents, businesses, and policy makers related to land use, commute choice, job and residential locations, and other factors will influence the system's effectiveness moving forward.

Analyzing data about travel characteristics will help inform the MTP and guide MDOT in prioritizing services and system investments. Figure 29 shows the travel choices of Maryland residents. Most respondents utilize services related to driving (e.g., driver's license, MDOT MVA services, roads, toll roads, tunnels, and bridges). Over three quarters of respondents used services at BWI Thurgood Marshall Airport. Just over a quarter of respondents used light rail services in the Baltimore area. Less than a quarter of respondents used MARC commuter rail, Baltimore area subway, cruise ship terminal, or MDOT MTA commuter bus services.

Figure 29. Percent of respondents who used Maryland's Transportation Services (2021)



Source: 2021 Customer Satisfaction Survey Report Maryland Department of Transportation

Commute Time

Based on U.S. Census data, Maryland has some of the longest commute times in the nation.

Table 5 shows the top ten states in terms of commute time, with Maryland second only to New York. Table 6 lists the top ten Maryland counties with the longest commute times.

Table 5. Top 10 States with the Longest Commute Times

Rank	State	Average Commute Time (Minutes)
1	New York	31.4
2	**Maryland**	**29.3**
3	New Jersey	28.6
4	D.C.	28.3
5	California	27.6
6	Massachusetts	27.5
7	Florida	27.1
8	Georgia	27.1
9	Illinois	26.8
10	Virginia	26.4

Source: U.S. Census American Community Survey (2021)

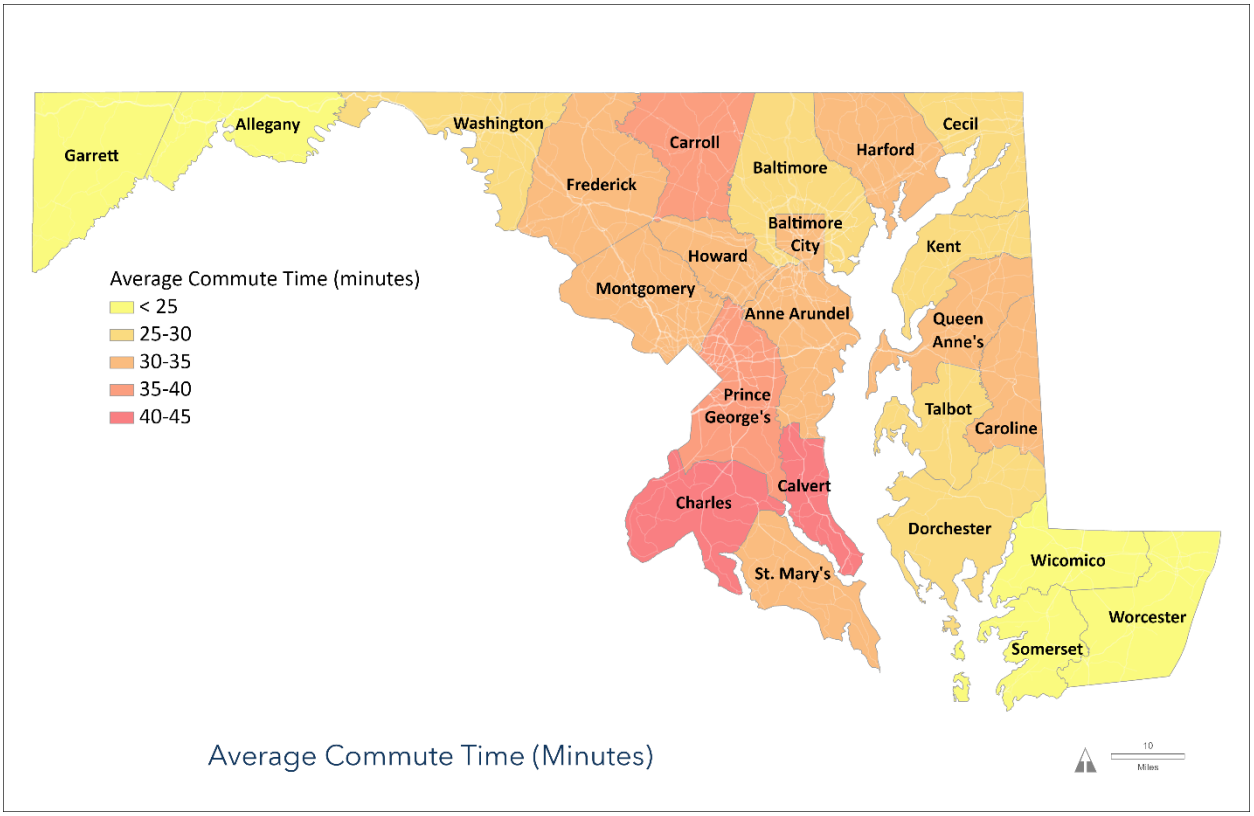
Table 6. Top 10 Maryland Counties with the Longest Commute Time

Rank	County	Average Commute Time (Minutes)
1	Charles County	45.4
2	Calvert County	42.2
3	Prince George's County	37.0
4	Carroll County	36.1
5	Queen Anne's County	36.0
6	Frederick County	35.4
7	Montgomery County	34.4
8	Caroline County	32.7
9	Harford County	32.7
10	St. Mary's County	31.7

Source: U.S. Census, American Community Survey, 2021 1-Year Estimate

Figure 30 shows that the longest commutes are concentrated in the center of the State; conversely, counties in Western Maryland and on the Eastern Shore have lower than average commute times, possibly due to lower levels of congestion and residents having the ability to live closer to their jobs.

Figure 30. Average Commuting Times by County



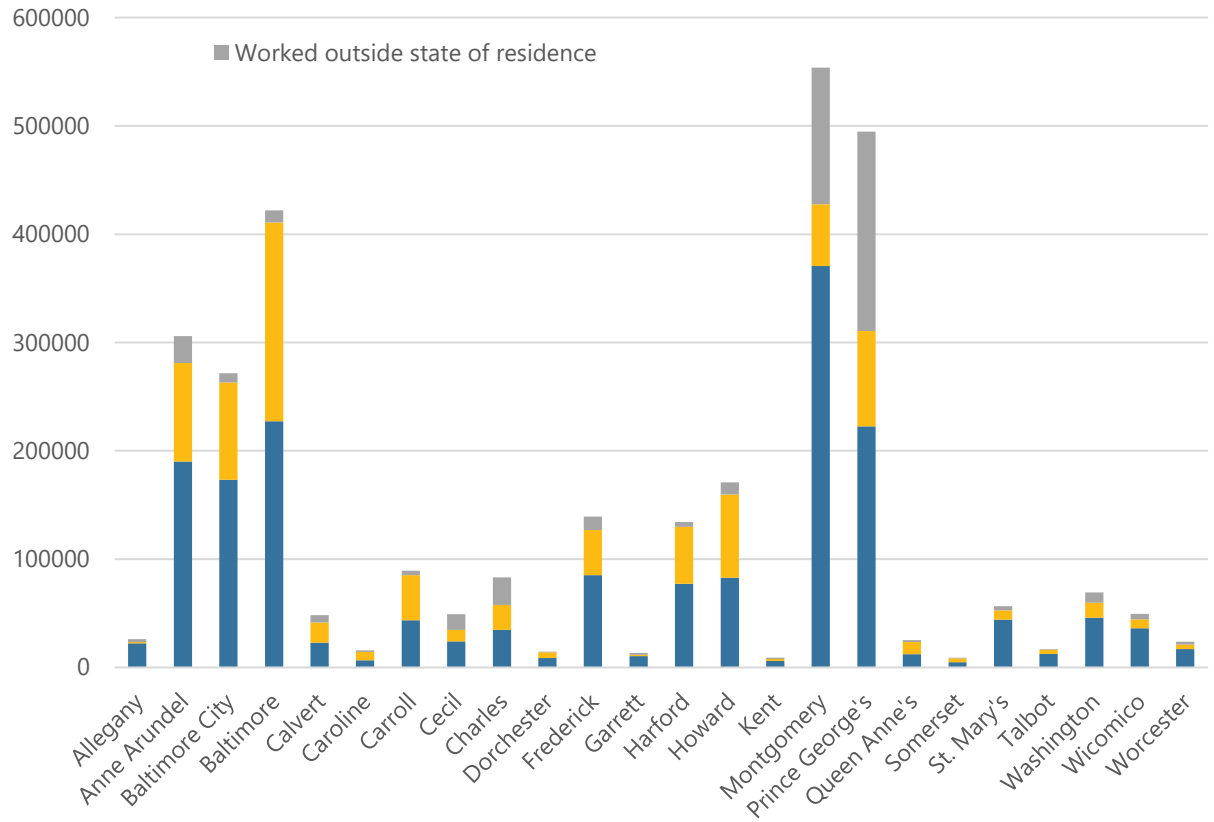
Source: U.S. Census, American Community Survey, 2021 5-Year Estimates

Commute Destinations

Figure 32. Employment by County

shows that for most Maryland counties, commuters tend to have work destinations within the state, and many are even within the same county as their residence. Montgomery County and Prince George's County are exceptions, with many commuters working in Washington D.C. or Northern Virginia.

Figure 31. Commute Destinations by County

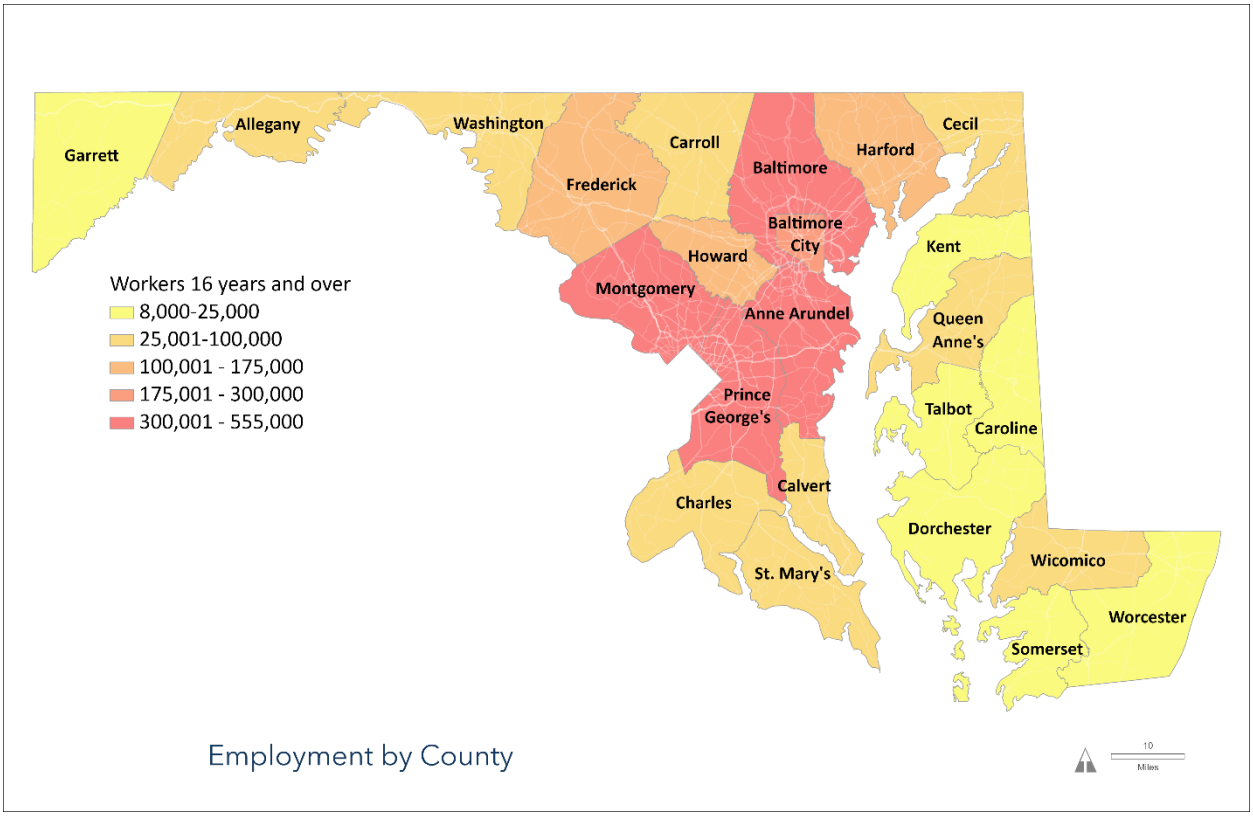


Source: U.S. Census Bureau, ACS 5-Year Estimates (2021)

Figure 32. Employment by County

shows the number of workers per county. Counties surrounding the Washington Metropolitan Region (Montgomery and Prince George's) and Baltimore Metropolitan Region (Baltimore and Anne Arundel) have the highest number of workers. Counties with the lowest number of workers are along the Eastern and Western state borders.

Figure 32. Employment by County

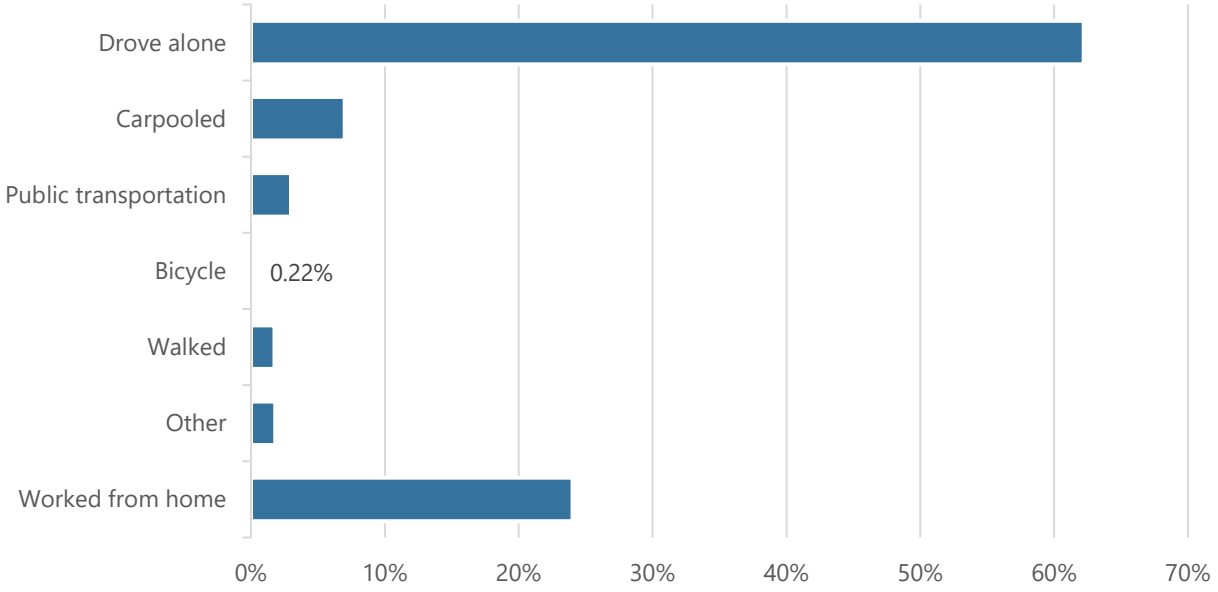


Source: U.S. Census, American Community Survey, 2021 5-Year Estimates

Commute Mode Split

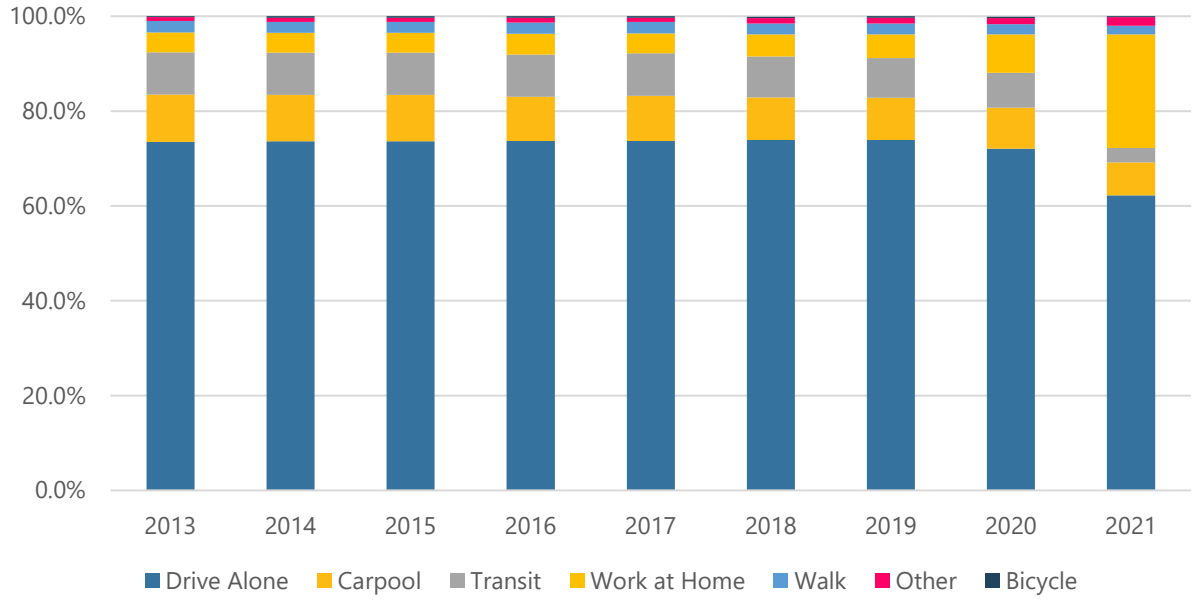
Figure 33 shows the mode split for Maryland commuters. Most people use a private car to travel to work, though since the COVID-19 pandemic nearly a quarter work from home. Prior to the COVID-19 pandemic, 89 percent of workers who worked outside of the home traveled to work in a private vehicle (Figure 33). Figure 34 shows Maryland's commute mode split over time.

Figure 33. Maryland Commute Mode Split (2021)



Source: U.S. Census, American Community Survey, 2021 1-Year Estimate

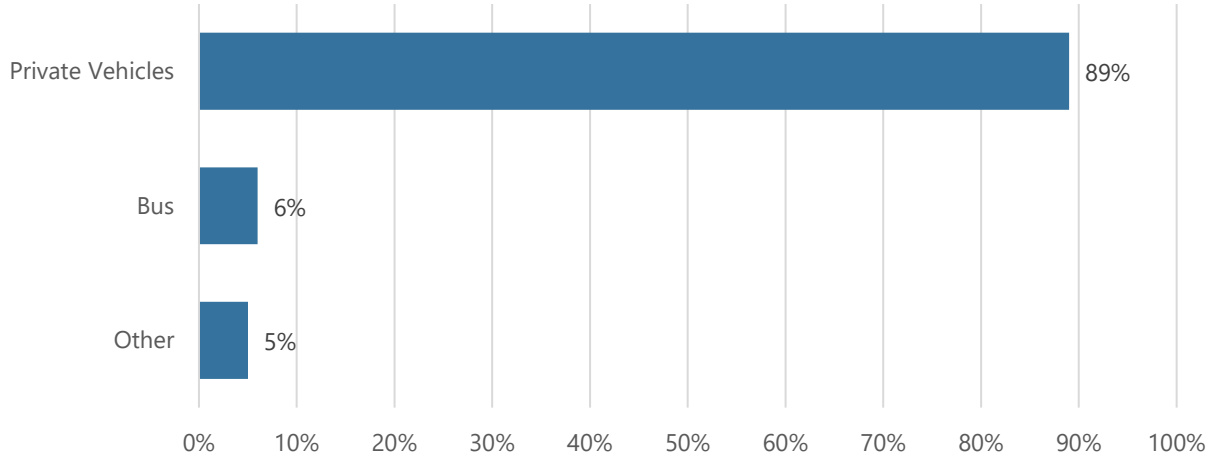
Figure 34. Maryland Commute Mode Split (2013 – 2021)



Source: MDOT 2023 Attainment Report

Only six percent of workers used a bus, and travel mode for the remainder of workers was split evenly between rideshare services, light rail, MARC train, bicycling and walking, and other commute modes (Figure 34).

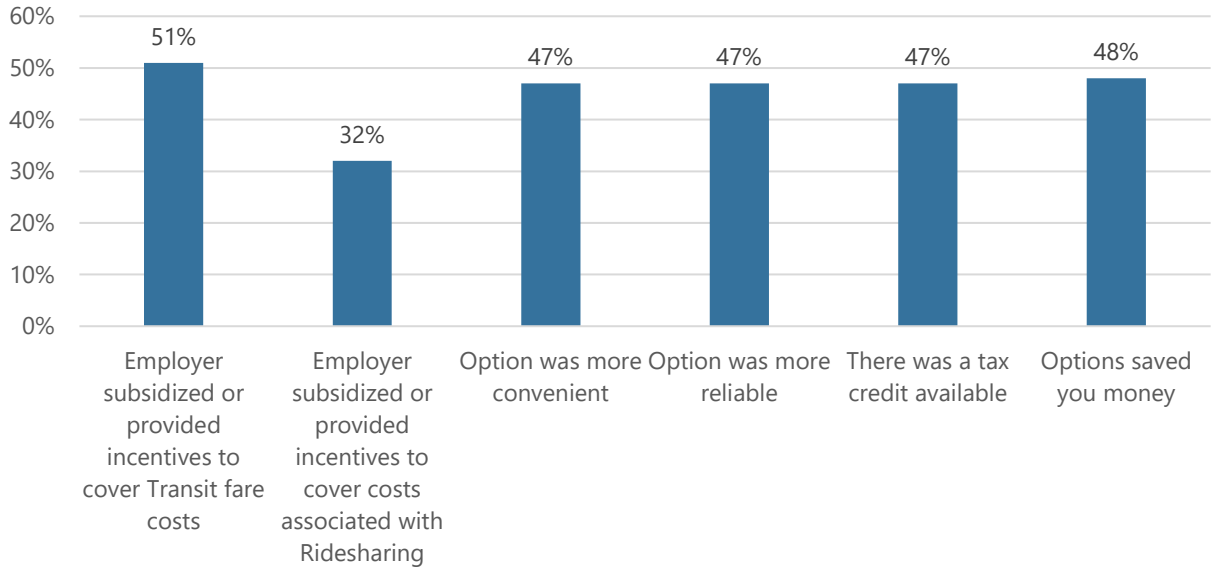
Figure 35. Commute Mode for Workers Who Worked Outside of the Home Prior to COVID-19 (2021)



Source: 2021 Customer Satisfaction Survey Report Maryland Department of Transportation

About half of those individuals who drive to work would consider alternative commute modes (Figure 36). The most common reason given for switching modes is if employers subsidized or provided incentives to cover transit fare costs. Current drivers were least likely to consider an alternative commute mode if their employer subsidized or provided incentives to cover the costs associated with ridesharing. A little under half of individuals who drive to work would consider an alternative if there was an option that was more convenient, reliable, or cost effective.

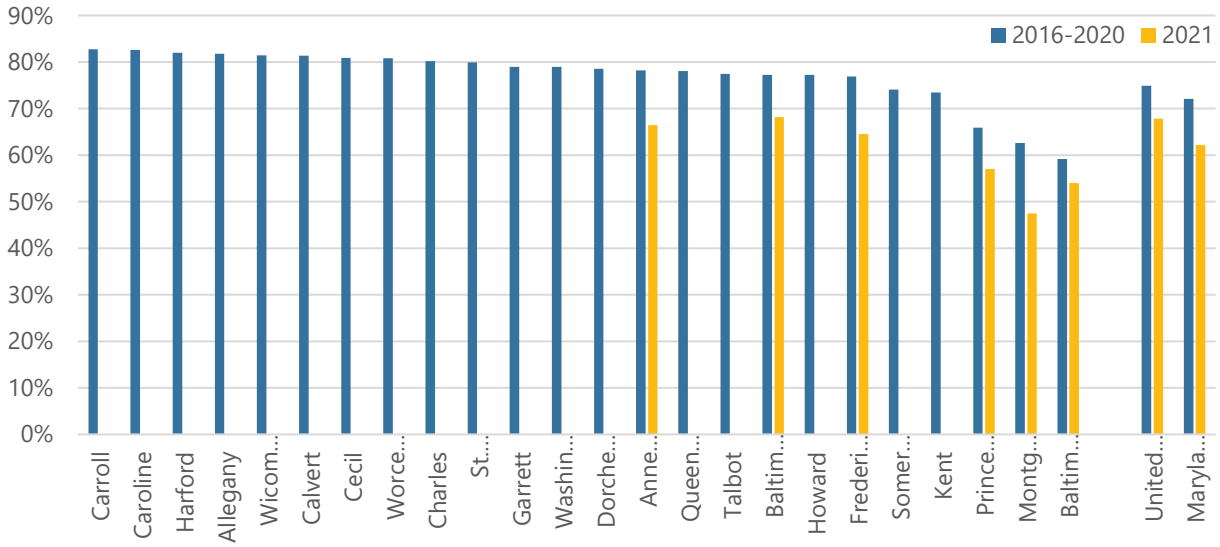
Figure 36. Percent of Individuals who Drive to Work who Would Consider Alternatives to Vehicles (2021)



Source: 2021 Customer Satisfaction Survey Report Maryland Department of Transportation

Figure 37 shows the percentage of workers driving alone by county in 2016-2020, along with preliminary data for six counties in 2021. Unsurprisingly, counties that have below-average drive-alone commute rates have more transit resources, as is the case in Baltimore City, Montgomery County, and Prince George's County. Even though these counties have below-average drive-alone commute rates, driving alone remains the dominant mode choice for those who do not work from home in all regions.

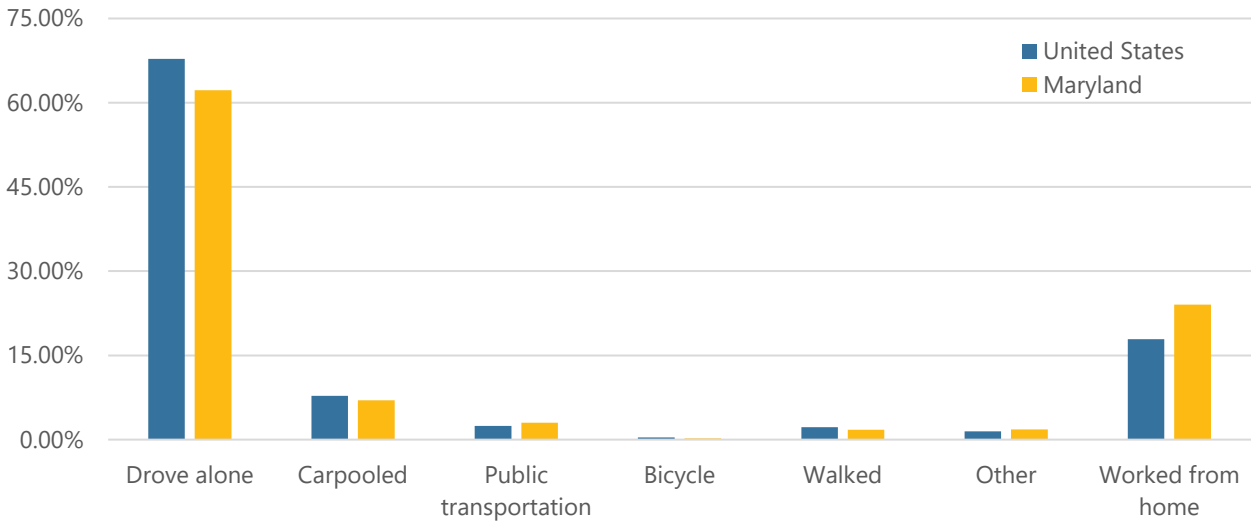
Figure 37. Percentage of Workers Who Drive Alone by County (2016-2020 and 2021)



Source: U.S. Census, American Community Survey, 2020 5-Year Estimate and 2021 1-year estimate

Figure 38 shows that Maryland has fewer people driving alone and more people taking transit and working from home compared to the U.S. However, Maryland has fewer commuters using active transportation (walking and biking) compared to the national average.

Figure 38. Comparison of Mode Split Between Maryland and United States (2021)



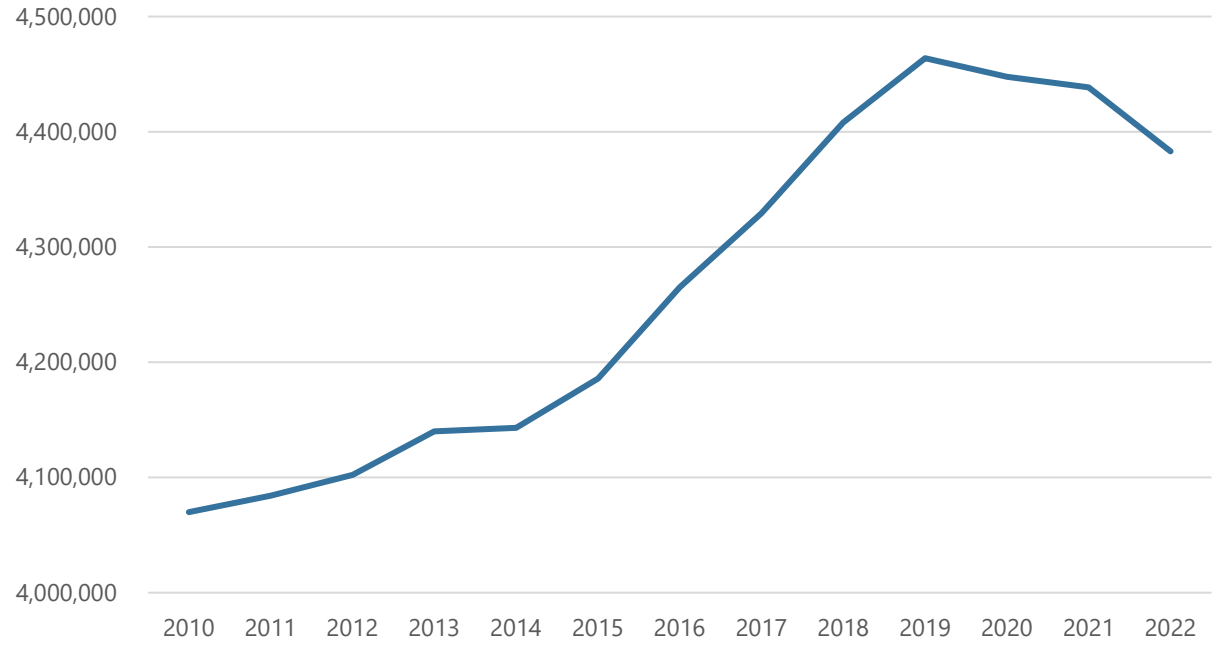
Source: U.S. Census, American Community Survey, 2021 1-Year Estimate

Maryland has embraced remote work more quickly than the nation as a whole. In 2019, 2.5 percent of Marylanders worked from home, less than the national average of 2.8 percent. However, in 2021, Maryland ranked behind only the District of Columbia and Washington State in the percentage of its workforce who worked from home, at 24.0 percent, well above the national average of 17.8 percent. This may be due to the high percentage of Maryland residents who are employed in finance, real estate, insurance, or professional services (34.7%) (Figure 26).

Licensed Drivers

In the last decade, Maryland has had between 4 to 4.5 million licensed drivers. The number of licensed drivers in Maryland rose between 2010 and 2019 and decreased between 2019 and 2022 (Figure 39).

Figure 39. Licensed Drivers (2010-2022)

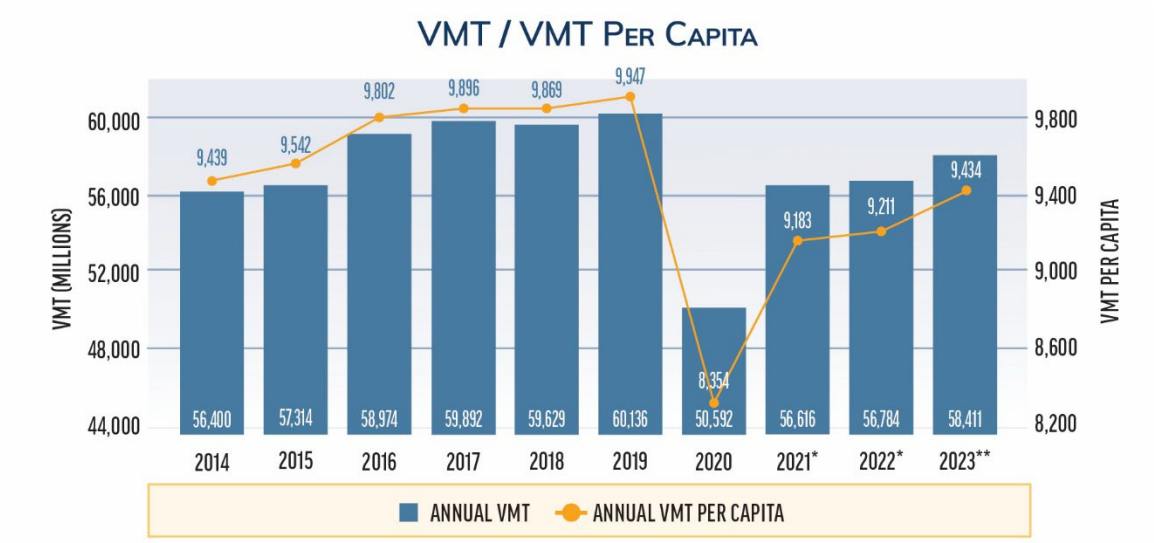


Source: OpenData.Maryland.gov - MVA Drivers Licenses

Vehicle Miles Traveled (VMT)

Between 2015 and 2017, annual VMT and VMT per capita rose. In 2018, annual VMT and VMT per capita flattened out, before falling dramatically due to COVID-19 lockdown restrictions and the rise of telework in 2020. Annual VMT and VMT per capita increased in 2021 but has not yet reached pre-COVID levels. Figure 40 shows annual VMT and VMT per capita over time.

Figure 40. Annual VMT and VMT per Capita (2014-2023)



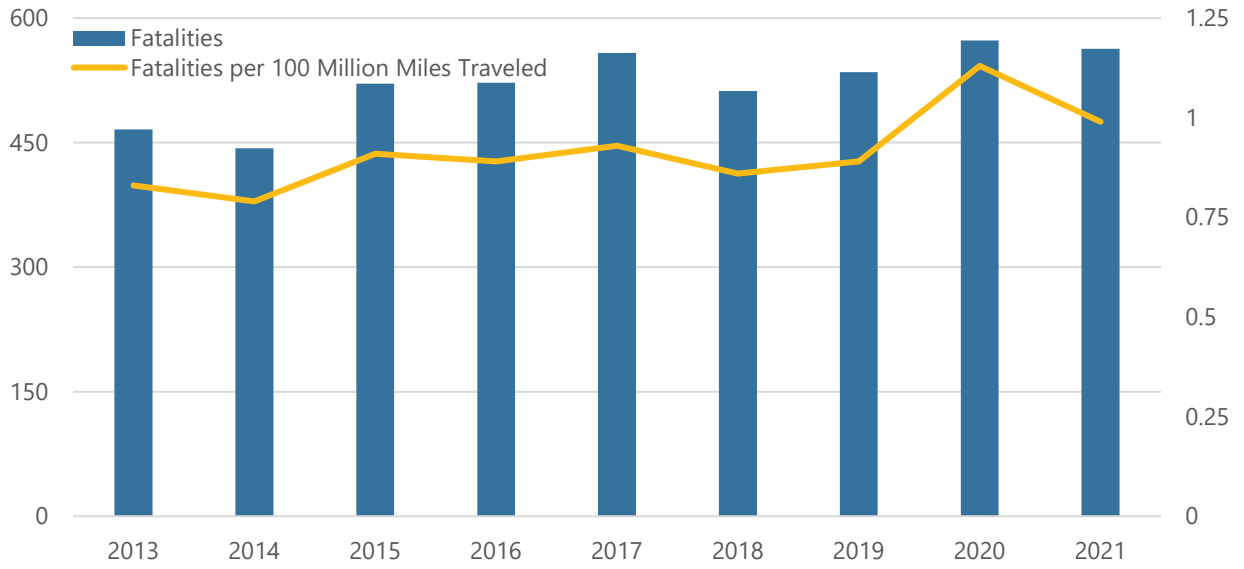
The VMT and VMT PER CAPITA were steadily rising but have declined due to COVID-19.

** 2021 and 2022 data have been revised from previous report.*
***2023 data are preliminary and subject to change.*
*OpenData.Maryland.gov - **MVA Drivers Licenses***
2024 Annual Attainment Report on Transportation System Performance

Safety

Maryland's roads became safer from 2000 to 2011. In the past decade the traffic fatality rate has fluctuated between 0.79 and 0.93 (Figure 41).

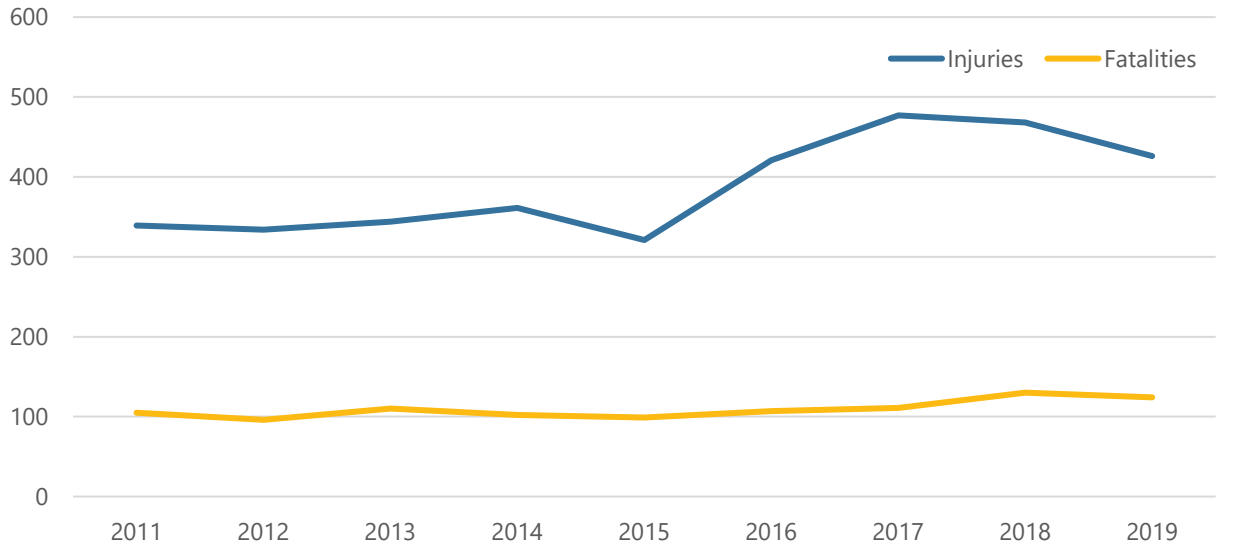
Figure 41. Traffic Fatality Rate (2011-2019)



Source: Maryland Department of Transportation, 2022 Annual Attainment Report on Transportation System Performance

Figure 42 shows a rise in pedestrian injuries from 2016 to 2017, followed by a decrease from 2017 to 2019. Pedestrian fatalities have remained fairly consistent since 2011. The MDOT Attainment Report Dashboard and the Strategic Highway Safety Plan show the traffic and transit fatalities over time.

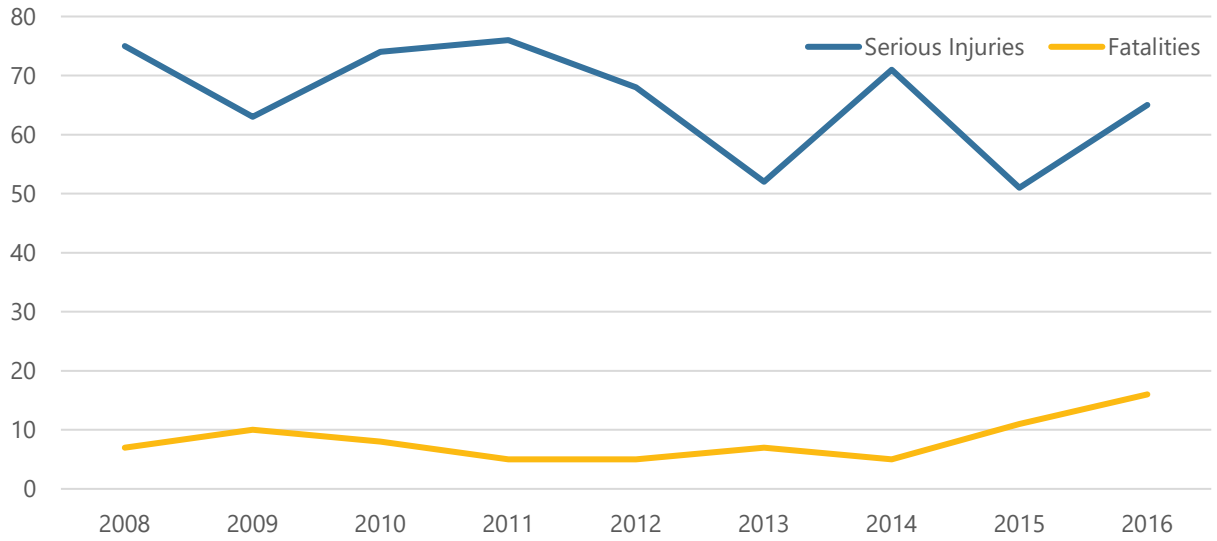
Figure 42. Pedestrian Fatalities and Injuries (2011-2019)



Source: Maryland Department of Transportation, 2021 Annual Attainment Report on Transportation System Performance

The number of serious injuries in crashes involving bicycles was steady between 2008 and 2015 but began to rise in 2016, while serious injuries fluctuated over the same time period. Figure 43 shows bicycle serious injuries and fatalities caused by crashes involving bicycles over time.

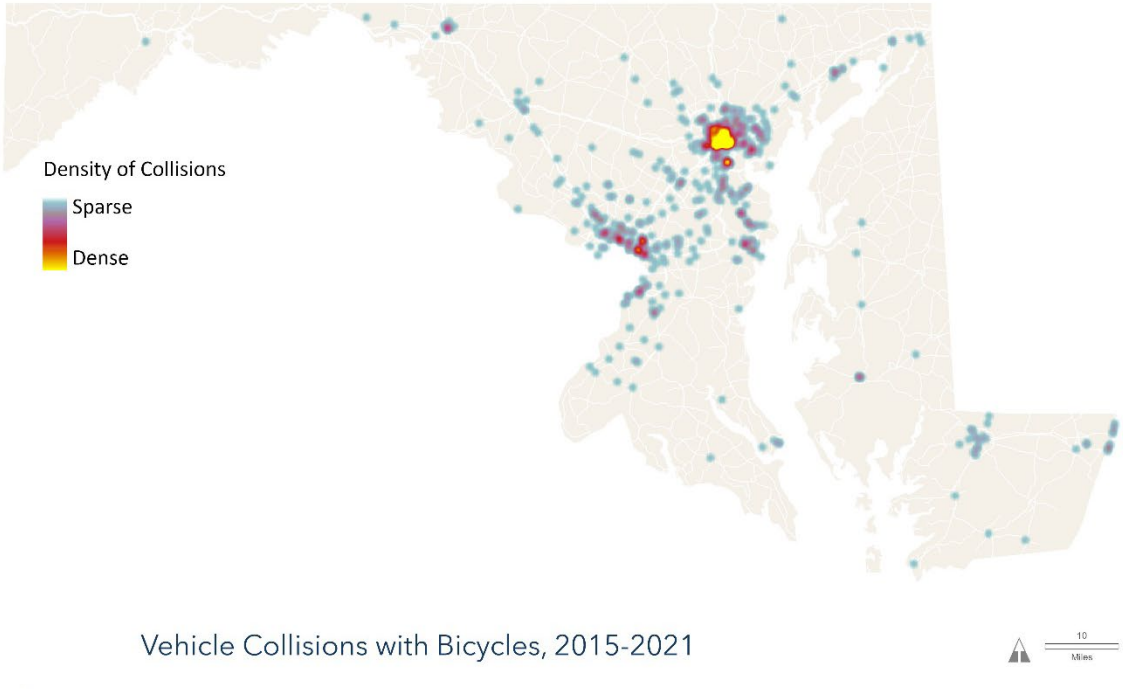
Figure 43. Bicycle Serious Injuries and Fatalities (2008-2016)



Source: Bicycle and Pedestrian Master Plan

MDOT established the Bicycle Level of Traffic Stress (LTS) metric to measure the perceived safety and comfort of bicyclists on roadways based on traffic volume, speed limit, number of lanes, pavement widths, and the presence of medians and street parking. MDOT has developed an interactive LTS web map that ranks roadways on a scale of one to five, with one indicating the lowest level of traffic stress and five indicating the highest level of traffic stress. Figure 44 shows that bicycle crash hotspots occur in Baltimore and around Washington, D.C.

Figure 44. Bicycle Crash Hotspots (2015-2022)

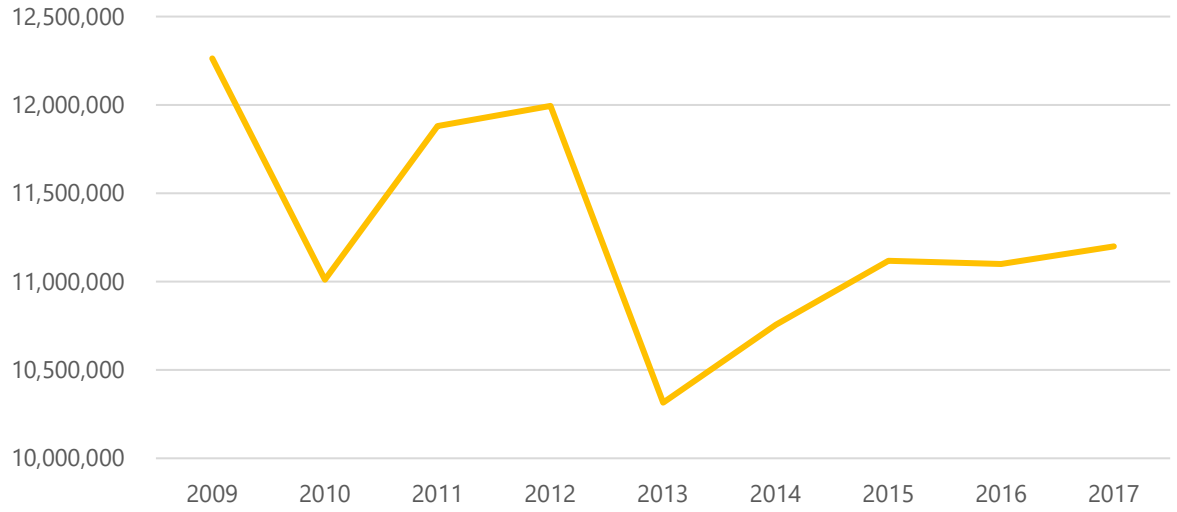


Source: MSDC – Auto Crashes with Bicycles

MDOT MVA Transactions

MDOT MVA transactions include licensing, registration, and titling. Figure 45 shows MDOT MVA transactions over time. MVA transactions fluctuated between 2009 and 2012. MVA transactions were at an all-time low in 2013 but have been rising steadily since.

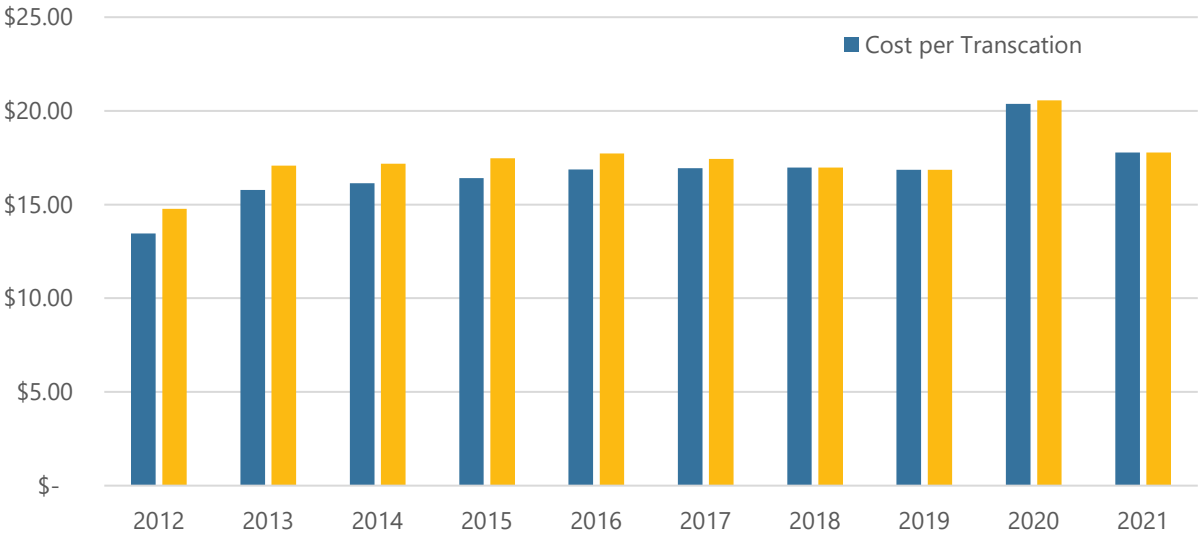
Figure 45. MDOT MVA Transactions (2009-2017)



Source: 2017 Attainment Report on Transportation System Performance

Figure 46 shows the MDOT MVA cost per transaction (e.g., licensing, registration, titling) over time. This metric is an indicator of cost effectiveness. The average cost per MVA transaction rose from $14.77 in 2012 (adjusted for inflation) to $17.77 in 2021. This is a decrease from the 2020 average cost per transaction ($20.56), which was likely high because a fewer number of transactions occurred in the early lockdown phase of the COVID-19 pandemic.

Figure 46. MDOT MVA Cost per Transaction (2012-2021)



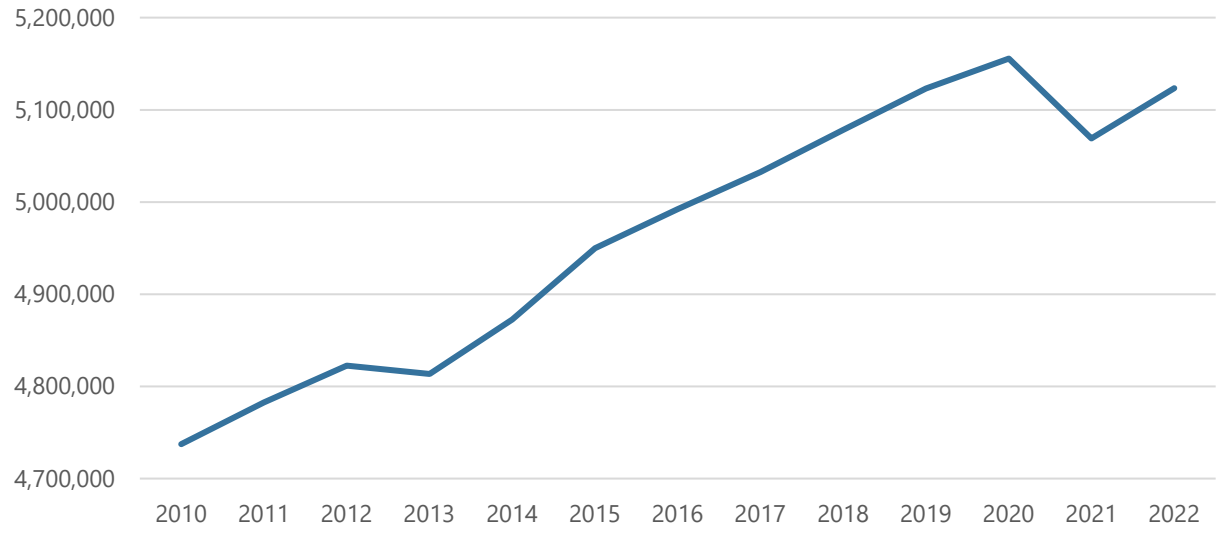
Source: MDOT MVA Cost Per Transaction Dashboard

Registered Vehicles

Vehicles

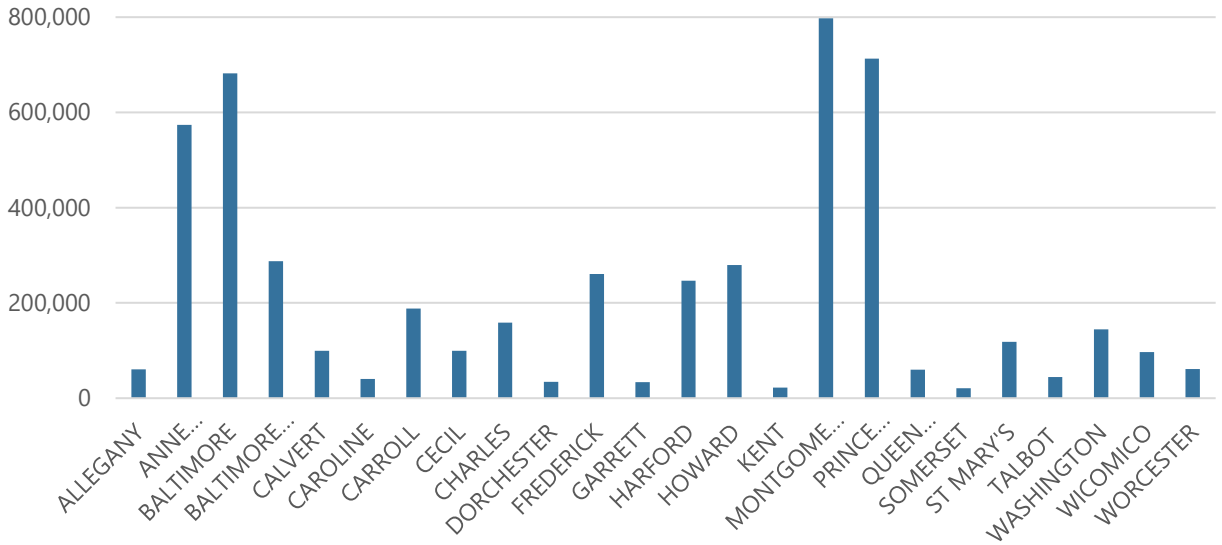
Figure 47 shows the total number of registered vehicles across time in Maryland. The number of registered vehicles had been steadily rising since 2010, with the exception of 2013, until 2021. At the county level, vehicle registration numbers have not fluctuated much over the last decade. Figure 48 breaks this trend down to the county level, and shows the vehicles registered in each county in 2022. Montgomery County, Prince George's County, and Baltimore County have the highest numbers of registered vehicles.

Figure 47. Vehicles Registered in Maryland (2010-2022)



Source: MDOT MVA Vehicle Registration by County

Figure 48. Vehicles Registered by County (2022)

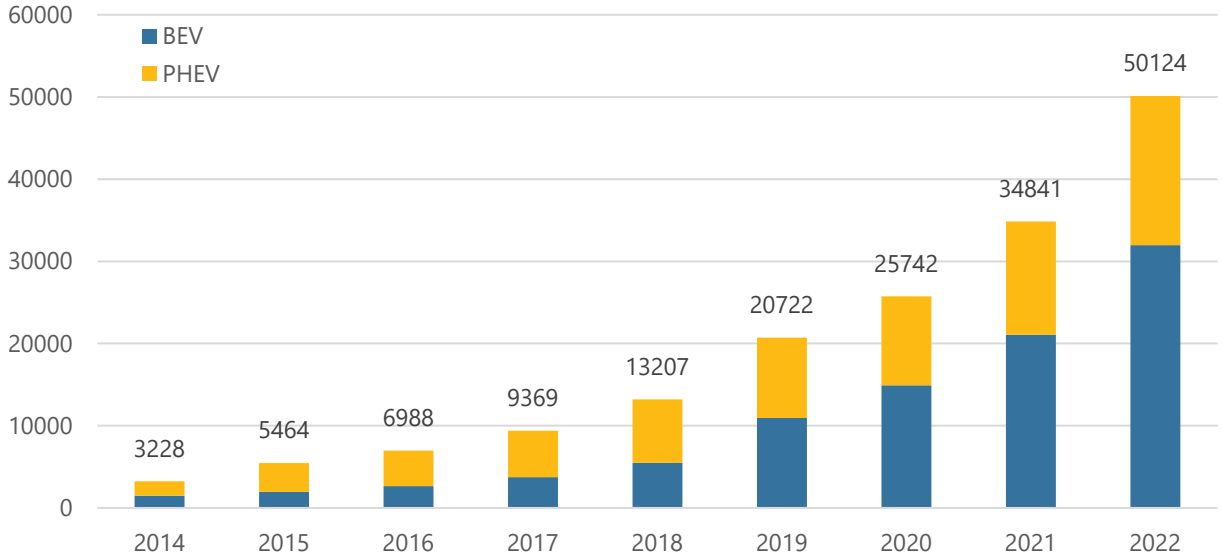


Source: MDOT MVA Vehicle Registration by County

Electric Vehicle Registration

Over the past eight years, there has been exponential growth in the number of registered electric vehicles in Maryland, as Figure 49 shows. There is now approximately one registered electric vehicle for every 122 people in Maryland. While initially there were more Plug-in Hybrid Electric Vehicles (PHEV) registered in Maryland, since 2019 there have been more Battery Electric Vehicles (BEV). PHEVs have an electric motor and internal combustion engine and can substitute electricity for gasoline. BEVs run exclusively on electricity and are charged by plugging the vehicle into an outlet or charging station.

Figure 49. Number of BEV and PHEV Registered in Maryland (2014-2022)



Source: Maryland Department of Transportation, Maryland State Plan for National Electric Vehicle Infrastructure (NEVI) Formula Funding Deployment, 2022

Total Freight Volume

Maryland's goods movement transportation network comprises 31,343 public road lane miles, 1,152 rail miles, 530 inland waterway miles, and 52,568 feet of air cargo runways. Together, these modes moved nearly 281 million tons of freight into, within, and out of the state, worth nearly $376 billion, in 2020, not counting freight passing through the state. Domestic freight represents 87 percent of the tonnage and 83 percent of the freight value in Maryland, while the remainder is import and export. By 2050, nearly 429 million tons of freight, worth close to $781 billion, is expected to move within Maryland.

In total, more than two thirds of freight tonnage and value is carried by truck in Maryland. Pipeline and rail make up for the majority of the remaining tonnage but carry less value. The multiple modes and mail category includes truck-rail, truck-water, and rail-water combinations, as well as parcel delivery services. This category carries most of the value of goods not carried by trucks because they include high value-per-ton goods, such as electronics. Table 7 shows the percent of shipments – by weight and by value – made via each domestic mode.

Table 7. Percent of Shipments by Domestic Mode (2020)

Mode	Total	Within Maryland	From Maryland	To Maryland
Truck Tonnage	78%	94%	69%	61%
Truck Value	*76%*	*92%*	*76%*	*67%*
Pipeline Tonnage	11%	4%	18%	17%
Pipeline Value	2%	1%	2%	2%
Rail Tonnage	8%	2%	10%	14%
Rail Value	*3%*	*1%*	*4%*	*4%*
Water Tonnage*	1%	--	<1%	3%
Water Value*	*<1%*	--	*<1%*	*<1%*
Air Tonnage**	<1%	--	<1%	<1%
Air Value*	*2%*	--	*2%*	*2%*
Multiple Modes and Mail Tonnage	2%	<1%	3%	5%
Multiple Modes and Mail Value	*17%*	*6%*	*15%*	*24%*

*Domestic water Includes shallow draft, deep draft, Great Lakes, and intra-port shipments, but does not include international waterborne trade through the Port of Baltimore. The domestic (landside) moves of Port of Baltimore trade are accounted for in other modes.

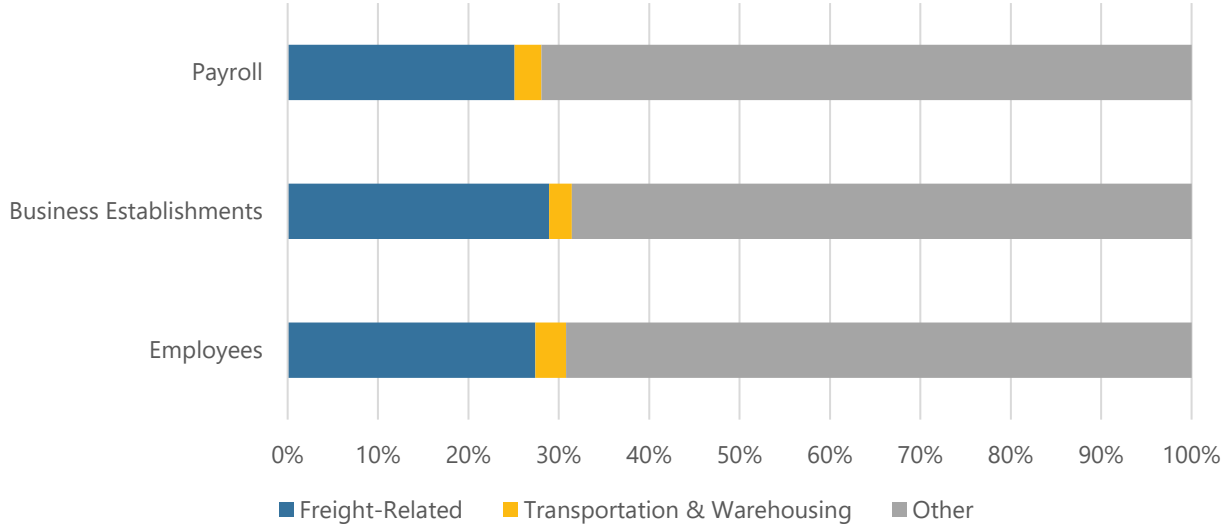
**Domestic air includes air cargo between U.S. and domestic origin-destination pairs. The domestic portions of international air cargo movements are accounted for in the appropriate domestic modes.

Source: Maryland Department of Transportation, State Freight Plan (2022 Draft)

Goods movement is essential to the economy. The health of an economy is directly connected to the performance of its transportation system and ability to transport goods. The need for the supply chain to have the capacity to provide reliable and cost-effective transportation is an integral component of this relationship. Simply put, the freight transportation network keeps commerce flowing.

Figure 50 shows the economic impact of freight-dependent industries in Maryland, including 31 percent out of the 2.38 million employees, 31 percent of 139 thousand business establishments, and 29 percent of $136.8 billion in payroll. In addition to transportation and warehousing, the North American Industry Classification System (NAICS) defines the following industries as freight-related: agriculture, forestry, fishing, and hunting; mining, quarrying, and oil and gas extraction; construction; manufacturing; wholesale trade; and retail trade.

Figure 50. Role of Freight Transportation and Warehousing and Freight-Dependent Industries on Maryland's Economy (2019)

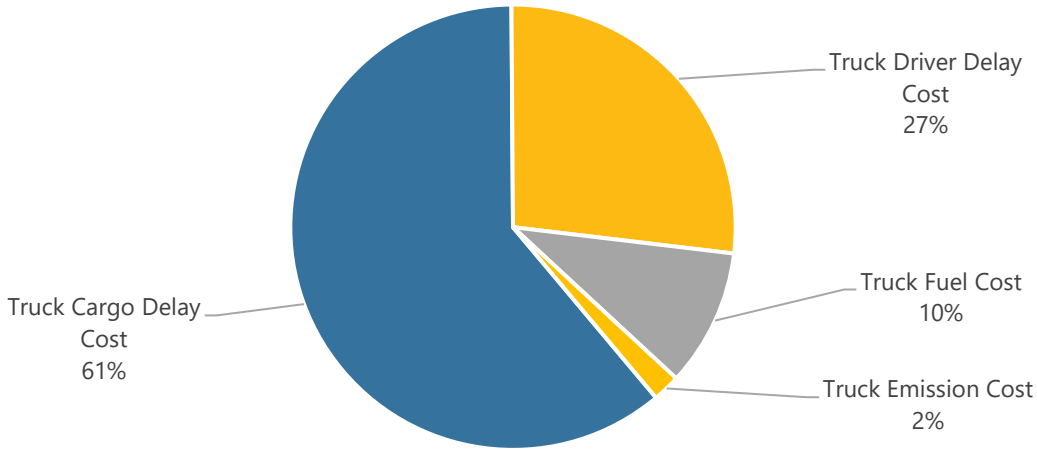


Source: Maryland Department of Transportation, State Freight Plan, August 2022 Draft

Roadways

Figure 51 shows the costs of congestion on the freeway/expressway system experienced by truckers. These include driver delay costs, cargo delay costs, diesel costs, and increased emissions, amounting to an estimated $251 million in 2019, and have been increasing since 2015. These costs are immediately borne by freight operators but are passed on to consumers as higher prices for goods.

Figure 51. Freight Congestion Cost on Maryland's Freeways and Expressways (2019)

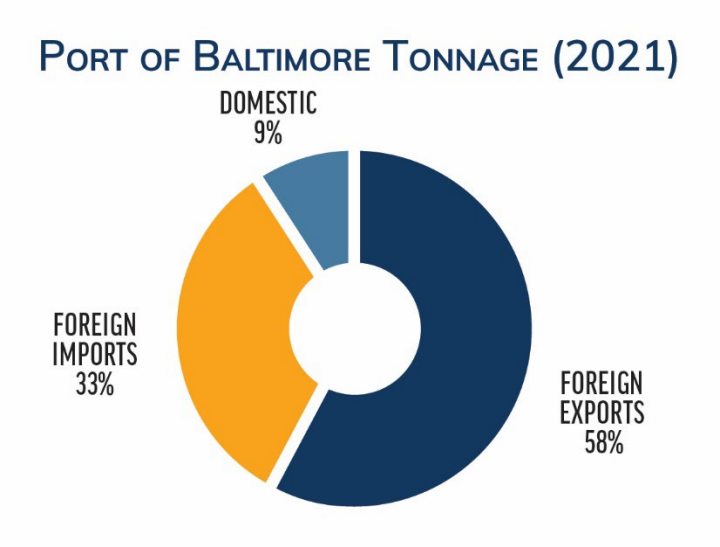


Source: Maryland Department of Transportation, State Freight Plan, August 2022 Draft

Ports

According to USATrade Online, Maryland's Port of Baltimore handled more than 43.3 million tons of freight (excluding domestic freight) in CY 2021, the majority of which was foreign exports, as shown in Figure 52.

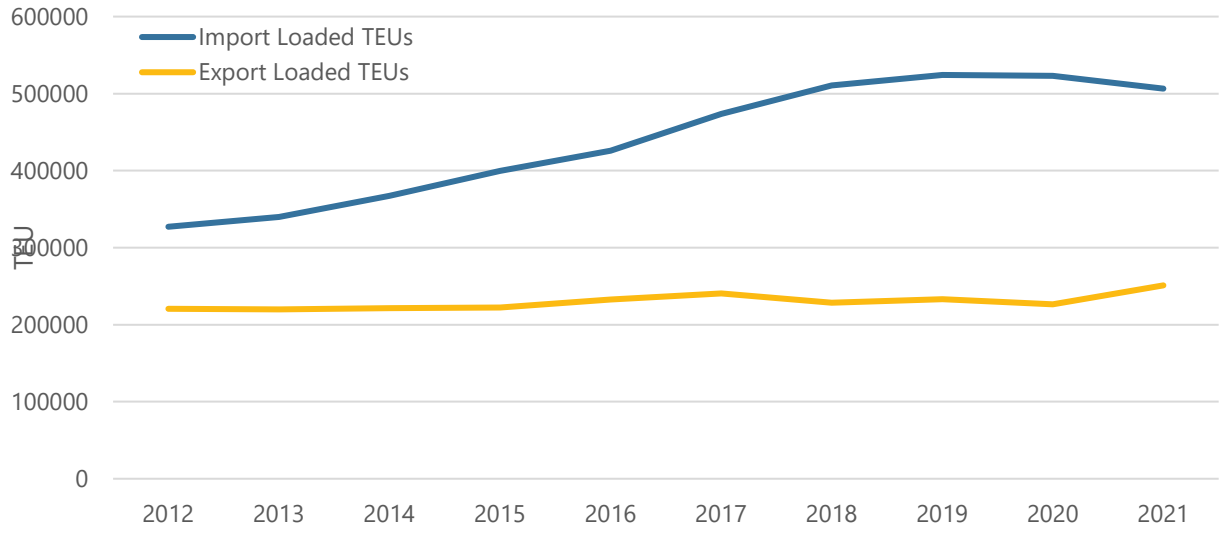
Figure 52. Port of Baltimore Tonnage Estimates (2021)



Source: Maryland Department of Transportation, State Freight Plan, 2022

While the total volume of cargo has grown since 2012, most of that growth has come from increased exports, as shown in Figure 53.

Figure 53. Port of Baltimore Import/ Export Loaded Twenty-Foot Equivalent Units (TEU)

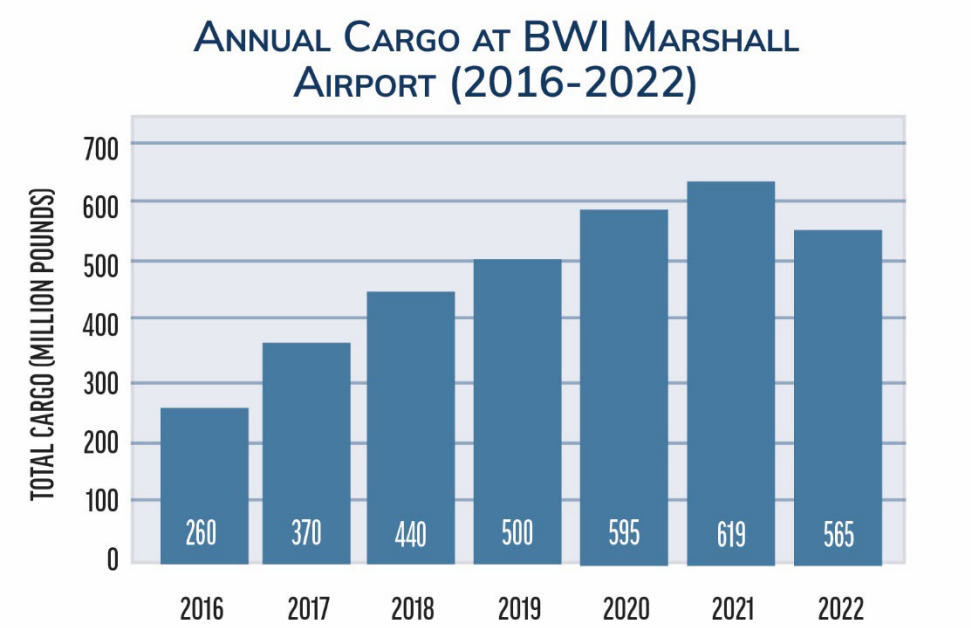


Source: Maryland Port Administration, General Cargo, Open Data Portal

Air Cargo

There are 35 public-use airports in Maryland, but only three are capable of cargo shipments: BWI Marshall Airport, Hagerstown (HGR), and Salisbury (SBY). BWI is the largest cargo airport in the Capital Region, which includes airports in the Washington, D.C. and Baltimore Metropolitan Areas, accounting for 55 percent of air cargo in the region. Figure 54 shows that cargo at BWI Marshall Airport has grown consistently since 2016, reaching a record 619 million pounds in 2021 before declining in 2022.

Figure 54. Annual Cargo (Freight and Mail) at BWI Marshall Airport, 2016-2022



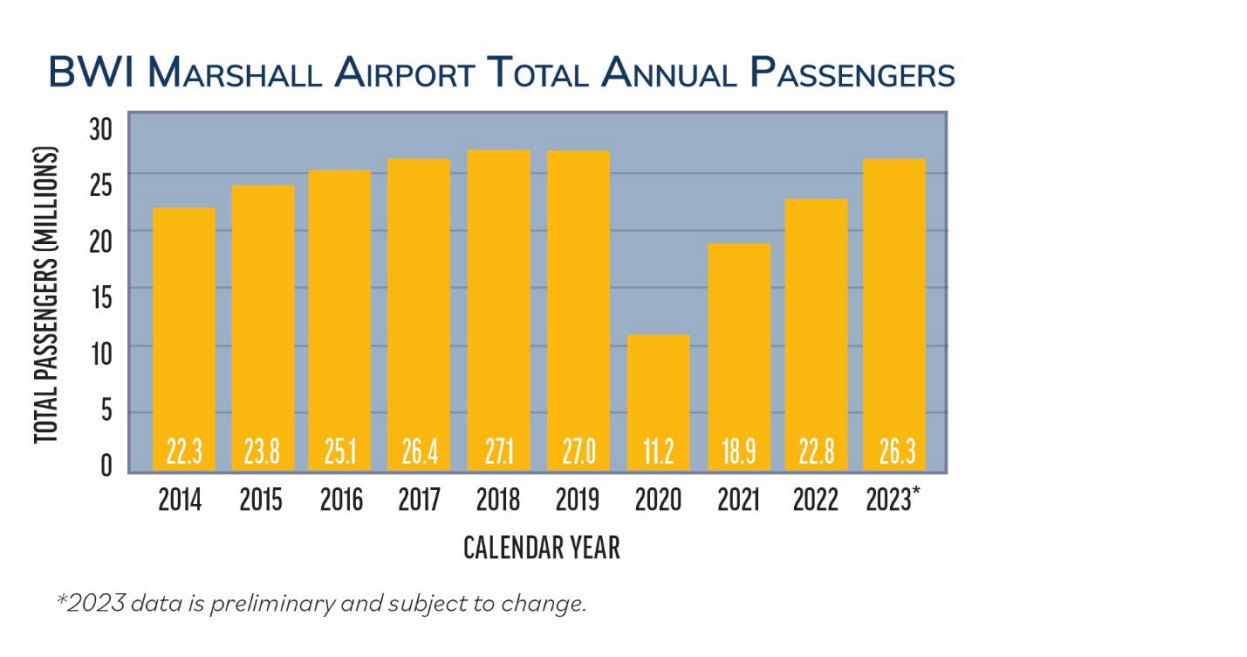
Since 2016, BWI Marshall Airport has experienced an increase in total cargo each year aside from 2022. The growth since 2020 has been fueled by e-commerce industry growth during the COVID-19 pandemic. A 200,000 square foot expansion in 2019 has helped to accommodate the growth.

Maryland Department of Transportation, State Freight Plan, December 2022

Passengers Traveling through BWI

Figure 55 shows the number of passengers at BWI Marshall Airport from 2014 to 2023. While passenger numbers increased steadily from 2014 to 2018, they dropped precipitously in 2020 due to the COIVD-19 pandemic, before recovering to 22.8 million passengers in 2022. Despite this large drop, BWI has maintained a steady position as the 22nd busiest airport in the country.

Figure 55. BWI Thurgood Marshall Passenger Numbers (2014-2023)



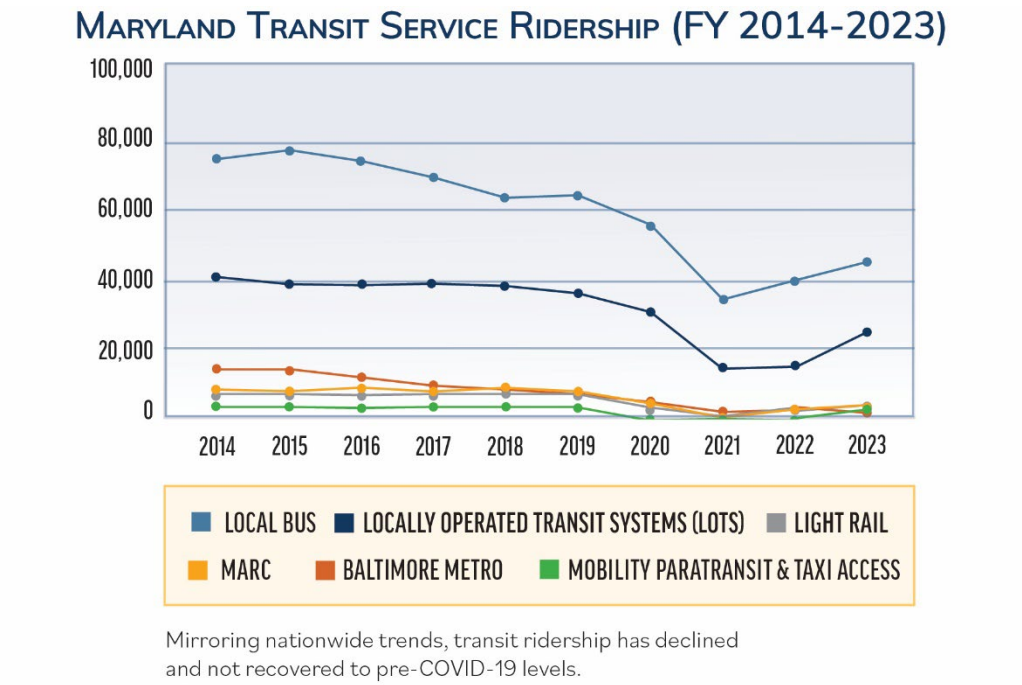
Source: Maryland Department of Transportation, 2024 Annual Attainment Report on Transportation System Performance

MDOT MAA also owns Martin State Airport (MTN), a joint civil-military public use airport in Baltimore County without commercial passenger flights. Among Maryland airports not owned by MAA, only Hagerstown (HGR), Salisbury (SBY), and College Park (CGS) have regularly scheduled service.

Transit Ridership

Marylanders have a variety of transit services available to them. As Figure 56 shows, transit ridership was declining before the COVID-19 pandemic but dropped more dramatically in FY2020 and FY2021.

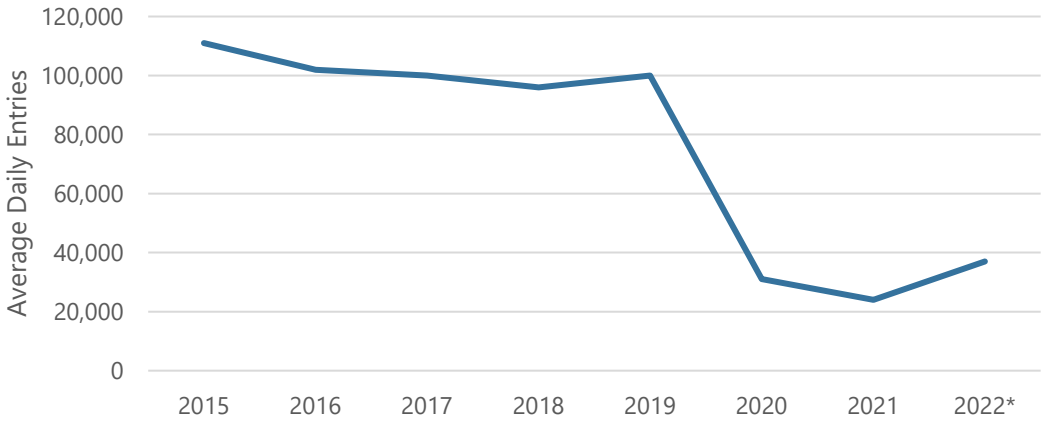
Figure 56. Maryland Transit Service Ridership (FY2014-2023)



Source: MDOT 2024 Attainment Report

WMATA boardings at stations in Maryland also decreased from 2015 to 2019, though they increased in 2019, as shown in Figure 57. WMATA experienced a sharp decline in 2020 and 2021 due to the COVID-19 pandemic, but initial data through October 2022 shows some recovery in average daily entries over 2020 levels.

Figure 57. WMATA Average Daily Boardings for Maryland Stations (2015-2022)



*Source: Washington Metropolitan Area Transit Authority, Rail Ridership Data Viewer (*2022 data through October only)*

Environment

Maryland's climate is described in the Zero Electric Vehicle (ZEV) Plan as follows:

> *"Since the beginning of the 20th century, Maryland has experienced an increase of 1.5˚F in the annual average temperature and the average of less than one day per year of nights below 0˚F in the winter since the mid-1990s. Maryland is expected to have a notable increase in days with extreme heat (over 90˚F) by 2050. Heat waves are likely to increase in frequency, intensity, and duration… Maryland's annual mean precipitation has been above average for the past two decades… Rising temperatures along with the increase in extreme weather events are the result of an increase in GHG emissions, particularly from the transportation sector, which accounts for over one-third of GHG emissions in Maryland. This could negatively impact, both directly and indirectly, Maryland's ecosystems, infrastructure, recreational opportunities, and economy. In addition, the effects of climate change could result in adverse health consequences for people throughout the state as well as negative outcomes for those in disadvantaged communities."*

For the purposes of our analysis, this review defines climate change, resilience, sustainability, and environmental stewardship as follows:

- Climate change is the "long-term shifts in temperatures and weather patterns… since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil, and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures."[xlii]
- Resilience is "the ability to prepare for changing conditions and withstand, respond to, and recover rapidly from disruptions. The ability of transportation agencies' to effectively manage, operate, and maintain a safe, reliable transportation system is being threatened by a changing climate."[xliii]
- Sustainability is "the integration of environmental health, social equity and economic vitality in order to create thriving, healthy, diverse and resilient communities for this generation and generations to come. The practice of sustainability recognizes how these issues are interconnected and requires a systems approach and an acknowledgement of complexity."[xliv]
- Environmental stewardship is the "responsible use and protection of the natural environment through conservation and sustainable practices to enhance ecosystem resilience and human well-being."[xlv]

In 2021, the MDOT Secretary established the Office of Climate Change Resilience and Adaptation (OCCRA), which is responsible for "establishing a cohesive, proactive, and coordinated response to the impacts of climate change across transportation systems, with consideration of state and federal climate change initiatives and opportunities to support the State of Maryland transportation climate-change-related activities and projects." As a member of the Maryland Commission on Climate Change (MCCC), MDOT and other state agencies, elected officials, and experts are responsible for advising leadership "on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change" and for maintaining a comprehensive action plan with five-year benchmarks to achieve reductions in greenhouse gas (GHG) emissions. Additionally, MDOT SHA completed the Climate Resilience Strategy, which identifies opportunities and strategies for integrating vulnerability assessment results and climate risk analyses into existing asset management

systems and processes. Overall, there is a trend towards delivering sustainable transportation infrastructure improvements that protect and reduce impacts to natural, historic, and cultural resources, enhancing the safety and security of the multimodal transportation system, and providing a transportation system that is resilient to natural and man-made disasters.

To address challenges related to resiliency, MDOT can leverage the information from the Critical Asset GIS Tool and the Climate Change Vulnerability Viewer to identify potential impacts to emergency response operations, utility interdependencies, water supply, stormwater, and the potential for cascading failures, providing uniform guidance for climate and extreme weather hazards to TBUs, and synchronizing short-term operational and long-term planning to accommodate life-cycle considerations, and more rapid degradation of systems from accelerating climate change and extreme weather impacts. Additionally, MDOT may face challenges developing dynamic modeling to provide a clearer picture of flooding and sedimentation impacts/risks, addressing aging infrastructure, creating data and adaptive design guidance for design engineers to inform climate resilient design decisions, and acquiring funding to execute planned climate resiliency projects and initiatives and for long-term operation and maintenance.

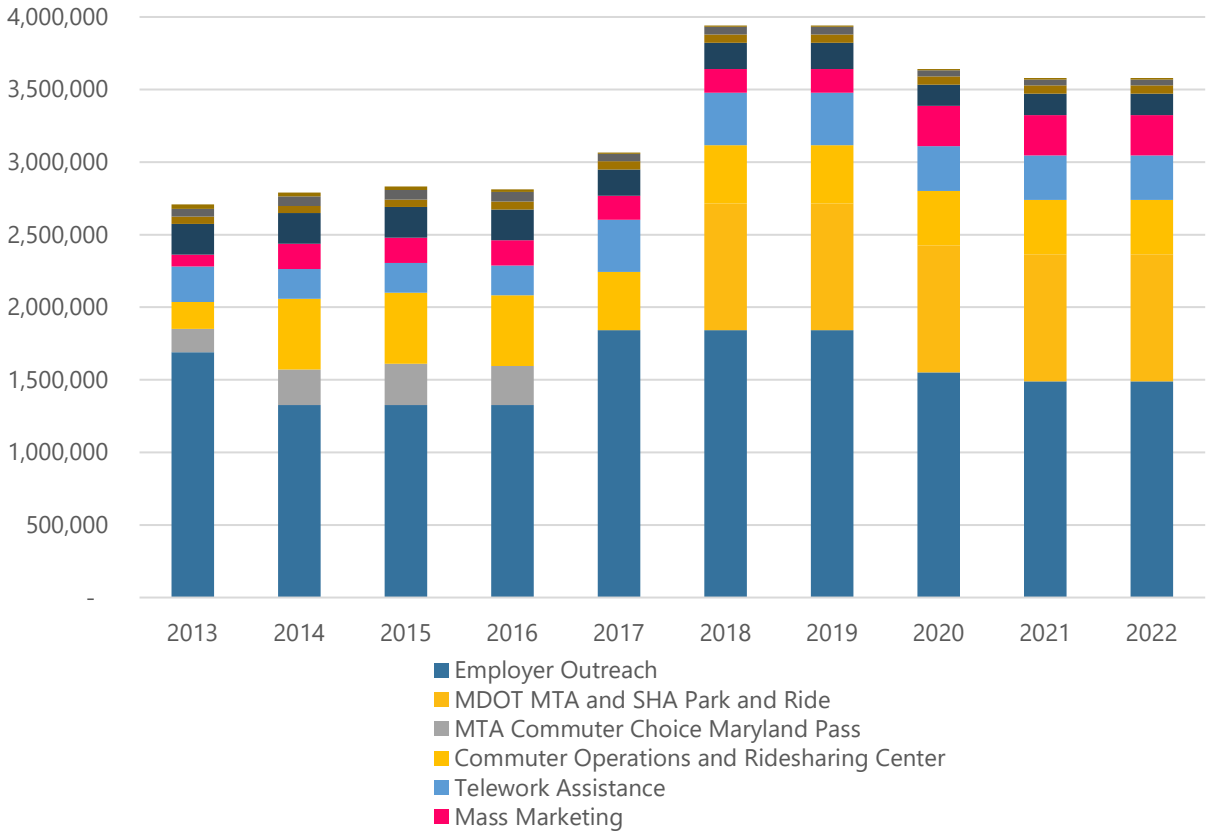
Environmental risks to assets include extreme weather events, extreme temperatures, sea level rise, flooding, and shoreline erosion. Climate change poses a threat to existing and future marine terminals due to their inherent location at the interface of land and water.

The transportation network impacts the environment in many ways. Transportation emissions impact air quality, and runoff from roadways and other transportation facilities contribute to the health of the Chesapeake Bay and other waterways. MDOT is working with Maryland Department of the Environment and other state and federal agencies to reduce emissions, decrease runoff, and protect waterways.

Transportation Demand Management

Transportation Demand Management (TDM) is a set of strategies designed to maximize traveler choice, facilitate economic opportunity, and conserve energy, which in turn helps protect the environment. TDM is a key component of MDOT's transportation portfolio and emphasizes multimodality, ridesharing, and alternative work schedules. Figure 58 shows the reduction in daily VMT generated by various TDM strategies. Employer outreach has been the most successful strategy, by far.

Figure 58. Daily Reduction in VMT of Different TDM Strategies (2013-2021)



Source: Maryland Department of Transportation, Annual Attainment Reports on Transportation System Performance (2013-2022)

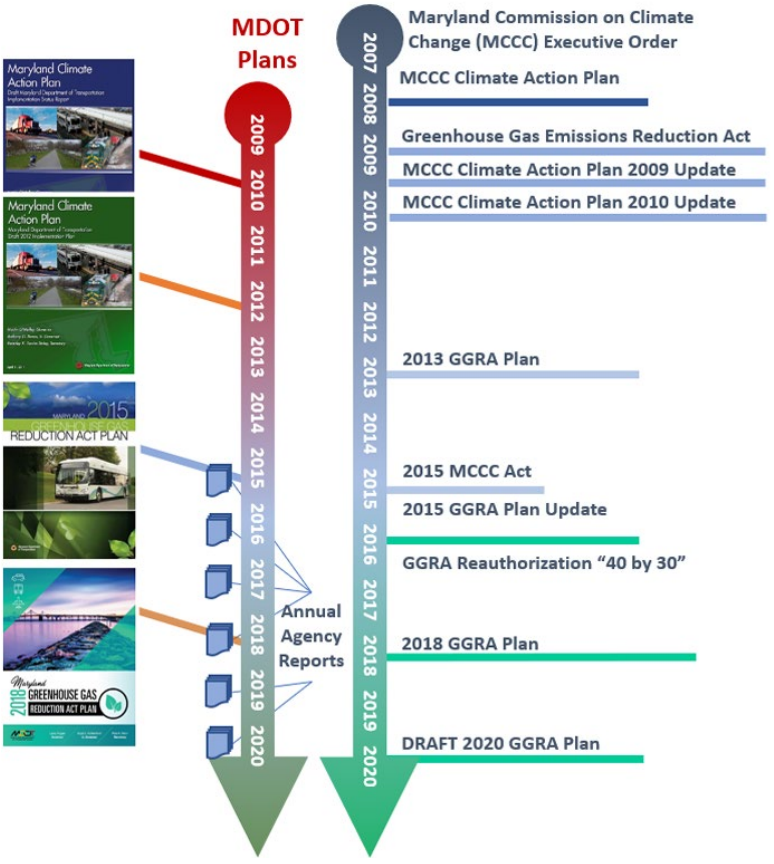
Greenhouse Gas Emissions

As Maryland's climate continues to change due to GHG emissions, there is potential for the occurrence of extreme temperatures and severe weather events, including flooding from increased rainfall, which could impact access to charging stations as well as the operations and uptime, resulting in stations being unavailable for an extended period of time.

In 2009, Maryland's General Assembly passed the Greenhouse Gas Reduction Act (GGRA), which requires the state to achieve a 25 percent reduction in GHG from 2006 levels by 2020. In 2016, the law was reauthorized. The bill not only maintains the 2009 bill's goal of reducing greenhouse gas (GHG) emissions by 25 percent by 2020, but it further extends the goal to a 40 percent reduction by 2030. MDOT has played a role in the reduction in several ways including supporting and expanding TDM programs; increasing the efficiencies of the MDOT SHA, MDTA, and MDOT MTA fleets; installing electric vehicle charging stations; and developing policies and securing funding to promote integration and expansion of electric vehicles.

The FY2020-2026 Consolidated Transportation Program (CTP) allocates 65 percent of its $12.39 billion budget to GHG reduction projects. Figure 59 depicts a timeline of MDOT's Resilience efforts between 2007 and 2020. In addition to the efforts show in Figure 59, MDOT collaborates with the Maryland Department of the Environment (MDE) collaboration with the MDE to produce annual State Agency Status Reports that reflect progress toward meeting the GGRA goals.

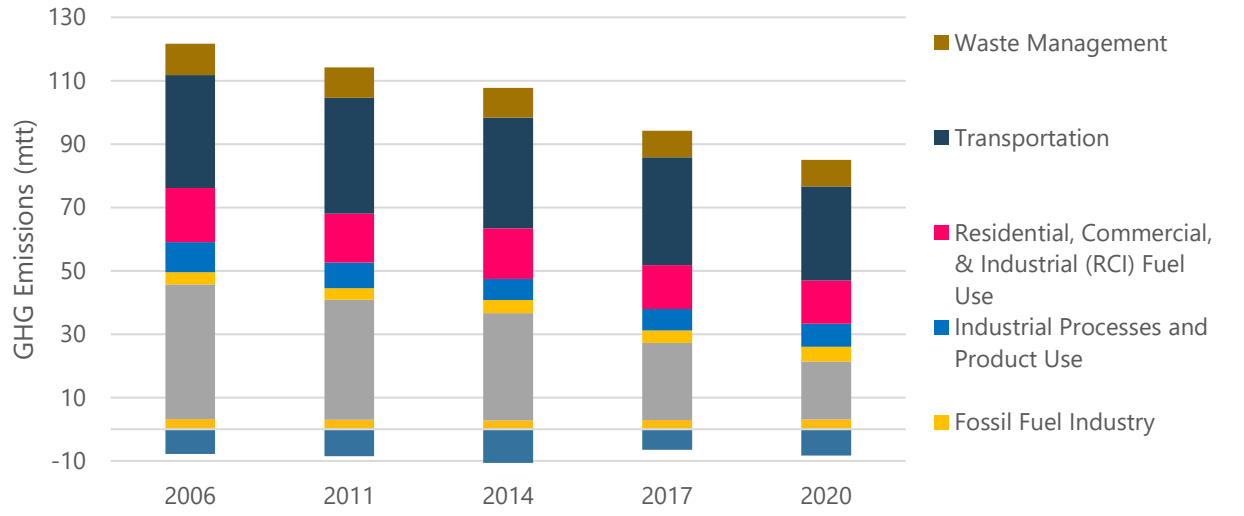
Figure 59. MDOT's Resilience Efforts (2007 – 2020)



Source: GGRA Plan Update

Figure 60 shows that total annual GHG emissions in Maryland has been steadily decreasing since 2006. Electricity use was the largest contributor of GHG emission since 2006 but this industry has since reduced emissions by over half. In 2014, transportation became the largest contributor of GHG emissions in Maryland.

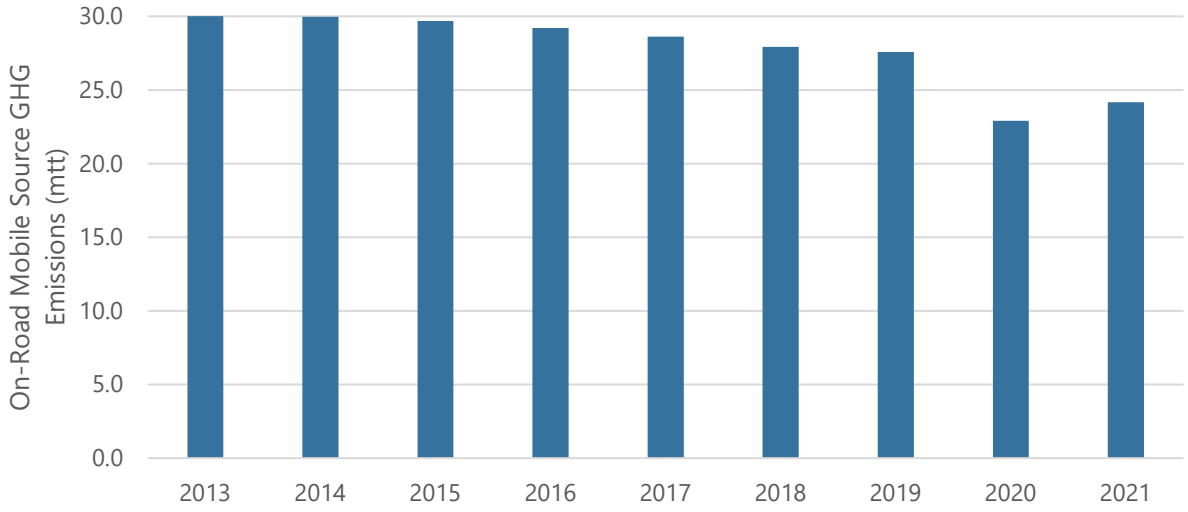
Figure 60. Total GHG Emissions in Maryland by Sector (2006-2020)



Source: Maryland DOE GHG Inventory

Maryland has been steadily reducing its transportation related GHG emissions. The slight increase between 2020 and 2021, is likely due to the dramatic reduction in VMT due to closures and social distancing requirements during the pandemic in 2020 and the gradual trend back toward pre-pandemic travel in 2021 (Figure 61).

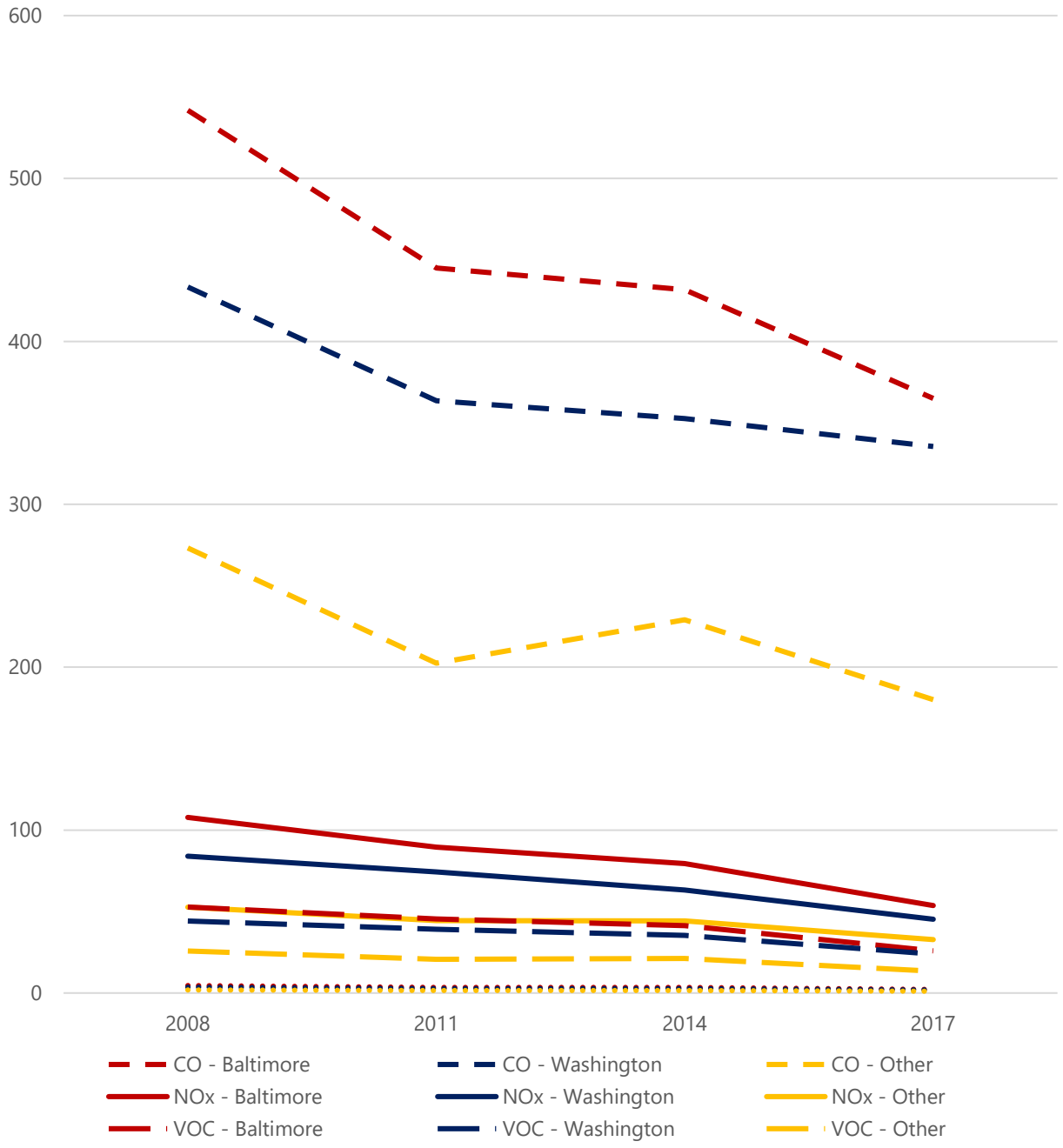
Figure 61. Transportation Related Greenhouse Gas Emissions (2013-2021)



Source: Maryland Department of Transportation, Annual Attainment Report on Transportation System Performance (2022)

Figure 62 illustrates transportation related GHG emissions by region over time and by type. Baltimore has the highest emission rate of all regions across all emission types. Washington has the next highest emission rate across all emission types.

Figure 62. Transportation Related GHG Emissions by Region (2008-2017)

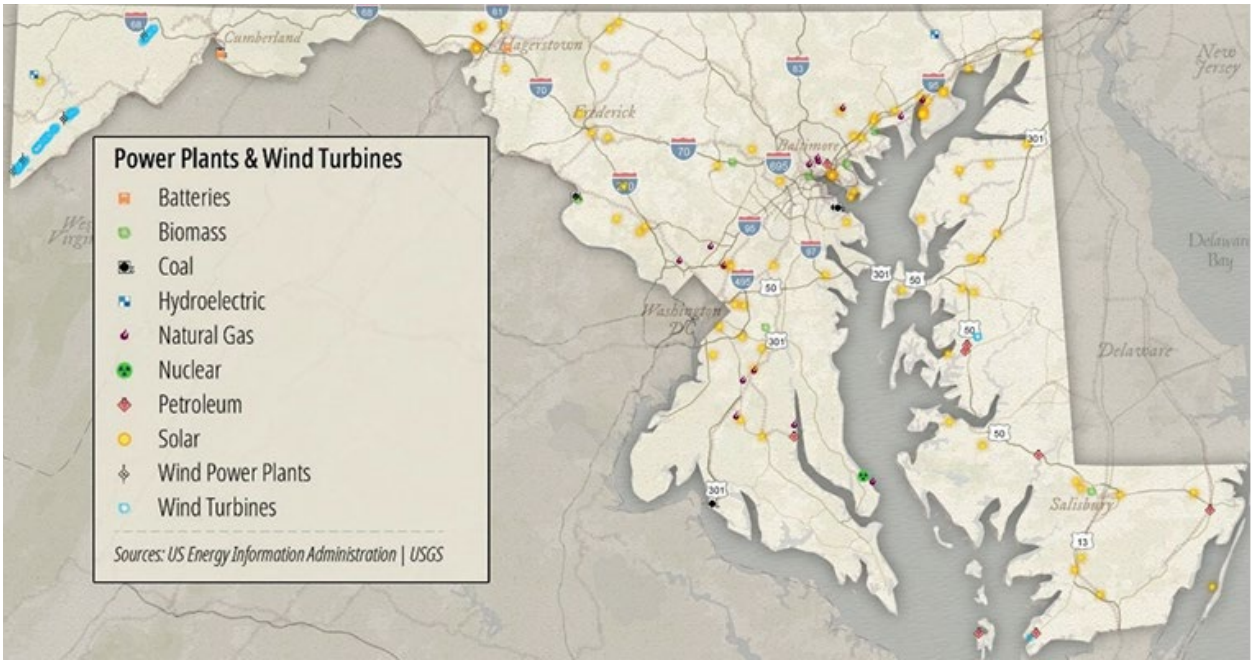


Source: Maryland State Freight Plan (2022 Draft)

Power and Energy

Energy infrastructure is critical to Maryland's transportation system. The location of power generation sites across the state is determined by clusters of activity, resources, and transportation links. Figure 63 shows a map of power generation sites by type. The western part of Maryland is home to a series of wind turbines and wind power plants, as well as one hydroelectric power plant. Solar power plants are dispersed throughout the state but are primarily located along interstate corridors. Natural gas power plants are also located along major roadways but are mainly concentrated in the middle of the state.

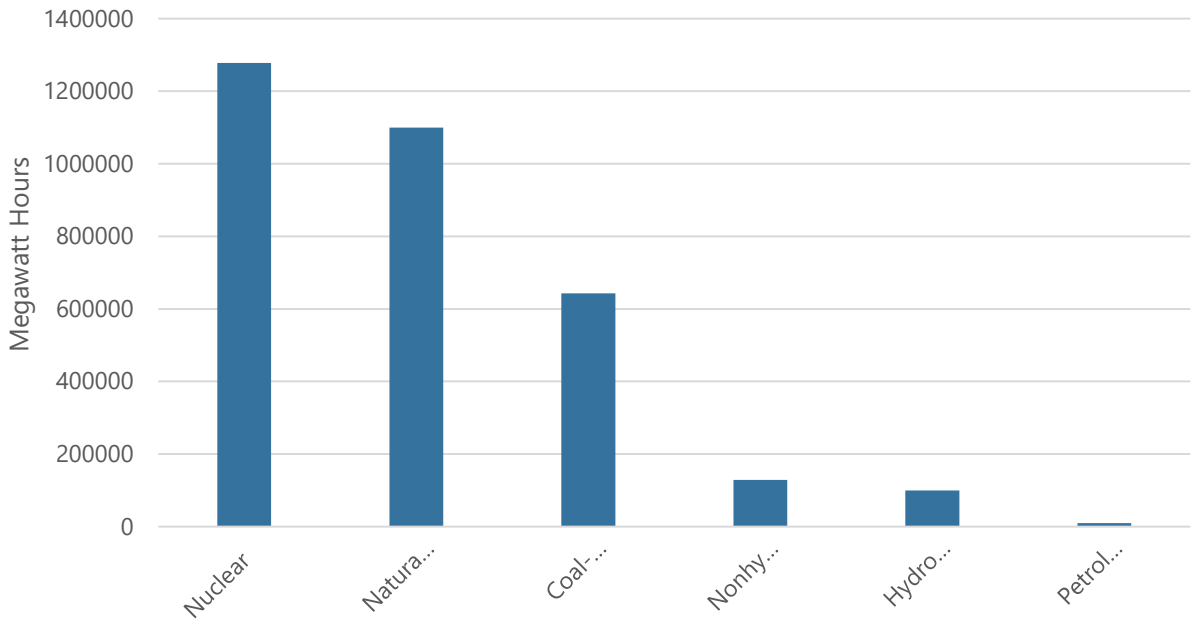
Figure 63. Power Generation Sites in Maryland



Source: Maryland State Freight Plan (2022 Draft)

Figure 64 shows the net electricity generation by source. Although Maryland has only one nuclear power plant, it is responsible for generating the largest amount of power. Natural gas generates the second greatest amount of power in the state, followed by coal fired. Nonhydroelectric renewables and hydroelectric renewables generate a similar amount of power. Petroleum-fired sources generate the least amount of power.

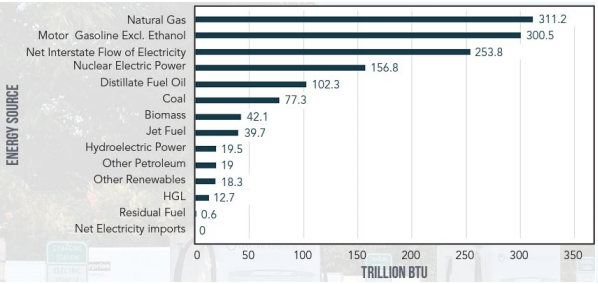
Figure 64. Net Electricity Generation by Source (2022)



Source: Maryland State Freight Plan (2022 Draft)

In 2019, Maryland ranked 42nd in total energy consumed per capita and 47th in total energy expenditures per capita. In terms of energy production, Maryland ranked 39th in total energy production (247 trillion British Thermal Units). By source, Maryland ranked 19th in coal production (1,471 thousand short tons), 31st in natural gas production (10 million cubic feet), and 38th in electrical energy production (3,295 thousand MWh). Figure 65 shows energy consumption by source and the utility electric use and renewable energy generation over time.

Figure 65. Energy Rankings and Energy Consumption by Source and Utility Electricity Use and Renewable Energy Generation (2019)



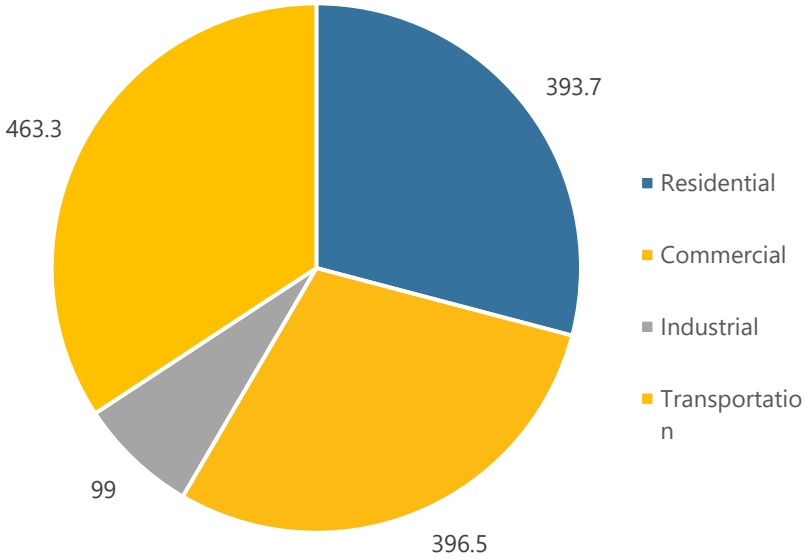
MEGAWATT HOURS IN THOUSANDS (FY)	2016	2017	2018	2019*	2020
Electricity Use	384	364	379	367	338
Renewable Energy Generation	1.998	1.629	1.431	1.275	1.127

** 2019 has been revised from previous report.*

Source: Maryland State Freight Plan (2022 Draft)

Figure 66 shows energy consumption in Maryland by end-use sector. The transportation sector is the largest consumer of energy (34.3%). The commercial (29.3%) and residential (29.1%) sectors consume a similar amount of energy. The industrial sector consumes the least amount of energy (7.3%).

Figure 66. Maryland's Energy Consumption by End-Use Sector in Trillion BTUs (2018)



Source: Maryland State Freight Plan (2022 Draft)

Maryland's power generation and energy use may be affected as electric vehicle adoption continues to expand across the state and as freight movement needs change on critical corridors. Increased use of alternative fuel sources could continue to decrease the use of coal and subsequently limit the need for freight movement of coal, which has the potential to impact rail demand, efficiency, and cost. The increased use of renewable energy that requires large high-value shipments (e.g., wind turbine blades, solar cells, and plant retrofit equipment) may lead to an increase in demand for specialized freight shipments that require oversize/overweight permitting, special hauling considerations, or other details that may affect logistics chains or permitting processes. Maryland Department of the Environment and the Maryland Department of Energy may address these changes with alternative fuel funding opportunities.

Water Resources

MDOT has made a commitment to creating, restoring, and improving wetland and wildlife habitats while completing projects. MDOT also set a goal to implement water quality treatments that protect and restore the condition of 4,261 acres of the Chesapeake Bay by 2021.

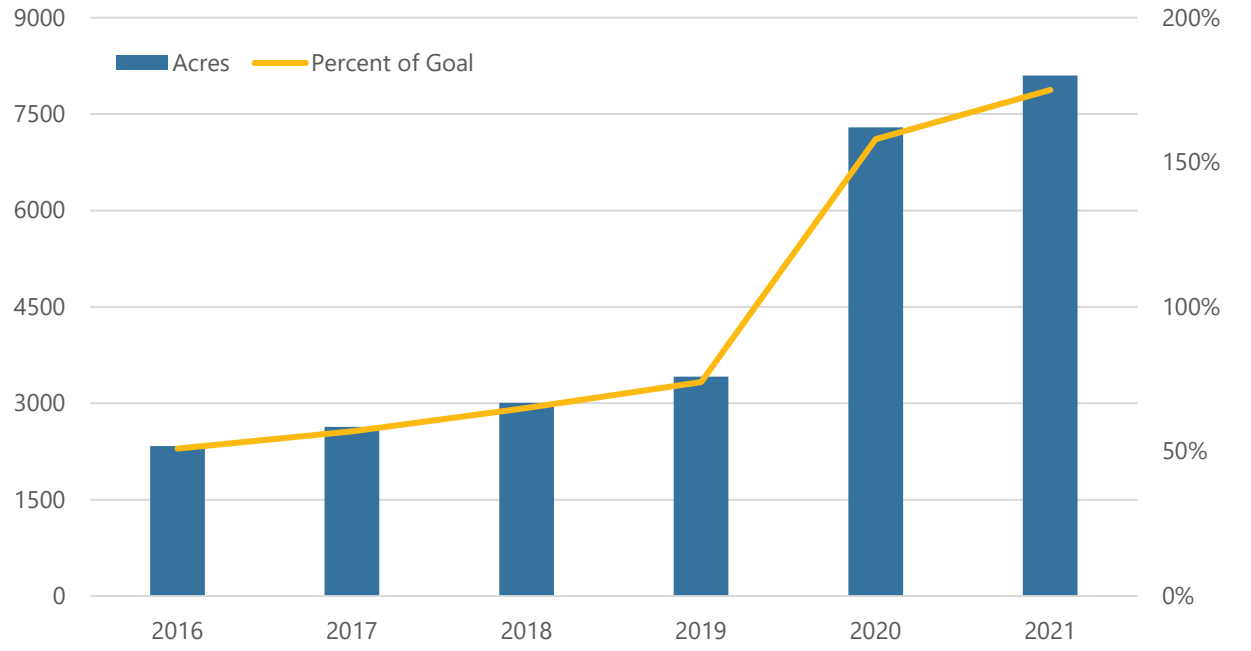
Stormwater Management

Stormwater runoff occurs when precipitation events create water that flows over land or impervious surfaces (i.e., paved streets, parking lots, and building rooftops) and does not soak into the ground. The runoff picks up pollutants (i.e., trash, chemicals, oils, dirt, and sediment) that pose a threat to waterways. Successful stormwater management leads to the protection of wetlands and aquatic ecosystems, improved quality of receiving waterbodies, conservation of water resources, protection of public health, and flood control.

To monitor project impacts on stormwater, MDOT SHA tracks how well it employs resource protection and conservation practices in project development, construction, operations, and maintenance of transportation assets. It measures this by determining the percentage of compliance on erosion and sediment control ratings.

Figure 67 show's MDOT's progress on water quality treatments in the Chesapeake Bay over time. MDOT achieved their goal of restoring over four thousand acres by 2020 and has since exceeded that goal by restoring over 7500 acres.

Figure 67. Water Quality Treatment to Protect and Restore the Chesapeake Bay (2016-2021)



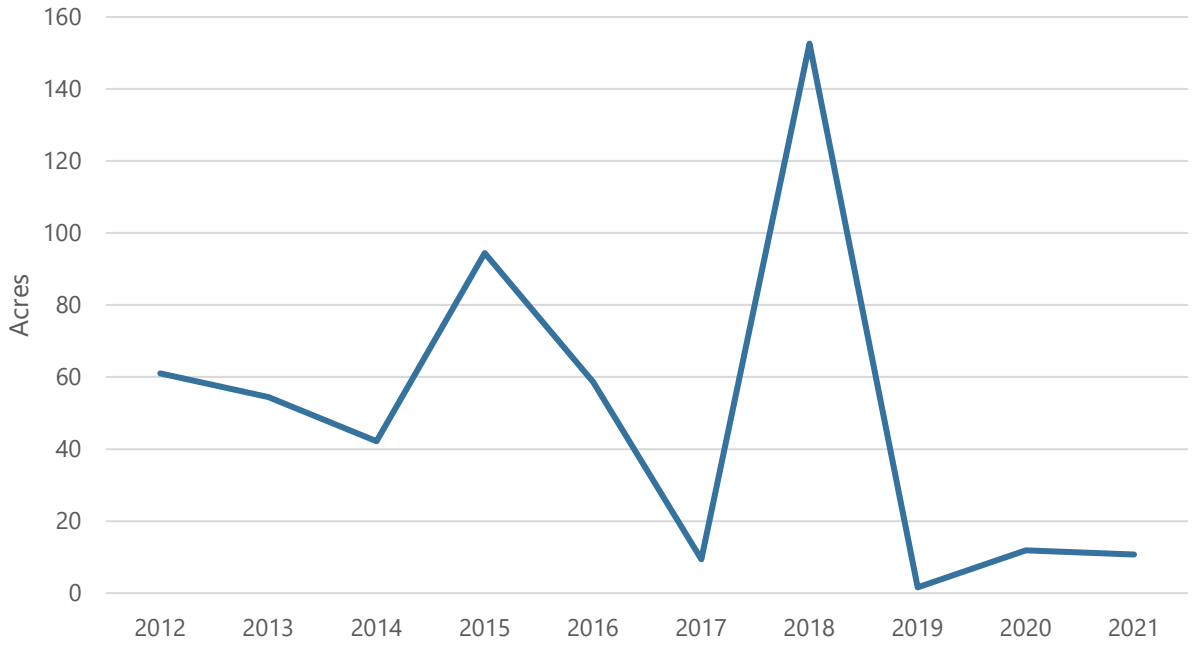
Source: 2022 Annual Attainment Report on Transportation System Performance

Wetlands and Waterways

Watersheds are areas of land where all streams, creeks, and rivers drain. Wetlands are water resources within watersheds. Wetlands (i.e., swamps, marshes, and bogs) have a diverse ecosystem and are home to a variety of plant and wildlife species such as cattails, sedges, fish, birds, turtles, salamanders, and frogs.

As transportation projects are constructed, wetlands that are impacted by the construction must be mitigated elsewhere. These mitigation efforts include (1) identifying ways to avoid impacts to wetlands and streams, (2) reducing effects, and (3) replacing resources when effects cannot be avoided or reduced. The MDOT SHA Mitigation Team is responsible for the protection and restoration of streams and wetlands throughout Maryland, paying particular attention to the Chesapeake Bay Watershed. Since 2007, MDOT SHA has restored 200 acres of wetlands and 9.8 miles of streams, exceeding the goal of 200 acres of wetlands and 5 miles of streams.[xlvi]

Figure 68. Acres of Wetland or Wildlife Habitat Created, Restored, or Improved (2012-2021)

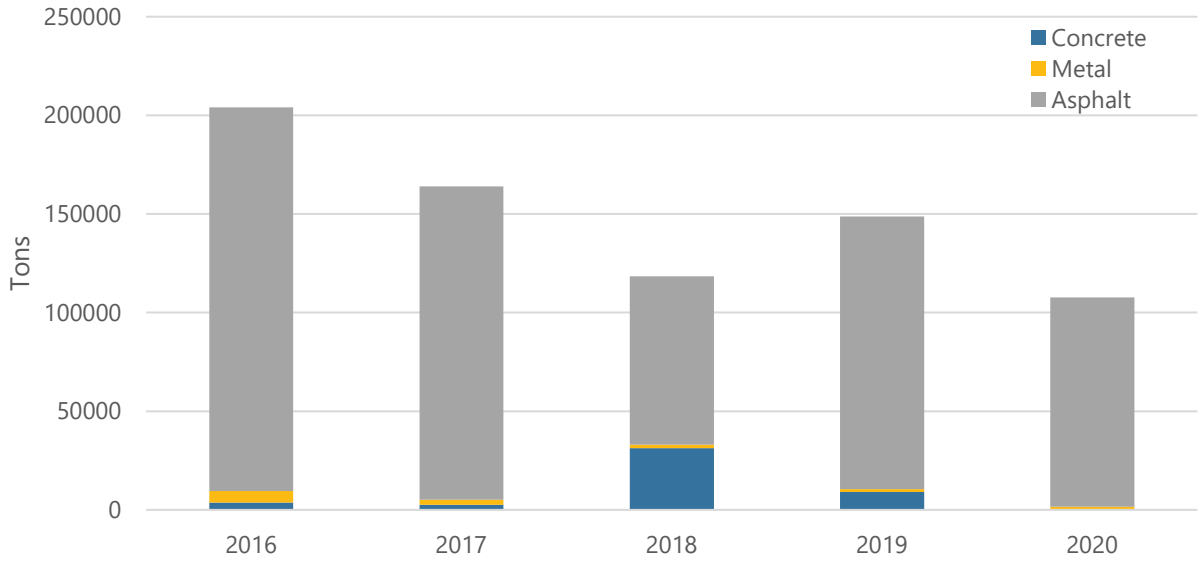


Source: 2022 Annual Attainment Report on Transportation System Performance

Other Environmental Stewardship Initiatives

MDOT has also made a commitment to recycle and reuse materials from other projects. Between 2016 and 2020, MDOT recycled 742,966 tons of concrete, metal, and asphalt from maintenance activities and construction and demolition projects (Figure 69).

Figure 69. Recycled and Reused Materials from Maintenance Activities and Construction and Demolition Projects (2016-2020)



Source: 2022 Annual Attainment Report on Transportation System Performance

Emerging Transportation Trends

Emerging trends are recurring themes seen throughout MDOT's reporting and planning documents. These trends fit into five major categories: new technologies (including shared mobility, electric vehicles, and connected and automated technology), resilience (including climate change, sustainability, and environmental stewardship), equity, public health, and long-term impacts caused by the COVID-19 pandemic (including teleworking and e-commerce). Due to the breadth of climate change data and existence of environmental stewardship initiatives, we address resilience in section 5. The remaining four trend categories (new technologies, equity, public health, and long-term COVID-19 impacts) are addressed in the following sections.

New Technologies

Rapidly changing technologies such as shared mobility, electric vehicles, and connected and automated technology are impacting transportation and will continue in the future as these technologies are adopted and become more conventional over time. The following sections describe considerations for long-term planning related to these emerging technologies.

Shared Mobility

The Federal Transit Administration (FTA) defines shared-use mobility as transportation services and vehicles that are shared among users. This may include public transit, taxis, bike-sharing, carsharing, ridesharing, ride-sourcing, scooter-sharing, and shuttles.[xlvii] Shared-use mobility has expanded rapidly due in part to mobility-on-demand (MOD) applications that connect users to a multi-modal network of safe, affordable, and reliable transportation.

MDOT has installed new and replacement bike racks at MTA rail stations, added new MARC cards to accommodate bicycles on busy lines, and increased the number of bikeshare stations at transit stations. MDOT has also designated new bicycle and pedestrian priority areas and completed plans associated with those areas. MDOT MTA has developed a paratransit program called MobilityLink, a rideshare service is for individuals with disabilities who are unable to use the MTA fixed route system by themselves (e.g., individuals who are unable to get to a bus stop, wait unassisted, or board or ride a service by themselves). MobilityLink helps individuals get from the first exterior door of a pick up location to the first exterior door of the destination. On the local level, many counties have completed bicycle and pedestrian plans.

Shared-use mobility services are changing the way people travel. New technologies and data play a crucial role in the advancement of shared-use mobility services. In 2018, Baltimore adopted Complete Streets legislation that elevated the priority of pedestrians, bicyclists, and transit users in planning and roadway design. In 2022, MDOT SHA funded a statewide public survey on accessible EVs, CAVs, and shared mobility in order to generate scenarios for the Maryland Statewide Transportation Model. In the context of rail, shared-use mobility comes into play with passenger rail improvements through multimodal connection improvement, bike and scooter rideshare stations at rail stations, and pick up areas for rideshare at rail stations.

Shared-use mobility has the potential to enhance equity in transportation by creating affordable options and connecting low-income areas to job opportunities. Shared mobility is

considered a disruptor with a currently unknown impact on GHG emissions, as it is a rapidly changing technology, and its market penetration is unknown.

Electric Vehicles

Electric vehicles (EVs) span numerous vehicle types and either operate solely on batteries (battery electric vehicles or fuel cell electric vehicles) or are hybrid models with both an electric motor and an internal combustion engine (Plug-In-Hybrid Vehicles, Hybrid Electric Vehicles).[xlviii] The reliability, compatibility, and resilience of charging equipment pose a threat to EV adoption. EVs can facilitate economic opportunity and reduce GHG emissions but successful adoption of the technology will erode traditional transportation funding.

Many new policies and initiatives support the expansion of EVs. The Clean Cars Act's light-duty ZEV sales goals require car manufacturers to sell more ZEVs in Maryland and hit specific benchmarks by 2025 and 2030. The Clean and Renewable Energy Standard (CARES) increases Maryland's Renewable Portfolio Standard (RPS) requirement over time. The GGRA requires a statewide reduction in emissions and identifies low and zero emission vehicles as a key strategy for reducing emissions. The Maryland Zero Emissions and Electric Vehicle Infrastructure Council (ZEEVIC) develops policies, recommendations, and incentives that increase awareness of ZEVs, support ZEV ownership and encourage private sector investments in ZEVs. Maryland joined the multi-state ZEV Memorandum of Understanding (MOU) and the Regional Greenhouse Gas Initiative and has signed the Medium-Heavy Duty (MHD) ZEV MOU. Local governments and MPOs have adopted policies and led initiatives that support ZEV infrastructure. Completion of the Fleet Innovation Plan will support the conversion of MDOT's light-duty and bus fleet to ZEVs. By 2030, 50 percent of the MTA fleet will be Zero Emission Buses (ZEB). This number will increase to 95 percent by 2045. Baltimore Washington International Thurgood Marshall Airport (BWI) installed 10 EV charging stations at its daily and hourly garages and four direct current fast-charging stations at its cell phone lot. MAA also prepared a white paper examining their current fleet of alternative fuel vehicles.

MDOT's ZEEVIC has set ambitious goals on registered EV adoption by 2030. Figure 70 shows the actual number of registered EVs between 2017 and June 2023. Figure 71 illustrates the projections for EV registration between 2023 and 2030. The ZEEVIC's 2022 priorities are to "(1) install more Electric Vehicle Supply Equipment (EVSE) and ensure EV readiness through strategic infrastructure planning, particularly focusing on rural communities, equitable EVSE placement in environmental justice communities, corridors, and multi-unit dwellings and apply lessons learned from EVSE deployment to continuously improve EVSE infrastructure, (2) maximize the use of grant and alternative funding opportunities for EV/EVSE in Maryland, particularly funds allocated to Maryland through the IIJA, by collaborating across local and state agencies to strategically target funds for optimal infrastructure expansion, and (3) continue ZEV education and outreach coordination, with a focus on diversity and equity, to increase ZEV deployment."[xlix] To incentivize Maryland residents to switch to EVs, MDOT MVA is offering a $1000 – $3000 Excise Tax Credit for Plug-in EVs. Individuals who purchase a qualifying zero-emission plug-in electric or fuel cell EV between July 1st, 2023 and June 30th, 2027 are eligible.

Figure 70. Number of Registered EVs

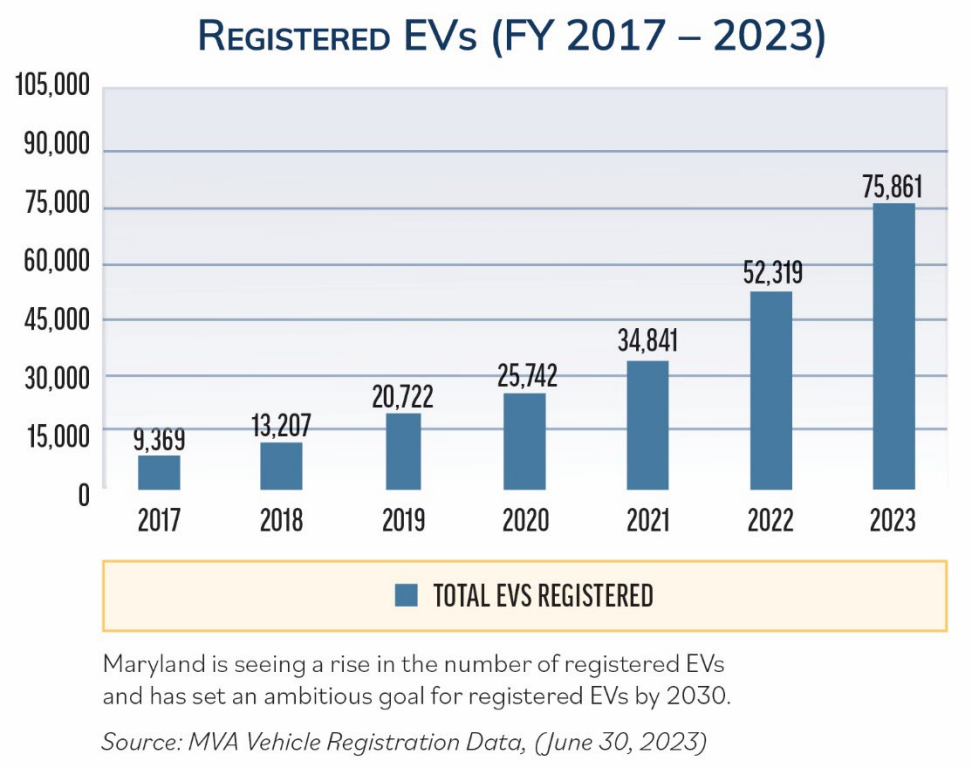


Figure 71. Registered EV Projections (2023-2030)

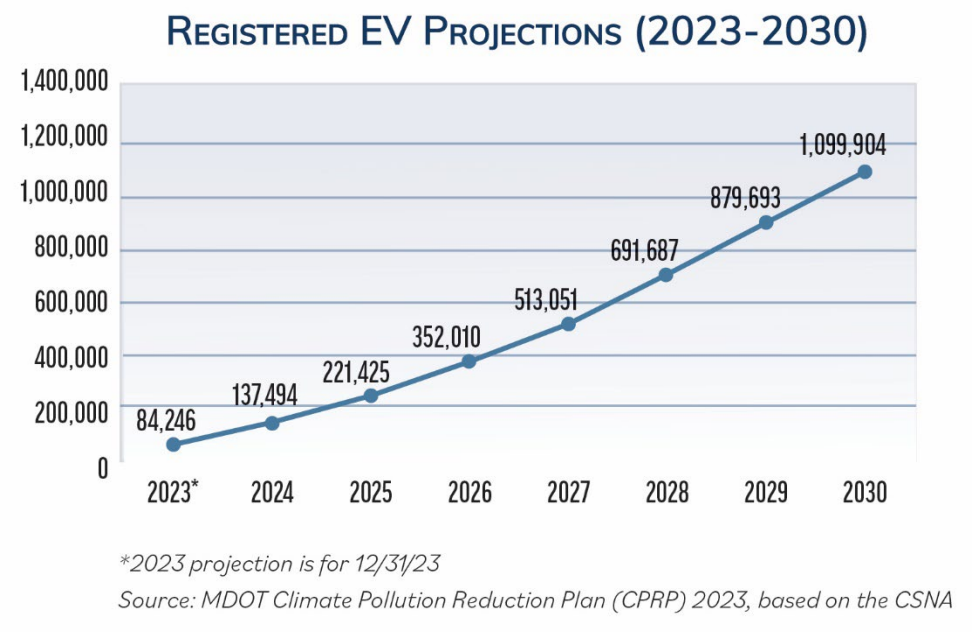
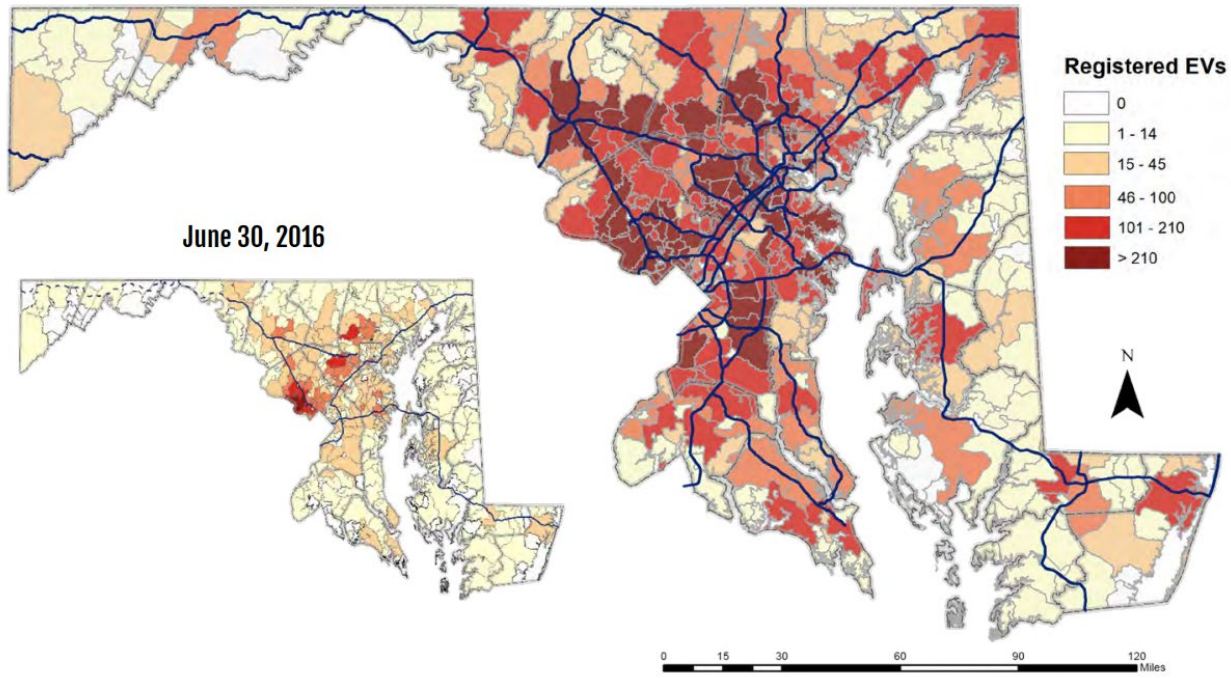


Figure 72 shows the number of registered electric vehicles by zip code.

Figure 72. Registered Electric Vehicles by Zip Code (2016 vs. 2022)



Source: Maryland State Plan for National Electric Vehicle Formula Funding Deployment

Connected and Automated Technology

Connected and Automated Technology includes Connected Vehicles (CVs), Automated Vehicles (AVs), and Connected and Automated Vehicles (CAVs). CVs "talk and listen" to infrastructure, other vehicles, and mobile devices. This communication enables applications that can warn a human driver of an impending hazard, enable a vehicle to operate more efficiently or guide a vehicle to take appropriate action given the surroundings. AVs use sensors and other technologies to understand the environment to assist drivers, and eventually perform driving tasks in place of a human driver. Lastly, CAVs leverage connected capabilities with automated features to bring the best of both worlds into one vehicle.

Because there are so many unknowns related to CAVs, they pose great potential for challenges or potential disruption to the transportation sector. However, CAV technologies also present the opportunity to:

- Save lives and reduce the severity of injuries, with the possibility of almost eliminating crashes altogether
- Improve reliability, potentially reducing congestion, reducing vehicular GHG emissions, and improving air quality
- Enable new mobility service solutions to enhance the lives of the young, aging, people with disabilities and medical conditions, and others who choose not to drive by providing better access to employment, medical services, health care, shopping, entertainment, or all opportunities for improved quality of life
- Improve the movement of commodities and service providers, thereby lowering the cost of goods and services to consumers.

MDOT conducted a public survey that collected input on accessible CAV technology. The survey results were then used to inform the Statewide Transportation Model. Autonomy and connectedness are key components of the MDOT Blueprint. In 2019, MDOT began automated vehicle testing at the Dorsey MARC parking lot and began planning for one or more automated shuttle pilots. MDOT SHA's CAV Strategic Action Plan was developed to prepare MDOT's infrastructure, policy, and operations for the changes brought on by CAV technology.

As of 2022, the MDOT's CAV-related efforts include the (1) US-1 Innovative Technology Deployment Corridor, (2) Smart Signals Program Participation in the National (Signal Phase and Timing) SPaT challenge – working to deploy infrastructure with SPaT broadcasts, (3) evaluation of ITS Infrastructure to make Maryland roads CAV-ready, (4) development of a data governance plan for CAV data, (5) Development of a Communications and Outreach Plan for CAV efforts, and (6) development of several web-based internal and external CAV-related planning tools (e.g., CAV Technology Deployment Dashboard and the CAV Public Policy across the U.S. application).

MDOT SHA also houses the CAV Working Group, which meets regularly to strategize and coordinate efforts related to CAV development, deployment, and implementation. The CAV Working Group is made up of a diverse membership of transportation stakeholders such as elected officials, state and local agency representatives, highway safety organizations, and representatives from the private sector and automotive industry. MDOT also has a CAV Freight Subgroup that focuses on freight-specific CAV technology. Additionally, MDOT participates in national CAV projects, including the Connected Vehicle Pooled Fund Study, Dedicated Short Range Communications (DSRC) Community of Interest, and Eastern Transportation Coalition (formerly I-95 Corridor Coalition).

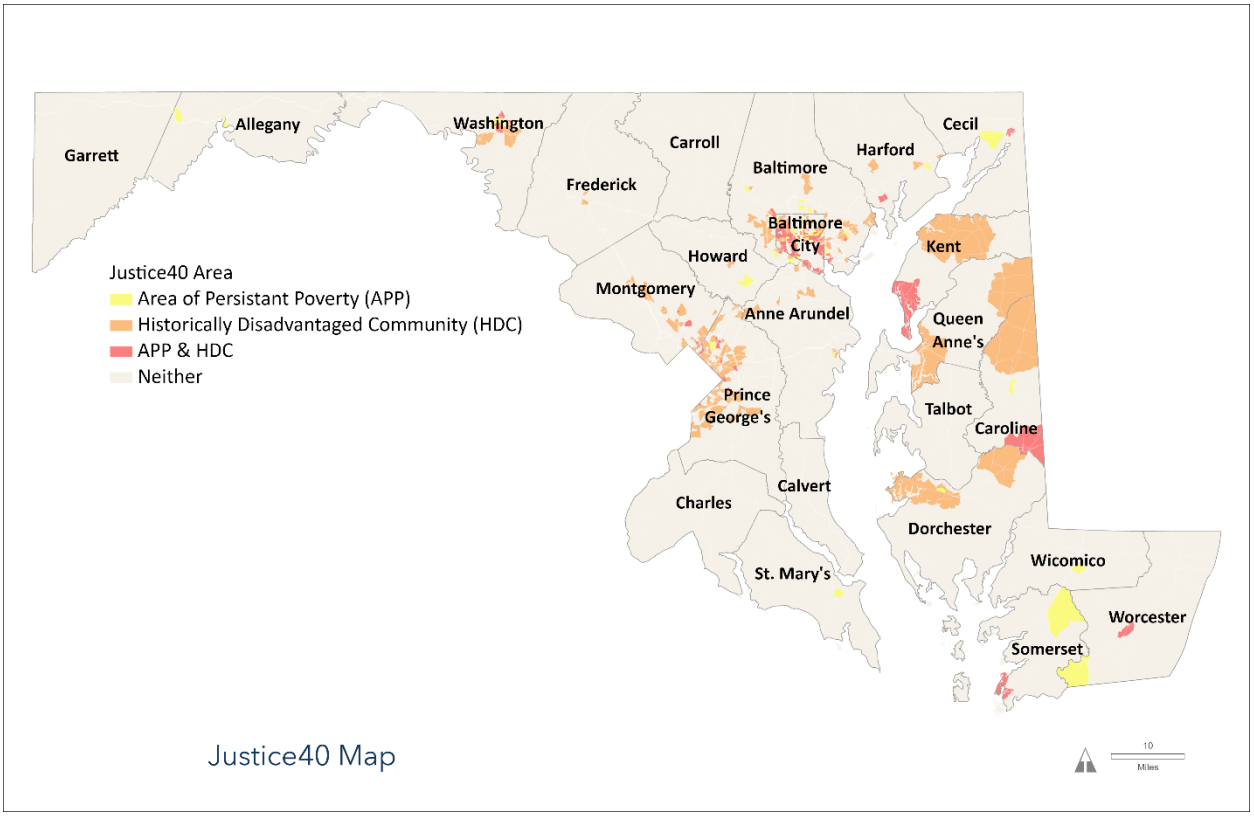
In addition to MDOT's CAV initiatives, Maryland residents have benefitted from CAV technologies through the U.S. Department of Energy's Advanced Research Projects Agency - Energy (ARPA-E) TRANSNET program grant. A $4.5 million grant was awarded to develop incenTrip, a multimodal trip planning application that uses connected technologies to incentivize travelers to make choices that reduce congestion. MDOT also created a website for all CAV-related updates.

Equity

Equity-focused transportation planning considerations include, but are not limited to, racial justice, ADA accessibility, Justice40 communities, historically disadvantaged communities (DACs), the aging population, low-income households, zero-car households, and affordability concerns. Transportation planning efforts can make equity considerations by prioritizing "the mobility, health, and opportunity of people of color and low-income communities while addressing systemic racial and economic inequities."[l] Equitable transportation is a mechanism for advancing racial equity. Transit planning extends to consider housing, healthcare, food access, and environmental justice.

Access to transportation is a social determinant of health. For minority and low-income communities in Central Maryland, safe and affordable mobility options are essential for overcoming long-standing disparities in the distribution of resources and opportunities. Equitable transportation planning requires coordination between transit providers, local jurisdictions, and the public to ensure that all residents, especially the most vulnerable, have access to an integrated transit network. Figure 73 shows Maryland's Justice40 Areas.

Figure 73. Justice40 Areas



Source: U.S. DOT Justice40 Initiative

MDOT uses the U.S. DOT's definition of environmental justice (EJ) as "the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations and policies." MDOT's EJ statement of intent is as follows:

> *"The Maryland Department of Transportation (MDOT) is committed to ensuring the equitable delivery of public transportation products, services, and solutions to all its users and stakeholders. MDOT will accomplish this by engaging with communities in a transparent and fair way regardless of race, culture, and income with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies in transportation decision making. Environmental Justice is a critical investment for MDOT to ensure the sustainability of its residents, employees, environment, and the diverse communities in which we live. In pursuit of this commitment, MDOT will align its strategic direction with efforts that make environmental justice the way we do business."*

MDOT follows three fundamental environmental justice principles:

- Promoting shovel-worthy, outcome-based, community-uplifting projects. Avoiding disproportionately high and adverse impacts on human health and the environment, while ensuring equitable benefit distribution.
- Intentionally pursuing all our diverse communities and stakeholders to foster meaningful engagement. Developing and implementing innovative methods of meaningful community participation that go beyond providing an opportunity, particularly in marginalized communities.
- Focusing on and assessing the total cost to the citizens of Maryland. Considering cumulative impacts and direct impacts when planning projects. With increased positive social and environmental impacts and emphasis on good stewardship of resources that affect positive change for people and our environment, with a focus on the intended outcome, not just a specific project.

There is an opportunity to address equity issues while also lowering GHG emissions through providing active transportation and public transportation mode options. However, it is worth noting that shared mobility has the potential to widen equity and accessibility gaps with limited availability of accessible vehicle features and lack of accessible technology to access shared mobility as a mode option.

Public Health

According to the Center for Disease Control (CDC) foundation, public health is "the science of protecting and improving the health of people and their communities. This work is achieved by promoting healthy lifestyles, researching disease and injury prevention, and detecting, preventing, and responding to infectious diseases. Overall, public health is concerned with protecting the health of entire populations. These populations can be as small as a local neighborhood, or as big as an entire country or region of the world."

Public health is becoming an important part of transportation planning. Health and safety must be part of all service provisions, paying consideration to communities that experience greater health disparities and adverse risks. This includes complying with established safety regulations to avoid known risks and being diligent, prepared, and creative in addressing emerging or sudden health and safety emergencies. Active transportation also plays a role in improving public health. Recent expansions of initiatives from the CDC, the American Association of State Highway and Transportation Officials (AASHTO), and the American Association of Retired Persons (AARP) help states and local governments to improve active transportation.

The effects of climate change can result in adverse health consequences for people, in particular those in disadvantaged communities. Opting to ship via rail (instead of the highway) and using green transportation reduces emissions, which in turn benefits public health. Reductions in emissions can help prevent premature deaths and asthma cases, which in turn leads to decreased public health costs.

The federal Congestion Mitigation and Air Quality (CMAQ) program funds projects that reduce criteria air pollutants, which would create public health benefits. Funding is available for areas in Maryland that do not meet the National Ambient Air Quality Standards (nonattainment areas) and former nonattainment areas that are now in compliance (maintenance areas). Maryland's CMAQ projects are programmed through MDOT MTA and SHA.

The FHWA Surface Transportation Block Grant Program includes the Transportation Alternatives (TA) Set-Aside program, which is a reimbursable federal aid funding program for transportation-related community projects that strengthen the intermodal transportation system. MDOT SHA uses these funds for the Recreational Trails and Transportation Alternatives Program (TAP). Maryland's TAP awards grant funding to projects that enhance the mobility, accessibility, environment, culture, aesthetics, and historic importance of the transportation network. These projects create bicycle and pedestrian facilities, restore historic transportation buildings, convert abandoned railway corridors to pedestrian trails, and mitigate highway runoff.

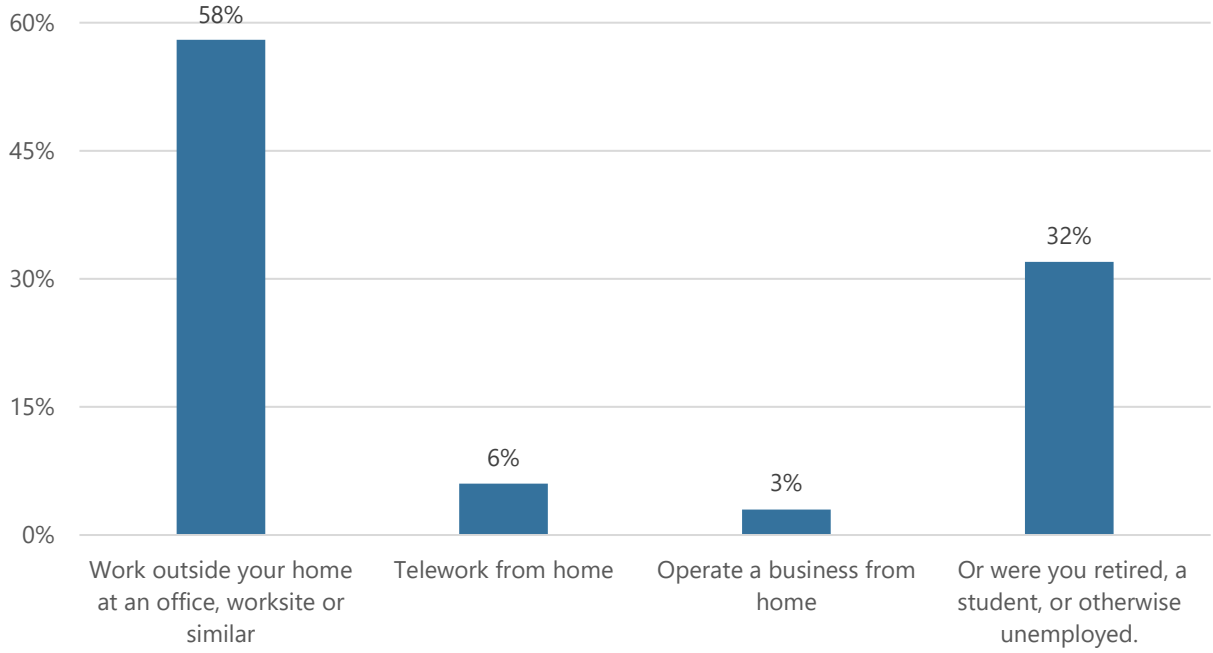
Long-term COVID Impacts

Teleworking and e-commerce have been expanding for the last two decades, but experienced rapid growth during COVID-19 pandemic and are expected to remain relevant to MDOT's planning efforts.

Telework

Teleworking, or telecommuting, is the practice of "working from home or remotely using modern technology and telecommunications to remain in touch with your employer or business. Teleworking allows individuals to work either at home, a local cafe with Wi-Fi, or at a local telework center for one or more days each week, or full time."[li] Figure 74 shows the work environments of survey respondents prior to COVID-19. Note that the survey was conducted in 2021, but this question asked respondents about their work environment prior to the pandemic.

Figure 74. Work Environment Prior to COVID-19



Source: 2021 Customer Satisfaction Survey Report Maryland Department of Transportation

Telework has become very popular with Maryland residents, as 65 percent of workers would prefer to telework two or more days per week according to the GGRA Plan Update. Maryland ranks third among all states in the percent of workers who work remotely. Maryland's teleworking rate is 24.0 percent, compared to the national average of 17.8 percent.[lii]

Telework is an opportunity to reduce GHG emissions via reduced VMT. The rise of teleworking brought on by the COVID-19 pandemic (2020-present) resulted in a decrease in VMT and congestion on Maryland roadways, which results in lower GHG emissions in Maryland. This decrease in VMT continues and is projected to continue. MDOT can continue to track VMT data over time to examine this trend further. Teleworking is one of MDOT's TDM

strategies to reduce GHG emissions in the GGRA Plan Update, but the State has limited ability to impact teleworking in the private sector.

E-Commerce

E-commerce, also known as electronic commerce or internet commerce, refers to the "buying and selling of goods or services using the internet, and the transfer of money and data to execute these transactions."[liii]

E-commerce has been growing rapidly for the better part of the last 20 years but has expanded exponentially during the COVID-19 pandemic. It is anticipated that this trend will continue with the use of omnichannel retailing strategies to facilitate consumer-retail interactions seamlessly across online, mobile platforms, in-store, television, or catalog-based activities. The growth of e-commerce and online shopping has led to BWI Marshall Airport becoming a hub for small package sorting and distribution to last-mile delivery service. High demand for final mile package deliveries by truck or local delivery vehicles, as well as up-and-coming technologies that expand into unmanned aerial vehicles or personal delivery devices. E-commerce also impacts reverse logistics, which describes the process of moving product returns from the consumer back to a wholesale fulfillment center or warehouse. Demands for product returns, particularly with the increased reliance on e-commerce and direct-to-consumer deliveries, further add to the truck/delivery traffic that travels along local streets and highways.

The rapid growth of e-commerce and related last-mile truck deliveries impact all segments of the highway network, which can further increase congestion, roadway degradation, and potential conflicts between trucks, passenger vehicles, or truck usage of local streets.

Takeaways

MDOT will plan for the future with consideration to the emerging trends and historic trends presented in this working paper. The 2050 MTP will provide a plan to address the future state transportation needs of the residents, businesses, and visitors in Maryland. These emerging trends will be considered in development of the strategic framework for the plan and will inform the development of the 2050 MTP strategies.

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