



2017 Status Report

Required under the

Maryland Commission on Climate Change Act

[EN §2-1305]

MSAR 10683

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Introduction

In 2009, the Maryland Department of Transportation (MDOT) began working with stakeholders to develop a comprehensive approach to reduce Greenhouse Gas (GHG) emissions from the transportation sector through and beyond 2020. This was in response to growing concern over the effects posed by climate change and the passage of the Greenhouse Gas Emission Reduction Act of 2009 (GGRA).

- In 2011, MDOT finalized the 2012 Implementation Plan required by the GGRA and subsequently worked with the Maryland Department of the Environment (MDE) and other state partners to develop the 2013 Greenhouse Gas Reduction Plan (2013 GGRP).
- The GGRA required a 2015 update to the 2013 GGRP indicating Maryland's progress in meeting the 2020 GHG emission reduction goal (25 percent below 2006 emissions by 2020). MDOT assisted MDE in development of the report for the transportation sector, and in parallel also developed its own [report](#) which details MDOT accomplishments to date, emission trends, and programs and projects planned for implementation that will support GHG emissions reductions through and beyond 2020.
- In 2016, Maryland passed a reauthorization of the GGRA, which sets the goal of reducing CO₂ emissions in the state by 40 percent reduction compared to 2006 levels by 2030.

The 2014 Executive Order (01.01.2014.14) and the 2015 Maryland Commission on Climate Change Act (Act) expanded the membership of the MCCC and required it to maintain a comprehensive action plan, with 5-year benchmarks, to achieve science-based reductions in Maryland's GHG emissions. The Maryland Commission on Climate Change (MCCC) submitted annual reports¹ in 2015 and 2016 to address the requirements of the Act.

MDOT's Transportation Role

MDOT's [mission](#) communicates the importance of a customer-driven transportation system. The mission, along with the six goals identified in the Maryland Transportation Plan, guides MDOT through statewide transportation planning, programming, and coordination across its transportation business units (TBUs) to facilitate the strategic development of Maryland's intermodal transportation system.

Attainment Report: The [Annual Attainment Report on System Performance](#) serves as an annual statewide report on "Transportation System Performance" that explores how MDOT has worked together in the past year and assesses progress towards achieving the goals and objectives of the [Maryland Transportation Plan](#) (MTP). Each chapter presents the progress made and the future strategies for each of the six MTP goals: safety & security, system preservation, quality of service, environmental stewardship, community vitality, and economic prosperity.

A number of measures within the Attainment Report are indicators for greenhouse gas emissions, such as measures that target the reduced rate of increase in travel activity (VMT) or program

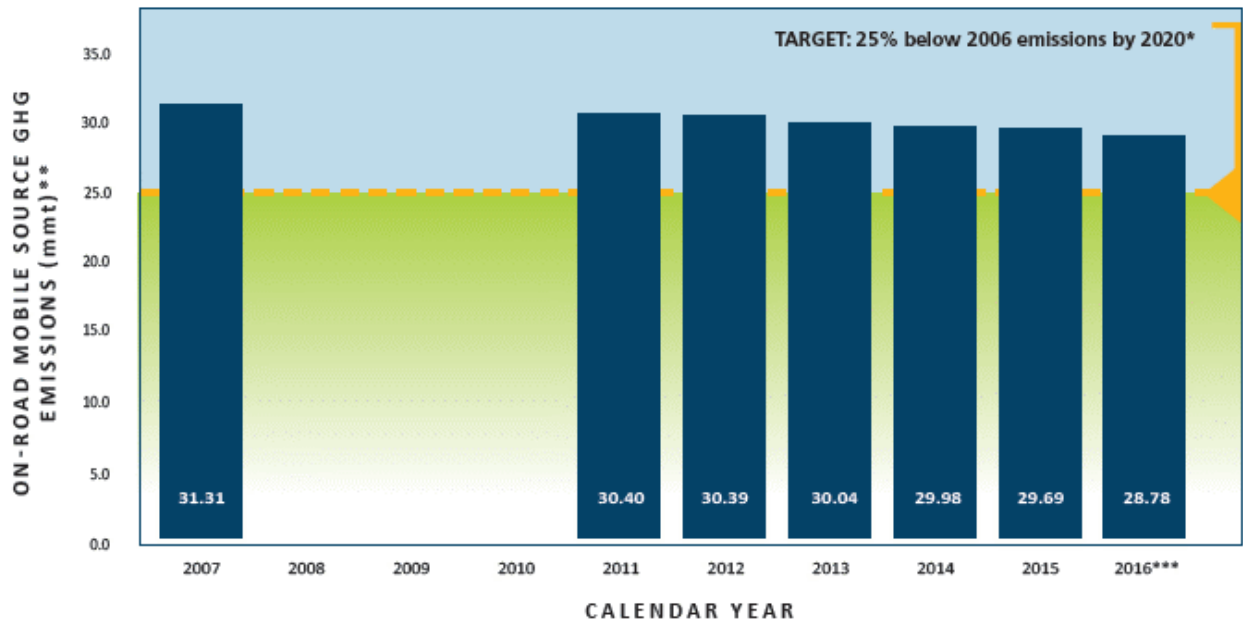
¹ Maryland Commission on Climate Change Annual Reports
<http://www.mde.state.md.us/programs/Air/ClimateChange/MCCC/Pages/MCCCReports.aspx>

specific VMT reductions, transit ridership, transit service reliability, roadway congestion, traffic safety, quality of the bicycle and pedestrian environment, and fuel consumption.

Within the Attainment Report, MDOT on an annual basis estimates total GHG emissions from on-road transportation in Maryland (shown in Figure 1) based on current vehicle miles traveled data and fleet characteristics.

On-road transportation GHG emissions continue to decrease in Maryland as the efficiency of the on-road vehicle fleet improves even as VMT growth continued in 2015 (1.4% increase) and 2016 (0.8%).

Figure 1. Transportation-Related Greenhouse Gas Emissions



* The MDOT selected GHG emission reduction goal (25% below 2006 emission by 2020) is consistent with the statewide target set in the 2009 Greenhouse Gas Reduction Act. For on-road transportation, the goal equals 23.5mmt CO₂e in 2020.

** MMT CO₂e stands for million metric tons of carbon dioxide equivalents, the standard unit of measurement for GHG emissions.

***Emissions are calculated using the most recent data and version of EPA's MOVES model available at time of analysis. MOVES2014 is used for analysis year 2016.

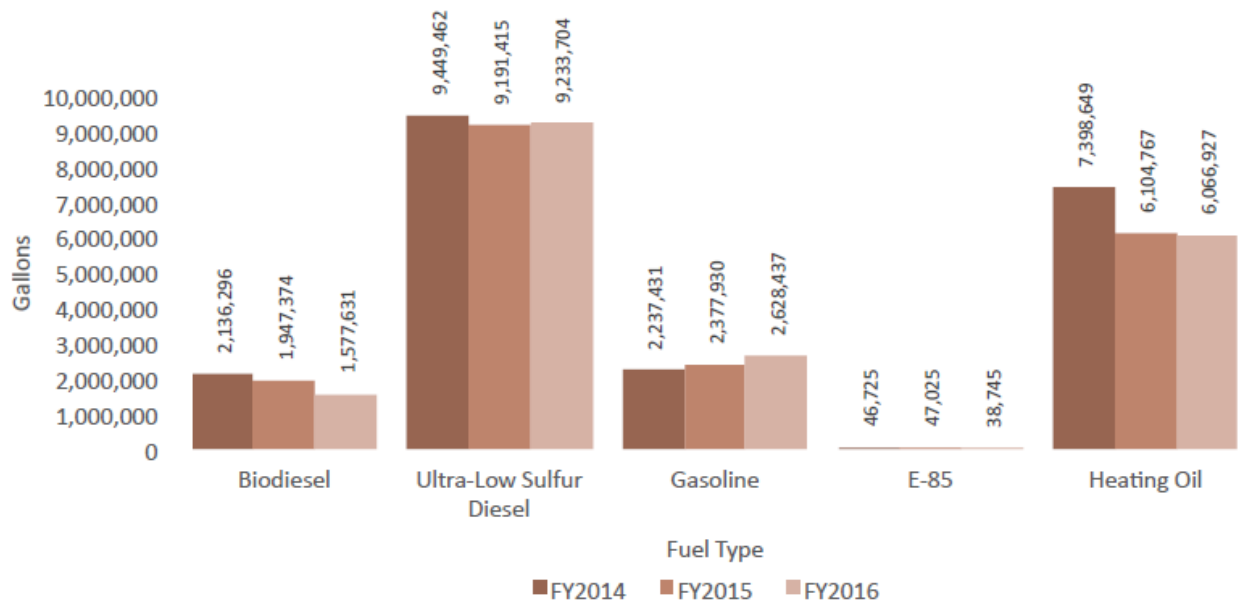
MDOT Excellerator: MDOT is now deploying a new performance management system, the MDOT Excellerator², which summarizes tangible results of MDOT's performance on a quarterly basis. This program is a living, evolving performance process that is in a constant state of evaluation, analysis, and action. The results represent critical data points that drive daily business decisions.

Similar to the Attainment Report, a number of measures within the MDOT Excellerator are indicators for greenhouse gas emissions, including: percent of tolls collected by cash, reliability

² MDOT Excellerator Performance Management System
<http://www.mdot.maryland.gov/newMDOT/Planning/Excellerator/MDOTExcellerator>

of highway travel, average highway incident duration, and total user cost savings due to congestion management. Tangible result #9 within the Excellerator, Be a Good Steward of the Environment, notes the following objective: “MDOT will be accountable to our customers for the wise use of limited resources and our impacts on the environment when designing, building, operating and maintaining a transportation system.” Measures directly relevant to GHG emissions include average MDOT light-duty fleet miles per gallon, the total gallons of fuel consumed quarterly by the MDOT fleet (see Figure 2), and total conventional energy use and renewable energy generation.

Figure 2. Total Gallons of Fuel Consumed, FY 2014 - FY 2016



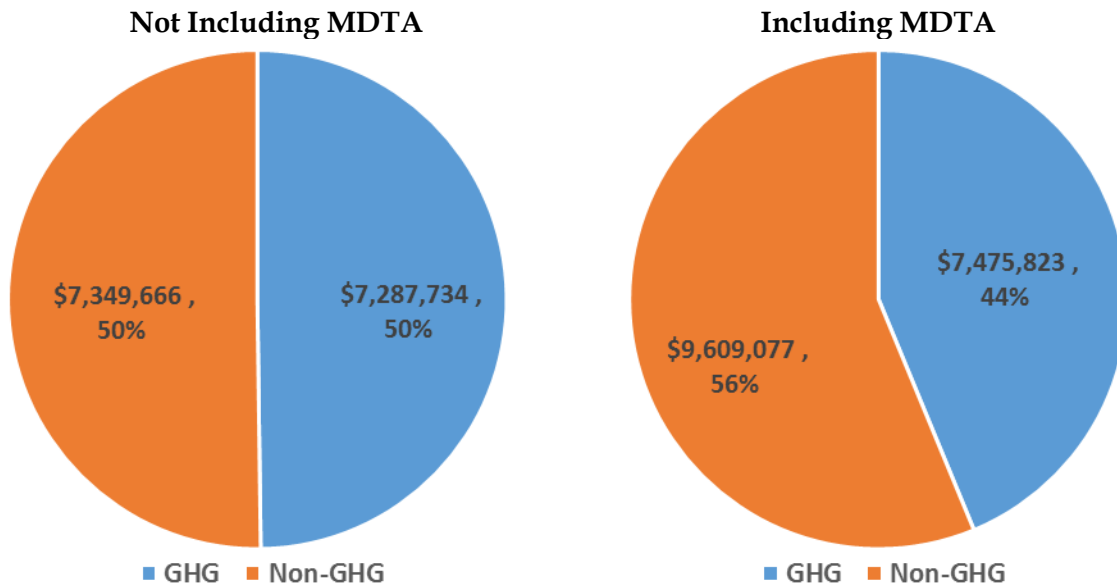
Consolidated Transportation Program: The goals of the MTP and the associated measures that reflect Maryland’s progress are indicative the diversity of current and future transportation conditions, challenges, and needs. The [Consolidated Transportation Program](#) (CTP), the State’s six-year capital investment program for transportation, identifies funding for specific road, bridge, transit, aviation, port, pedestrian and bikeway projects based on the priorities established in the MTP. Many of the goal areas identified in the MTP include projects and programs in the CTP that directly or indirectly yield GHG emission reductions from transportation system users or the actual operation of the transportation system itself.

Within the 2015 report as well as prior reports, MDOT has reported the share of CTP funding dedicated to GHG beneficial projects. Within the FY 2017 - 2022 CTP, MDOT estimates that 50 percent (approximately \$7.287 billion) of Maryland’s \$14.637 billion six-year capital program (excluding capital salaries, wages, and other costs) is associated with investments that could reduce GHG emissions by 2020 and beyond (see Figure 3). When including the Maryland Transportation Authority, which is primarily funded through toll revenues and bonding capacity, the share decreases to 44 percent (associated with an extensive commitment of MDTA resources toward preservation of the toll system and its bridges and tunnels). Note, \$6.019 billion

of the six-year capital program (41 percent) is committed to projects that maintain and preserve Maryland’s multimodal transportation system.

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Figure 3. 2017-2022 CTP GHG Beneficial Projects



The successful maintenance, operation, and expansion of Maryland’s transportation system requires extensive coordination between MDOT and a diversity of Federal, State, regional, and local partners. This coordination is extremely critical given the shared approach between multiple government agencies as well as private entities in delivering Maryland’s transportation system. Regulatory, financial, political, legal, and contractual matters, among others, create a complex framework within which MDOT manages Maryland’s transportation system. This framework guides how MDOT, other transportation planning agencies, and transportation service providers function. The consideration of climate change is one of many factors embedded within this framework.

More than any other sector, the performance of Maryland’s transportation system as well as MDOT’s ability to maintain and enhance the system, is influenced by social, technological, and economic trends (including fuel prices, which have a significant impact on travel activity). Emerging trends toward a “sharing economy” (particularly in transportation), vehicle technology and fuel advancements including electric and autonomous/connected vehicles, and changing logistics and supply chain patterns will greatly impact use of the transportation system. These trends will considerably shape Maryland’s ability to reduce GHG emissions from the transportation sector over the coming decades. In many cases Maryland, and MDOT specifically, has little control in how these trends will play out.

The Role of Transportation in Maryland GHG Emissions

In 2015, transportation represented 34 percent of Maryland GHG emissions. Of the 34 percent, 31 percent is from on-road mobile sources (e.g., cars, buses, and trucks), and the remaining 3 percent is from non-road transportation (e.g., airplanes, boats, locomotives, and construction equipment).³

Within the transportation sector:

- **66 percent of emissions come from on-road gasoline vehicles** (e.g., typical passenger cars and light-duty trucks),
- **17 percent of emissions come from on-road diesel vehicles** (e.g., delivery trucks, combination trucks, and buses), and
- **17 percent of emissions are from the off-road sector** including: aviation (6 percent), marine (3 percent), rail (<1 percent), non-road gasoline and diesel (7 percent), and liquefied natural gas (LNG) vehicles and off-road equipment (1 percent).

Maryland's transportation sector proportion is above the nationwide average of 28 percent. This is partly attributable to the extensive pass-thru transportation in Maryland, resulting in a higher emissions impact proportional to Maryland's economy. MDOT programs can directly impact GHG emissions from on-road vehicles. Levers to impact emissions from aviation, marine, rail, and non-road sources are indirect and primarily focus on operations within the boundaries of the Port of Baltimore and Maryland's airports, but not on the remainder of commercial operations (where most of the emissions actually occur).

Understanding and MDOT Reporting Approach

The Act requires submission of an annual report by each Department reflecting progress toward meeting the GGRA goals. MDOT's 2017 status report includes the following sections:

- **Introduction** - A general summary of MDOT's role and climate change related planning efforts to date.
 - The introduction generally addresses: 2-1305(A)(1) "EACH STATE AGENCY SHALL REVIEW ITS PLANNING, REGULATORY, AND FISCAL PROGRAMS TO IDENTIFY AND RECOMMEND ACTIONS TO MORE FULLY INTEGRATE THE CONSIDERATION OF MARYLAND'S GREENHOUSE GAS REDUCTION GOAL"
- **Impacts of Climate Change/Climate Adaptation** - A description of each transportation business unit's (TBU) efforts regarding transportation system adaptation to climate change and resiliency planning.
 - This section generally addresses: 2-1305(A)(2) "THE REVIEW SHALL INCLUDE THE CONSIDERATION OF: (I) SEA LEVEL RISE; (II) STORM SURGES AND FLOODING; (III)

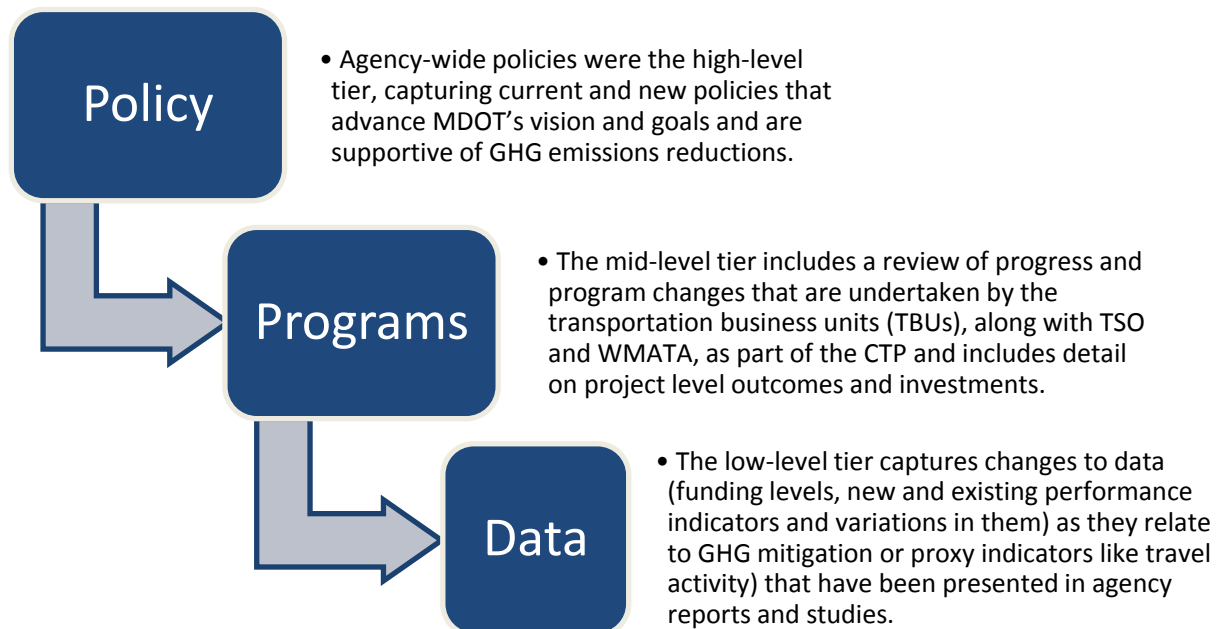
³ Greenhouse Gas Emissions Reduction Act Plan - 2015 Update. Maryland 2006 Base Year and Projected 2020 GHG Emissions, by Sector.

INCREASED PRECIPITATION AND TEMPERATURE; AND (IV) EXTREME WEATHER EVENTS.”

- This section also generally addresses annual status reporting required in 2-1305(C)(1)&(2) as it relates to MDOTs efforts to incorporate climate change considerations into planning, regulatory, and fiscal programs.
- **Annual Status Report on Actions to Support Maryland’s GHG Reduction Efforts** - This section includes four status reports for the policy options associated with the transportation sector in the 2015 GGRA Plan. Each of the four status reports - Transportation Technologies, Public Transportation, Pricing Initiatives, and Other Innovative Transportation Programs - report on accomplishments and ongoing actions to support GHG emission reductions.
 - This section generally addresses: 2-1305(C)(1)&(2) “REPORT ANNUALLY ON THE STATUS OF PROGRAMS THAT SUPPORT THE STATE’S GREENHOUSE GAS REDUCTION EFFORTS OR ADDRESS CLIMATE CHANGE”

2017 Annual Status Report Summary

Updates to the annual status reports followed a tiered review approach. Three tiers of review were conducted in order to account for full scope of activities so far in 2017: policy, programs, and data.



Successes highlighted in each status report document MDOTs ongoing commitment to a multimodal and multifaceted approach to mitigating GHG emissions including plans, programs, and projects that will support GHG emission reductions across Maryland through 2020 and beyond.

2017 Status Report Accomplishment Highlights	
Adaptation & Resilience	State Highway Administration (SHA) completed a statewide coastal vulnerability assessment with the best available climate projections and LiDAR data to help inform all aspects of planning, programming and design to ensure resilient and reliable transportation.
	MTA Environmental Planning Division (EPD) completed a climate change focused Vulnerability Plan in 2016 and is continuing to utilize the results in development of adaptation measures and resiliency planning.
Transportation Technologies	MDOTs leadership of the Electric Vehicle Infrastructure Council (EVIC) continues to build opportunities, financial incentives and promotion of the purchase of EVs and the installation of electric vehicle supply equipment (EVSE) to support the State’s EV goals. Total battery-electric and plug-in hybrid electric vehicles registered in Maryland is approaching 10,000 vehicles in 2017.
	SHAs investment into a “progressive” design-build approach to improve reliability and reduce congestion in the I-270 corridor is an example of a project that will utilize innovative and technology focused approaches to manage congestion.
	SHAs CHART program continues to yield substantial GHG reductions associated with the efficient management of incidents, traveler information, and other on-road infrastructure technologies that reduce delay.
Public Transportation	The multi-year planning process and successful start-up of BaltimoreLink in 2017 was a major effort resulting in the reconfiguration of local and commuter bus service throughout Baltimore. BaltimoreLink results in a more efficient and accessible system, including an estimated 32% increase in the population within ¼ mile of transit service.
	Supported by two TIGER Grant awards from US DOT, MTA is working with Baltimore City to deliver the North Avenue Rising project and Montgomery County to deliver the US 29 Bus Rapid Transit project. Both projects were added to the construction program in the 2017-2022 CTP, and will provide enhanced and more efficient transit options in these critical corridors.
	Groundbreaking for the Purple Line in August 2017 through securing of \$900 million from the Federal Transit Administration to match State, local, and private funding.
Transportation Pricing	MDOT and MTA continue to work with Maryland’s metropolitan planning organizations, major employers, and universities, to expand transportation emission reduction and monitoring (TERM) programs, aimed at providing commuters and student’s access to financial incentives and information to support ridesharing and transit use.
	MDTA continues to update the technical capabilities and efficient operations of toll facilities, including strategic planning and procurement of new tolling hardware and software which supports an eventual shift to all-electronic tolling.
Bicycle and Pedestrian	Since its inception in 2012, the Bikeways Program has awarded \$16 million to 130 local bicycle transportation projects. The Bikeways Program is one of multiple grant programs that provides funding for a diversity of bicycle and pedestrian investments in Maryland, including bike share, recreational trails program, and transportation alternatives program.

Actions and Recommendations

In [MDOT's GGRA Plan 2015 Update](#), MDOT extensively documented the current programs and projects that are supporting the GHG reduction goal, as well as the future potential policies and actions where MDOT may further support GHG reduction goals in 2020 and beyond. In 2017, these programs and projects continued to advance and expand, as described in the status reports for each of the four transportation policy options. Starting in fall 2017, MDOT will initiate the process of developing the Draft 2018 GGRA Plan focused on the 40 by 30 goal. This process in 2017 and 2018 will include:

- Stakeholder input into 2030 strategy selection and evaluation,
- Strategy estimation process enrichment to include approaches for estimating the synergies of different strategy bundles,
- Considerations for cross-sectoral consistency in assumptions, particularly regarding land use and development,
- Continued evaluation of best available statewide inputs to emission modeling processes including areas not covered by MPO travel models, and
- Estimation of strategy co-benefits including social equity, public health, and other environmental benefits.

Climate Change Adaptation and Resilience

Program Description and Objectives

MDOT is developing vulnerability assessment data and resiliency plans to address the current and future impacts of climate change on the transportation network. MDOT's TBU representatives are members of the Maryland Commission on Climate Change's Adaptation and Response Workgroup and provide invaluable input as well as coordination with other state agencies. This report contains details for each TBU within MDOT on adaptation and resiliency measures undertaken since October 2016 as summarized below.

SHA	<p>The MDOT SHA completed a statewide coastal vulnerability assessment with the best available climate projections and LiDAR data. Data from the vulnerability assessment will be integrated into all aspects of planning, programming and design to ensure resilient and reliable transportation. Vulnerability assessment data is available for counties to utilize and has been incorporated into county reports that will provide roadway vulnerability information for all state and locally maintained roads. The completed data will be hosted on a server for free access for county planners and emergency services and is being integrated into asset management plans and project planning. Pilot studies are anticipated in the next year to assess vulnerability to flooding in non-coastal locations.</p>
MTA	<p>The MDOT MTA Environmental Planning Division (EPD) completed a climate change focused Vulnerability Plan in 2016 and is continuing to utilize the results in development of adaptation measures and resiliency planning. Implementation of the adaptation measures will provide security and resilience for MTA assets identified as susceptible to sea level rise, hurricane storm surge, and flooding events.</p>
MPA	<p>The MDOT MPA began development of a resilience program for climate change with its 2010 vulnerability assessment of port infrastructure, and has incorporated several Coast Smart best management practices (BMPs) into design engineering for new terminals, structures and dredged material management facilities.</p> <p>A significant portion of the MPA's terminals and facilities are in the 100-year flood plain, and it would be both disruptive to operations and cost prohibitive to attempt to raise facilities. MPA will consider implementing enhanced resiliency when undertaking new construction or rehabilitation of existing facilities. In 2017, the MPA conducted a Strategic Thinking Session to review climate change vulnerability in the context of current science and climate modeling. As a result of that session, the MPA convened an inter-departmental team to continue planning and implementing climate adaptation and resilience strategies.</p>
MAA	<p>Over the past few years, MDOT MAA participated in the development of the Coast Smart Construction Guidance through the Coast Smart Construction Council. During the meeting process, MAA received sea level rise/inundation mapping from the Maryland Department of Natural Resources (DNR), and included the 2-foot, 5-foot, and 10-foot projected sea level rise as a layer superimposed on the Airport Layout Plan (ALPs) for Martin State Airport to assist with future planning efforts.</p>
MDTA	<p>MDTA is continuing to develop a framework that creates the process and methodologies to support in identifying vulnerabilities as well as developing adaptation measures for improved infrastructure resiliency. This framework can be used for a variety of climate stressors including sea level rise, storm surge, temperature, precipitation, and extreme weather events.</p>

Implementation Activity

Each MDOT TBU has documented actions undertaken to improve transportation network resiliency to climate change since October 2016.

MDOT SHA

- Completed MDOT SHA District 2 and District 4 (Talbot, Queen Anne's, Kent, Cecil, Harford, and Baltimore Counties and Baltimore City) Flood Depth Grids for 2015, 2050, and 2100 containing two sea level measures (Mean Sea Level and Mean High High Water) and five storm scenarios, 10%, 4%, 2%, 1%, 0.2%, and no-flood.
- Drafted Reports to show all mapped flood depth grids and impacts to roads (local and state) for each of the Maryland tidally influenced counties.
- Worked with Salisbury University's Eastern Shore Regional GIS Cooperative to update 2050 and 2100 Sea Level Change (SLC) mapping based on the US Army Corps of Engineers 2013 guidance per FHWA guidance with the most recent LiDAR data (post-Sandy studies).
- Updated the Programmatic Categorical Exclusion NEPA document that includes review of the 2050 and 2100 SLC mapping to ensure project design engineers are aware of the future conditions and consider SLC in design.
- Presented coastal vulnerability study findings to the Baltimore Regional Transportation Board and Hazard Mitigation Planners at the Baltimore Metropolitan Council.
- Provided SLC and storm projection information and mapping to Calvert and Somerset Counties for Hazard Mitigation Planning.
- Created a data driven methodology to review flooded roadway segments as shown in the Hazard Vulnerability Index and prioritize locations in need of further study.

MDOT MDTA

- Coast Smart recommendations are considered and incorporated into design during drainage repair projects and new State projects, most recently the Nice Bridge.
- Floodplain and sea level rise layers are included in MDTA GIS data. Using this data, MDTA assessed, at high-level, the vulnerability of its nine maintenance facilities for sea level rise, storm surge, precipitation, and temperature for years 2050 and 2100. This vulnerability assessment provided insight on the potentially most vulnerable assets. Overall, this study can provide MDTA with planning level information needed to prioritize and allocate resources.
- MDTA includes the 2050 and 2100 sea level rise mapping into NEPA/MEPA review of projects.

MDOT MTA

- Included identification of infrastructure and assets vulnerable to sea level rise and 100- and 500-year flood events in MTA's Climate Change Vulnerability Assessment. Adaptation of the high-risk locations will be conducted through MTA's Asset Management Planning and system preservation program.
- MTA's infrastructure impacted by extreme weather events is inspected, maintained and replaced through MTA's system preservation program.
- A GIS dataset has been developed which includes all MTA assets, current and planned. Layers within the dataset outline the potential impacts of sea level rise at 2, 4 and 6 feet above mean sea level. In addition to depicting MTA assets, the layers outline core transit routes and locations where these routes will be impacted by each of the scenarios.
- MTA is incorporating 2050 and 2100 sea level rise mapping in its conceptual planning for capital projects to ensure relevant design criteria, as outlined in the Coast Smart Construction Program, is taken into consideration in preliminary engineering.

MDOT MPA

Resiliency measures are being implemented at the Port. The list below demonstrates the variety of projects that ensure flood resistant infrastructure and reduce the Port's carbon footprint.

- Investing in stormwater management infrastructure improvements.
- Elevated the cruise terminal parking.
- Replacement for Dundalk Marine Terminal (DMT) Building 91C is being elevated to at least +10 ft.
- Filling and raising the elevation of the FMT Wet Basin and South Locust Point Fruit Slip as much as possible, yet allow for cargo operations seamlessly with adjacent lots.
- Nearing completion of second forced main storm water vault at C Street to prevent recurrent flooding due to frequent, severe rain events.
- Installed computer-controlled high mast lighting on Marine Terminals to reduce electrical consumption.
- Upgraded lighting, occupancy sensors, and programmable thermostats at MPA facilities.
- Installed an energy management control system and HVAC upgrades at the World Trade Center.

MDOT MAA

MDOT MAA is the owner of Martin State Airport, and can report that there have been no projects at Martin State Airport that have occurred in areas of projected sea level rise/inundation.

Enhancement Opportunities

Opportunities for ongoing planning and implementation rely on the significant progress already made by each of MDOT's TBUs and expand these resources to support planning and investment decisions across multiple agencies, including other State and local partners.

MDOT SHA

- Integration of the coastal vulnerability data into asset management and project development.
- Participating with the "Maryland Resiliency Partnership" in collaboration with Maryland Department of the Environment, MEMA, FEMA, and the Department of Natural Resources.
- Integrating system resiliency into the current planning processes by utilizing vulnerability data in development of a highway project prioritization tool.
- Developing future precipitation projections to integrate with GISHydro data utilized by engineers in hydrology and hydraulic design.
- Utilizing future precipitation data developed for Maryland, United States Geological Service stream data, and Maryland Department of the Environment stream modeling to improve storm event data predictive analysis.
- Coordinating with other states and participating in Transportation Research Board and American Association of State Highway and Transportation Officials research to remain on the cutting edge regarding climate resiliency and adaptation.

MDOT MDTA

- MDTA will utilize the vulnerability data of nine maintenance facilities to inform the prioritization and allocation of resources.

MDOT MTA

- Information gained from MTA's Climate Change Vulnerability Assessment will be used to develop and implement mitigation or adaptation measures at sites identified as posing a high or very high risk to MTA's services.
- Cost estimates to complete adaptation measures will be developed in coordination with relevant state agencies including the Maryland Emergency Management Agency.
- Results of the Climate Change Vulnerability Assessment will be incorporated into MTA's Asset Management Plan and system preservation program as appropriate.

MDOT MPA

- Developing robust GIS and engineering tools to help estimate risks, vulnerabilities and costs.

- Considering feasibility of incentives to partners/tenants to help reduce GHG emissions, for example clean diesel, dray replacements, new technologies, etc.
- Increasing the elevation of DMT Berths 1-3 and Lots 100-300 is currently under consideration and study, with the wharf increasing to +9 for operational issues. This could have the added benefit of reducing inundation at the bottom of the wharf structure.
- Updating emergency preparedness plans periodically, including tenant notification SOPs and coordinated cargo moves to higher locations.
- Stockpiling/reuse dredge materials for use in raising terminals and other land/infrastructure projects.
- Initiating a study to determine carbon sequestration in the created wetland/coastal ecosystems at Hart Miller Island.

Funding

SHA has a dedicated position to develop vulnerability studies and integrate infrastructure resiliency throughout the agency, as well as manage greenhouse gas reduction efforts. State DOTs are required to develop risk-based Transportation Asset Management Plans (TAMPs) in the fulfillment of MAP-21 requirements (23 U.S.C. 119(e)(1), MAP-21 § 1106). In addition, the most recent surface transportation law, the FAST Act (23 CFR 450.306) requires improved resiliency and reliability of the transportation system. SHA will address these requirements by incorporating vulnerability data into the asset management program. SHA is able to use FHWA Federal-Aid Highway funding for the State Planning and Research Program to accomplish this work as well as grant opportunities from FHWA.

FEMA/MEMA grants may be an option for MDOT projects. MTA has been in consultation with MEMA to identify adaptation and resiliency projects eligible for funding. All TBUs will continue to seek funding opportunities for infrastructure adaptation.

Challenges

MDOT is in various stages of resiliency work. Because of the vulnerability assessments and time required to implement systemic organizational change, some TBUs are still planning and others are already implementing adaptation measures. The increased cost of adaptation is not known for many projects at this time; however, the vulnerability assessments are ongoing and provide data for the determination of adaptation needs.

While infrastructure adaptation may increase costs, it could also increase the life span, improve reliability and reduce maintenance requirements for the infrastructure. It is important to consider and quantify all benefits now and in the future. MDOT is thoughtfully approaching the challenges of evaluating and changing current practices. Utilization of new technologies and procedures need to be evaluated and considered in construction, engineering, planning, and operations and maintenance that can reduce potential flood impacts.

GGRA Program Status – Transportation Technologies

Program Description and Objectives

Transportation technologies continue to be a major contributor in reducing GHG emissions. The technology advances of the on-road fleet are comprised of state and federal initiatives that set fuel economy standards and reduce tailpipe emissions of both light-duty vehicles, and medium and heavy-duty trucks. The GHG emissions benefits are produced through three primary strategies: (1) overall fuel economy proficiencies; (2) cleaner fuels; and (3) vehicle emissions technologies. The programs specific to vehicle technology efficiencies include the following:

- The Maryland Clean Car Program that incorporates the California low emission vehicle (LEV) standards and zero emissions vehicles (ZEV) mandates
- Corporate Average Fuel Economy Standards (CAFE) standards for model years 2008-2011
- The National Fuel Economy Program – Phase 1 for model years 2012 to 2016
- The National Fuel Economy Program – Phase 2 for model years 2017 to 2025
- Medium/Heavy-duty vehicle (trucks and buses) standards for model years 2014 to 2018 medium and heavy-duty vehicles
- Federal Renewable Fuels and Tier 3 Fuel Standards

MDOT chairs the Electric Vehicle Infrastructure Council (EVIC) that seeks opportunities, financial incentives and promotes the purchase of electric vehicles (EVs) and the installation of electric vehicle supply equipment (EVSE) to support the State's EV goals.

MDOT's Coordinated Highway Action Response Team (CHART) program utilizes intelligent transportation system (ITS) technologies to enhance travel and reduce traffic congestion. The advanced traffic management system (ATMS) and advanced traffic information system (ATIS) include cameras, traffic detectors, weather sensors, dynamic message signs, traffic websites, and telecommunications networks.

The CHART program combined with strategic roadway capacity and operations projects and programs are designed to reduce traffic delay, bottlenecks, or other capacity inefficiencies that contribute to GHG reductions. A major focus of these capacity and operation strategies are to reduce delay and increase the reliability of freight movement in Maryland – as heavy-duty trucks are a fast increasing share of on-road GHG emissions. SHA also continuously works to improve the efficient operation of signalized intersections throughout Maryland, to ensure improved corridor-level synchronization. In addition, the transportation program includes technology and efficiency strategies for the Port of Baltimore, aviation, and freight movement in Maryland.

Implementation Milestones

The transportation technology programs related to vehicle fuel economy and GHG emissions are implemented through state and federal regulations.

- The Maryland Clean Cars Act of 2007 has been fully implemented through regulations and codified in COMAR 26.11.34.
- The National Fuel Economy Program standards are implemented and enforced through federal regulations adopted by EPA and the National Highway Traffic Safety Administration (NHTSA). The Phase 1 standards were adopted in 2010 and required manufacturers to meet a 35.5 miles per gallon (mpg) equivalent by model year (MY) 2016. Phase 2 standards were adopted in 2012 and require a 54.5 mpg equivalent by MY 2025. While the newer federal programs supersede NHTSA's pre-existing CAFE standards for model years 2008-2011, those earlier MY vehicles remain in the fleet and are projected to continue to produce benefits in 2020.
- EPA's annual GHG Performance Report formally documents the status of auto manufacturer's compliance with the GHG fuel economy standards that took effect in the 2012 model year. Findings show that the auto industry is outperforming the GHG grams / mile standard. As the GHG standard becomes more stringent through model year 2025, most of the auto manufacturers are already positioned to meet the requirements, ensuring continued and increasing GHG benefits.
- The Medium- and Heavy-duty Vehicle Standards were jointly adopted by EPA and NHSTA in 2011 and apply to semi-trucks, large pick-ups and vans, all types of work and delivery trucks and buses.

Maryland is a leading state advancing the deployment of EV charging equipment and other alternative fueling stations and setting aggressive targets through incentives and other programs for a growing EV/AFV market.

- In addition to leading EVIC, MDOT actively participates in the Clean Vehicles and Fuels Workgroup of the Transportation Climate Initiative (TCI), and the Diesel Emissions Roundtable. MDOT successfully submitted and received designation of alternative fuel / electric vehicle corridors under the Fixing America's Surface Transportation (FAST) Act. The four corridors include: I-95, US 50, I-270 and I-70/I-68. All of these efforts, combined with Maryland EV Excise Tax Incentive renewed during the 2016 Legislative Session, are focused on increasing EV sales and enhancing the availability of EVSEs.
- Figure 4 illustrates the existing electric vehicle ownership (battery EVs (BEV) and plug-in hybrid EVs (PHEV)), charging infrastructure, and the alternative fuel / EV corridors as of July 2017. Figure 5 demonstrates the continued growth of EVs in Maryland since 2012. As the number of registered EVs grows exponentially, reaching the State goals in 2020 appears unsurmountable. However, the EV technology is rapidly improving and additional models are becoming available that will improve the EV market.

Figure 4. Existing Maryland Electric Vehicle Density and Charging Station Locations

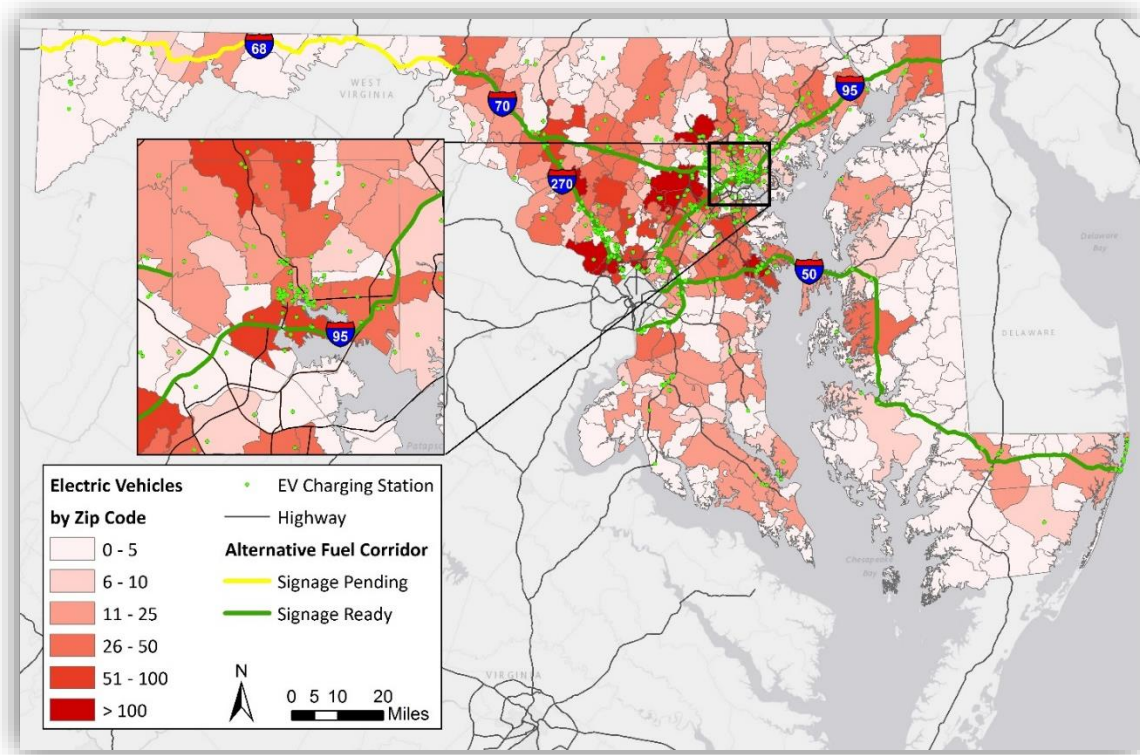
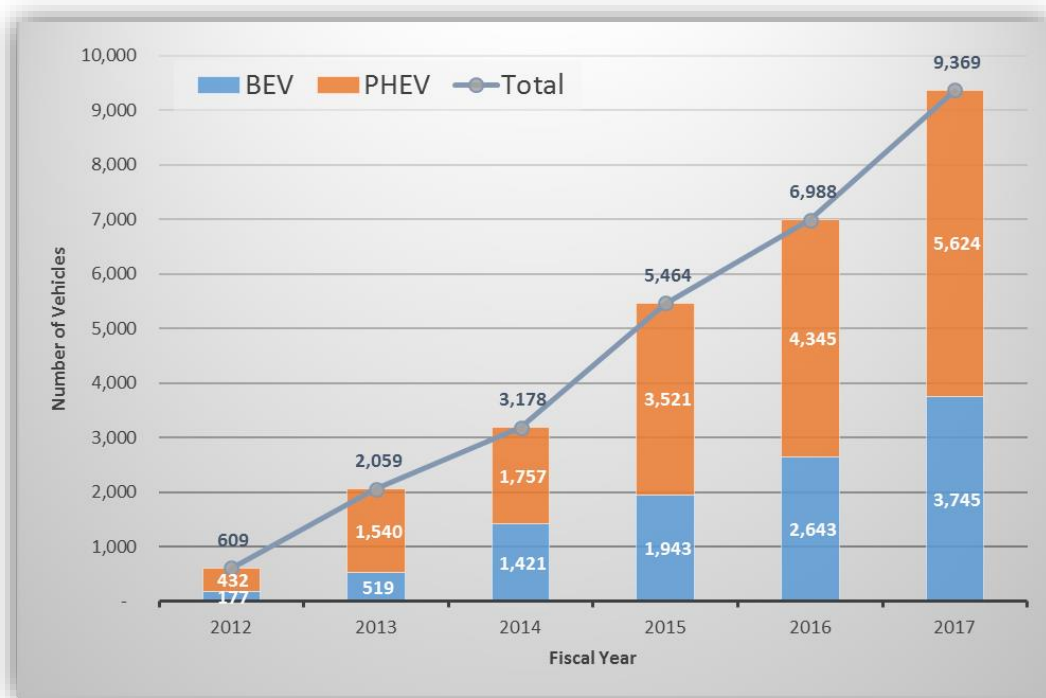


Figure 5. Existing Maryland Battery and Plug-In Hybrid Electric Vehicle Registrations



- MDOT issued a Request for Proposal (RFP) in June 2017 to create a Master Services Agreement (MSA) to select qualified contractors to design, construct, commission, finance, operate, and maintain renewable energy facilities at MDOT locations throughout Maryland. The MSA resulting from this RFP will provide MDOT with the flexibility of developing renewable energy systems quickly and efficiently. The scope of the RFP includes solar, geothermal, and microhydropower renewable energy systems. Table 1 provides the current MDOT renewable energy facilities along with their GHG benefit.

Table 1. MDOT Renewable Energy Facilities

Solar and Wind Technologies - Lifetime Totals (as of June 2017)				
	Capacity (kw)	Generation (kWh)	CO2 (lb)	Install Date
MAA	505	3,390,000	10,234,544	Sep-11
MDTA		131,716	186,231	Apr-13
MPA (Cruise Terminal)	249.6	1,370,000	4,151,540	Aug-12
MPA (Shed 10)	505.44	2,310,000	6,970,462	Aug-12
MTA	535.39	3,050,000	9,222,403	Feb-12
SHA (Wind)	2.4	5,579	7,887	2009
Total:	1,797.73	10,257,294	30,773,067	

On-road technologies and operational strategies to reduce criteria pollutant and GHG emissions resulting from delay and other inefficient travel conditions are a major focus of MDOT's Consolidated Transportation Program.

- The CHART program is comprised of five major components: 1) Traffic and Roadway Monitoring; 2) Incident Management; 3) "511" - Traveler's Information; 4) System Integration and Communication; and, 5) Traffic Management. The effectiveness of CHART in detecting and managing incidents provide measurable benefits in delay, fuel consumption, emissions reductions and cost savings.

CHART Annual Savings to Maryland:
 Delay - 43.5 million vehicle hours
 Fuel Consumption - 8.2 million gallons
 GHG Emissions - 70,000 metric tons
 Cost Savings - \$1.5 billion
- Maryland's Strategic Goods Movement Plan (2017 Update) develops specific strategies to address the forecasted doubling of freight activity throughout the mid-Atlantic region by 2030. As much of Maryland's freight network is shared with passenger or vehicle operations, both freight and passenger growth will exacerbate already congested infrastructure throughout the State. The resulting chokepoints create significant challenges for freight and passenger movement in the region. In 2015, the cost of congestion on Maryland's freeway/expressway system to truckers was estimated at \$119 million. MDOT developed a Corridor Priority Tool to evaluate truck volumes, freight density, intermodal connections and bottlenecks to identify Maryland's critical urban and rural freight corridors and to prioritize freight-related projects.

Enhancement Opportunities

Technology innovations are the largest contributor to GHG reductions for the transportation sector. Maryland and other leadership states have played an active role in encouraging technological advances and more stringent national standards.

- For the light-duty fleet beyond the 2025 national fuel economy standards, MDOT encourages EPA and NHSTA to continue promoting more stringent fuel economy standards.
- EPA and NHTSA recently established new standards for medium- and heavy-duty vehicles to reduce GHG and improve fuel efficiency for model years 2018 through 2027. This program is expected to achieve an additional 10 percent GHG reduction and has a favorable payback period of under two-years to recoup the extra cost of the technology in fuel savings.
- Maryland's zero emissions vehicle (ZEV) program is part of the California Clean Cars Program that Maryland adopted in 2007. It requires vehicle manufacturers to sell an increasing number of ZEVs in the state. Maryland is currently working with NESCAUM and other ZEV MOU states to re-evaluate the ZEV goals. While Maryland is making significant progress in supporting EVs and the infrastructure to match, the State goals have been ambitious from the beginning: 60,000 EVs by 2020, 300,000 by 2025. The latest estimates, which were updated with the submission of EV Corridor nominations to US DOT, project that 100,000 EVs will be registered in the State in 2020.
- Technology enhancements in the non-road sector could also bring additional GHG reductions to include construction equipment, port and airport support vehicles, locomotives, and marine engines. MDOT, MDE and MPA have signed an MOU to enhance emissions reductions in Maryland's ports, and in August 2016, EPA finalized the first step to address GHG from aircraft emissions.
- MDOT is leading the State's efforts on emerging connected and autonomous vehicle technologies that have the potential to significantly reduce traffic incidents while enhancing the capacity and efficiency of the transportation system. As these technologies are more broadly deployed, there are opportunities to reduce GHG emissions associated with recurring and non-recurring congestion.
- In addition to the CHART real-time information, there are also new navigation and rideshare technologies that reduce the amount of time people sit in traffic by providing alternate routes and travel options. Examples include WAZE, Google and INRIX and this technology is being integrated into routing technologies across all sectors to help create more efficient pathways for everything from delivery trucks to street sweepers.
- The Strategic Goods Movement Plan noted reducing freight bottlenecks, enhancing port operations and throughput, and improving freight infrastructure through technology enhancements and capacity as the path forward to maintain Maryland's market position.
- MDOT submitted a FASTLANE Grant Application to FHWA in 2016 in a partnership with CSX to expand the Howard Street Tunnel which will accommodate double stacking of freight cars through region - making the Port of Baltimore more competitive and supporting the diversion of freight from trucks to rail - a net GHG emissions benefit.

Funding

The transportation technology standards are implemented by the vehicle manufacturers at no cost to the State of Maryland. There may be additional costs to the consumers purchasing new vehicles, but the costs can be offset by reduced fuel costs over the life span of the vehicle.

In the near-term, Maryland will continue to invest in EV and EVSE incentives. Under the federal Volkswagen Settlement, Maryland is seeking opportunities to enhance the EVSE infrastructure through the National ZEV Investment Plan and the Maryland Volkswagen Mitigation Plan. The

MDOT has committed \$18.2 million for FY2016 and \$105.6 million over the next six years to improve, maintain, and enhance the CHART program with on-road operational technologies and strategic capacity / operational enhancements. In total, in the 2017-2022 CTP, MDOT estimates that \$394.6 million is committed to projects that will enhance transportation technologies, including CHART, or relieve critical bottlenecks at intermodal facilities, which will result in overall better management and operations of Maryland's multimodal transportation system.

In addition, in the 2017-2022 CTP, there is \$2.56 billion committed to SHA projects that relieve key bottlenecks on Maryland's roadway network through strategic capacity enhancements. In the short term, these projects are expected to mitigate delay and the additional GHG emissions generated by inefficient, and low-speed travel by passenger and commercial vehicles. Many of these projects address the

The National Freight Program (NFP) provided new sources of funding for Maryland with the passage of the FAST Act. Over the next five years, Maryland's NFP allocation will be \$95.6 million. In addition, a new Federal discretionary program (INFRA) will help to fund larger projects supporting freight. The Strategic Goods Movement Plan identified Maryland's segments within the National Highway Freight Network which are eligible for the NFP.

Challenges

While technologies offer the most significant GHG emissions reduction potential for the transportation sector, the full potential of GHG benefits will not be fully achieved until the fleet turns over with newer fuel efficient and GHG beneficial vehicles. The federal technology standards will not be fully implemented until model years 2025 and 2027 for light-duty and medium- / heavy-duty vehicles, respectively.

EPA is currently performing a mid-term evaluation of GHG emissions standards for light-duty 2022-2025 model years. As a result of the review, the Trump administration may consider rolling back the fuel economy standards that were adopted during the Obama administration for light duty vehicles. This may reduce the GHG benefits for 2022 and newer model years as these vehicles may not meet the 54.5 mpg equivalent standard. However, California is likely to challenge any action related to relaxing the federal standards. Since Maryland's Clean Car program adopted California's standards, the program may not be impacted if California is able to defend its programs.

Meeting the Maryland Clean Car Program ZEV mandate goals by 2020 and 2025 will be challenging. Despite the rapid growth in EVs and EVSE infrastructure and market improvements, these goals are currently being reviewed and evaluated.

Estimated Greenhouse Gas Reductions

As technology advances and the vehicle fleet in Maryland turns over as newer cars and trucks replace older vehicles, the GHG benefits will continue to increase post-2020. Transportation technologies will be a significant contributor to meeting the 40% reduction goal in 2030.

As noted in the introduction section, even as VMT has increased in Maryland by over 2% in 2015 and 2016, estimated on-road GHG emissions have continued to decrease, primarily due to transportation technologies.

GGRA Program Status – Public Transportation

Program Description and Objectives

Public transportation contributes to GHG emission reductions in Maryland’s transportation sector by providing alternatives to travel in personal vehicles, thus reducing vehicle miles traveled (VMT). Public transportation emits roughly 40 to 50 percent less GHG emissions per passenger mile than an average single occupancy vehicle (SOV). The programs in this policy option include: transit initiatives that support a goal of substantially increasing public transit ridership, and intercity transportation initiatives that support MARC and other intercity transit services such as Amtrak. MDOT, the Maryland Transit Administration, and Maryland’s locally operated transit systems (in each of the 23 counties, Annapolis, Baltimore City, and Ocean City) work with MPOs and other local agencies in Maryland in advancing community projects aimed at advancing the multimodal transport system. These include transportation demand management programs (such as MTAs Commuter Choice Maryland and MWCOGs Commuter Connections), transit supportive enhancements including bicycle and pedestrian access projects, bicycle parking and bike racks on buses, and coordination with expanding bike share programs.

Public Transportation Initiatives

Program Description and Objectives

This program advances efforts to substantially increase transit ridership in Maryland. In order to maintain and enhance operations of the current system while strategically expanding services to support more Marylanders, systematic and coordinated actions are needed. These actions increase the availability, attractiveness, and convenience of public transportation, they improve the operational efficiency of the system, and they increase system capacity. Ongoing high-priority operational and capacity actions include implementation of the BaltimoreLink system and construction of the Purple Line.

Actions related to land use planning, including Maryland’s commitment to transit oriented development, incentives for riding transit, and bike and pedestrian access improvements are also necessary to continue to enable Maryland’s residents and commuters to have safe, efficient, and affordable transportation options.

Intercity Transportation Initiatives

Program Description and Objectives

Improvements to Maryland's intercity passenger transportation systems is one approach to addressing intercity mobility constraints. Improvements to MARC are helping to enhance connectivity, reliability, and access to intercity passenger rail, for both commuting and leisure trips for Maryland residents, employees, and visitors. In addition, through coordination with the Northeast Corridor Commission, the Federal Railroad Administration, and Amtrak, Maryland is supporting plans to address key bottlenecks to enhance the reliability of high-speed rail. This program overall includes the continued maintenance, operations, and expansion of intercity

passenger rail, high-speed rail, and intercity bus services in Maryland as well as improved connections between air, rail, intercity bus, and regional or local transit systems.

MTA continues to work with CSX and Amtrak to improve infrastructure on the MARC Brunswick, Camden, and Penn Lines, including improved signals, track improvements, and station area enhancements, including at Baltimore Penn and Washington Union stations. The launch of BaltimoreLink added and enhanced several Commuter Bus routes to improve regional mobility including connections between Baltimore and Annapolis as well as between Baltimore and Anne Arundel County.

Implementation Milestones

Public and intercity passenger transportation investments support improved accessibility, convenience, and reliability of services which create more incentive for travelers to use transit instead of taking a vehicle trip.

Support for transit investments are presented in MDOT's annual capital program, the Consolidated Transportation Program (CTP). Highlighted projects recently implemented through the CTP include:

- BaltimoreLink: Following 18 months of planning and public outreach, BaltimoreLink successfully launched on June 18, 2017. BaltimoreLink is a complete overhaul and rebranding of the core transit system operating within the Baltimore City and throughout the greater Baltimore region, resulting in a more efficient and reliable bus network by redeveloping the entire bus network to more effectively spread out service across the region, creating a grid of higher speed, high-frequency routes crossing the region, creating new run times for each route based on segment by segment vehicle data, and investing heavily on capital improvements that will help increase transit viability and usability for generations to come. Some of the capital investments include the implementation of dedicated bus lanes and transit signal priority on key corridors to maintain reliable service, and the construction of a new transit hub at the West Baltimore MARC station that allows for quick and convenient transfers. It is estimated that an additional 60,700 people will be within ¼ of the BaltimoreLink frequent transit network (meaning any route that operates every 15 minutes or less during the peak or midday periods).
- CAD/AVL Systems, Central Control Center, and Closed Circuit Television Improvements: Improved technologies supporting MDOT MTA bus system operations and reliability including automatic vehicle locator system deployment, enhancements to MTA's Central Control Center, and improvements and expansion to camera systems for safety and security.
- Southern Maryland Commuter Bus Initiative: New and expanded park and ride lots were completed at Dunkirk and Waldorf in 2016 providing new capacity for riders on the four daily commuter bus routes connecting southern Maryland to Washington D.C.
- Takoma/Langley Park Transit Center – This new transit center, located at the busiest bus transfer point in the Washington region, opened in December 2016. This off-street covered transit center includes 12 bus bays to provide service for 11 routes, Associated MTA

improvements include passenger shelters, a canopy over the entire facility, transit information services and new sidewalks and crosswalks. The project was designed to accommodate a future Purple Line station.

- Paul S. Sarbanes Transit Center: Located next to the Red Line Metrorail station, and MARC station in Silver Spring, this transit center features more than 30 bus bays serving Metrobus, Montgomery County Ride-On, VanGo and the University of Maryland shuttle.
- The FRA selected a preferred alternative for a replacement of the Baltimore & Potomac Tunnel in spring 2017, following 3 years of MDOT led study. The project, not yet funded, would remove and replace a critical bottleneck for the Amtrak Northeast Corridor and MARC Penn Line service through downtown Baltimore, while also facilitating more capacity for freight rail service to and from the Port of Baltimore.

Projects planned for implementation in the 2017 – 2022 CTP include:

- MARC BWI Rail Station upgrades and repairs will provide a more passenger-friendly station with additional seating and a new pedestrian overpass connecting the garage and station.
- MDOT in partnership with the Montgomery County Department of Transportation (MCDOT), conducted a corridor planning study to identify transportation needs and evaluate alternatives to accommodate high frequency, reliable Bus Rapid Transit (BRT) service on US 29 between Burtonsville Park and Ride and the Silver Spring Transit Center (approximately 14 miles). The study resulted in a successful joint application to the U.S. DOT Transportation Investments Generating Economic Recovery (TIGER) program and is now fully funded for construction within the 2017-2022 CTP.
- The MDOT MTA and Baltimore City submitted a successful joint application to the U.S. DOT TIGER program to support a \$27.3 million program of improvements to the North Avenue corridor, in Baltimore City. The North Avenue Rising project is a unique suite of proposed transportation investments intended to improve corridor and regional mobility and leverage these transportation improvements with other City, State, and private development initiatives to revitalize the surrounding area. The North Avenue Rising project includes dedicated bus lanes, new bike facilities, enhancing MDOT MTA Metro and Light Rail stations, targeted improvements at major bus stops, improved sidewalks, streetscaping, and needed roadway re-pavement along the corridor.
- Construction of the Purple Line, a light rail line that will provide service between Bethesda in Montgomery County and New Carrollton in Prince George's County. The Bethesda to Silver Spring segment will include a parallel hiker/biker trail.
- The WMATA Capital Improvement Program (CIP) includes \$1.2 billion of funding from Maryland to match federal formula funds received directly by WMATA as well as Maryland's share of additional funds for WMATA capital projects. The CIP is focused on safety, infrastructure rehabilitation and replacement and maintaining the Washington region's transit system in a state of good repair.

- MDOT MTA and LOTS continue to regularly update and renew their bus fleets in order to maintain the average age of the fleet, yielding reliability benefits and environmental benefits through reduced emissions, fuel consumption, and noise.

Enhancement Opportunities

Any enhancement of this program requires resource infusion in the form of capital or operating investments to provide new and improved services to areas that are lacking service or could be better served by existing services.

Implementation of BaltimoreLink provides a good example of how to expand service and enhance efficiency with a comparatively low capital commitment. Another example, through support from the MDOT Bikeways Program, is MTAs effort to retrofit its fleet of bi-level MARC cars to accommodate two full size bicycles per car. Investments like this help address first/last-mile access to transit issues.

Enhancements to the currently funded program will create opportunities to increase transit service and reliability, which can increase ridership, in terms of capturing choice transit riders, but also create economic opportunity for Maryland residents with limited transportation options. BaltimoreLink, North Avenue Rising, and US 29 Bus Rapid Transit are all examples of innovative partnerships for service expansion and improvements in developing areas and corridors – where the investment in transit can help to spur further mixed-use and transit-supportive development. These projects are also using existing infrastructure and new technologies to optimize service delivery and reliability. Ongoing planning by MDOT MTA and MDOT SHA for bus rapid transit, and MTA and WMATA activities regarding transit signal priority, bus-only lanes, and other on-board bus communication and location technologies will help maintain service quality while meeting public demand for reliable service.

MDOT is continuing to push forward with private partners on the design-build approach to the Purple Line, as well as longer-term transit investments such as the Corridor Cities Transitway and multiple components of the MARC Growth and Investment Plan, including replacements for the Baltimore & Potomac Tunnel and the Susquehanna River Bridge – two major bottlenecks on the Amtrak Northeast Corridor.

MDOT MTA is leading ongoing and new studies in 2017 and beyond focused on improvements to the Baltimore Metro/Light Rail network connectivity and service, ongoing bus rapid transit corridors studies in partnership with Montgomery and Howard Counties and MDOT SHA, transit development plans for multiple local operators, and an evaluation of bus-on-shoulder effectiveness and opportunities in the Washington D.C. region.

There are other areas of implementation which could be targeted for more aggressive short-term strategies now through 2020. These strategies will need additional funding through the Consolidated Transportation Program, as well as funding through other non-transportation sources as well as possible legislative support. These include continued bus replacement to cleaner alternatives and hybrid technologies (85% of MDOT MTAs fleet at present), ongoing technical support to local jurisdictions and partnerships (such as MDOT and WMATA joint development agreements) to help promote and create Transit Oriented Development (TOD)

projects, continued funding, evaluation, and expansion of transportation demand management programs and tax credits for employers for participation, consideration of new partnerships and potential service opportunities afforded by transportation network companies, and enhancing multimodal connections, particularly for bicycles and pedestrians.

Funding

Transit investments are strongly supported in the FY 2017–FY 2022 CTP, including the Purple Line construction, MARC maintenance and service expansion, BaltimoreLink operations, support of Washington Metropolitan Area Transit Authority (WMATA) in the Capital Region, and support of Locally Operated Transit Services (LOTS) across Maryland.

- MDOT MTA directs funding and statewide assistance to LOTS serving each of Maryland’s 23 counties, providing about \$119.2 million in grants in FY 2017. MDOT MTA continues to invest in transit infrastructure statewide, enabling Maryland’s residents and commuters to have safe, efficient and affordable transportation options. The US 29 BRT and North Avenue Rising projects together were awarded \$20 million by USDOT’s TIGER grant program. In the case of BaltimoreLink, \$135 million has already been spent, with scope for future investments as project improvements and updates to the plan are carried out.
- The Purple Line presents a new and innovative approach to transit infrastructure funding by using a Public Private Partnership (P3) agreement. The innovative P3 project delivery creates a predictable, transparent, and streamlined approach, incorporating best practices and lessons learned from other states and countries, while addressing the transportation and economic development needs of Marylanders. In August 2017, the USDOT announced a full funding grant agreement for the project, providing \$900 million in Federal funding to match local and private funding.
- In total, in the 2017-2022 CTP, MDOT estimates that \$3.574 billion is programmed to be spent on transit projects that help increase transit reliability, convenience, and accessibility, resulting in a more competitive system that helps to reduce emissions through mode shift from vehicle trips in addition to reducing emissions from transit service.
- An estimated \$358 million is programmed to be spent on intercity passenger service, particularly MARC service, commuter bus service, and overall improvements to the Northeast Corridor that will provide a more competitive travel option in the I-95 corridor.

Challenges

MDOT strives to maintain a balanced and multi-modal approach to the state’s transportation system to provide users with an array of transportation options including public transit. However, alternative choices like bicycling and pedestrian modes should be developed to supplement use of public transit due to their key role in first and last-mile connectivity. This is an area that continues to evolve as the state advances its design standards to implement “complete streets policy” where practical.

MDOT is aware of the increase in VMT and decrease in transit ridership over the past few years and is working to develop solutions that provide better multimodal connections that are less environmentally impactful.

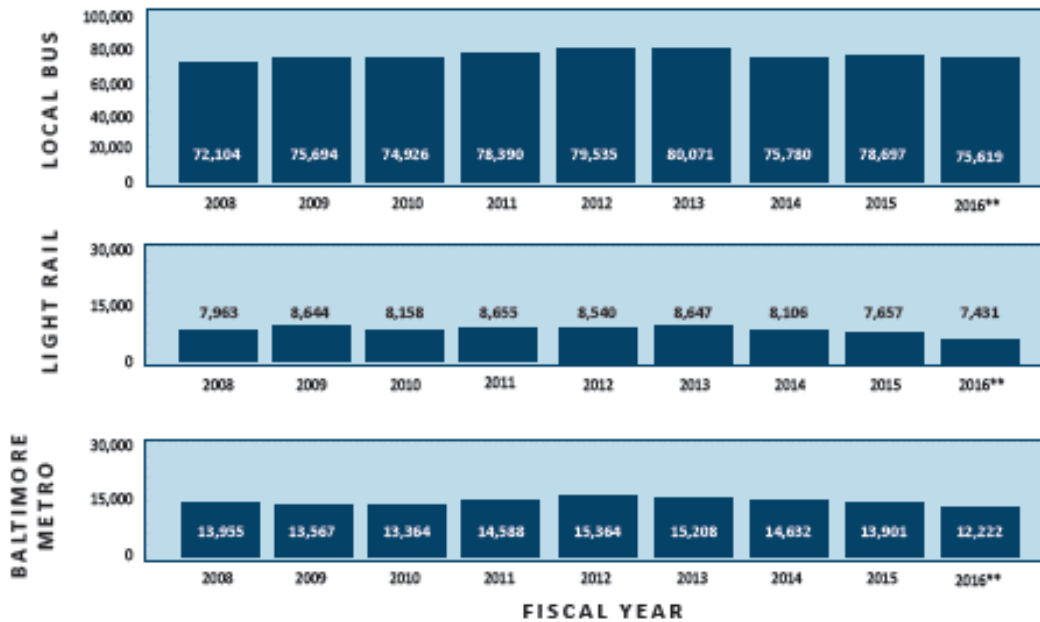
Estimated Greenhouse Gas Reductions

MDOT's Annual Attainment Report includes measures presenting transit ridership, commute mode share, total passenger and revenue miles of service, total transit investment, and on-time performance that serve as key indicators of progress towards the program goals and resulting greenhouse gas benefits. Figure 6 shows the weekday and annual transit usage as reported by MTA and other contracted services and as presented in the 2017 Attainment Report (available [here](#)). Ridership or passenger mile traveled are indicators of potential greenhouse gas emission reduction benefits from transit. Other indicators include revenue vehicle miles of service and/or average fleet age or fuel consumption data which are indicators of total transit operation emissions. MTA tracks these measures and others annually through its annual Transit Modernization Report as well as on a quarterly basis on its performance improvement website.

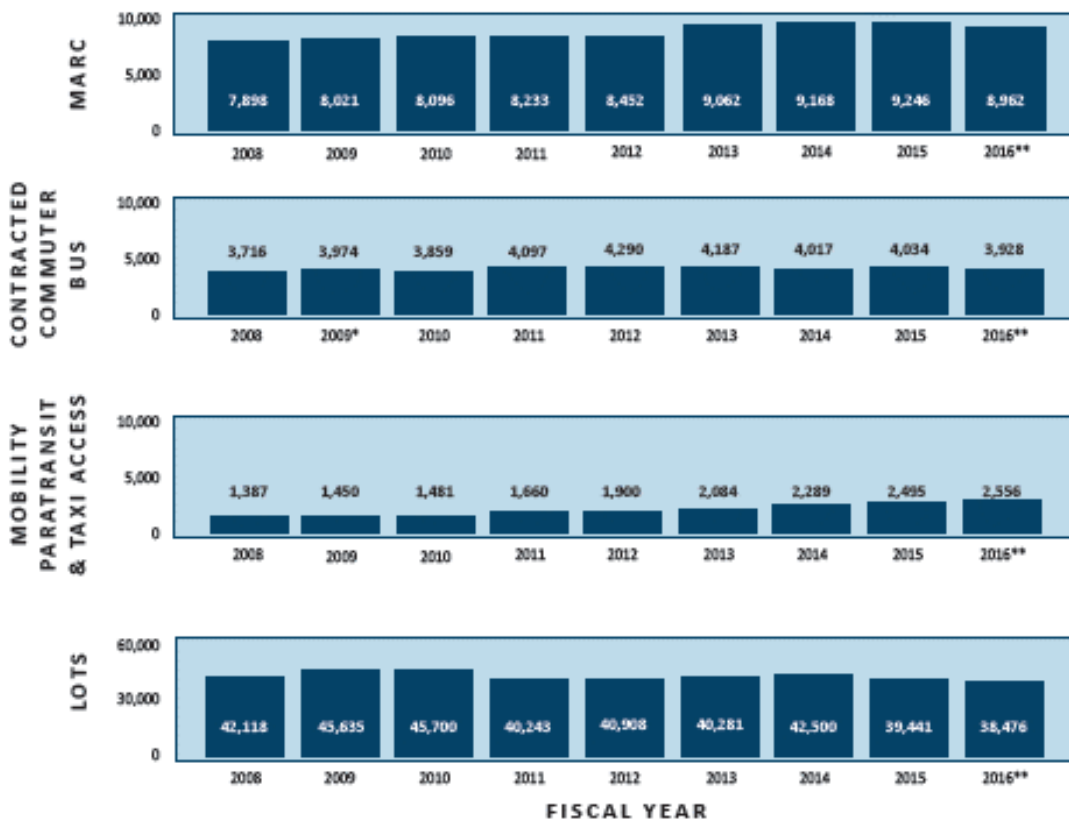
More than 111 million passengers used the WMATA Metrorail, Metrobus, and MetroAccess system in Maryland in 2016. SafeTrack led to substantial decreases in Metrorail ridership in 2016 and the first half of 2017 as a result of line closings and extensive single-tracking operations. The SafeTrack program and the associated rebuilding "surges" concluded in June 2017. Ongoing maintenance returns to normal levels for the remainder of 2017. Benefits of the year-long effort should overall increase reliability of the system and ultimately help bring riders back to Metrorail.

Figure 6. Maryland Transit Ridership Trend - 2008 to 2016

TRANSIT RIDERSHIP—MTA DIRECT-OPERATED SERVICES (THOUSANDS)



TRANSIT RIDERSHIP—CONTRACTED SERVICES AND LOTS (THOUSANDS)



* 2009 Contracted Commuter Bus data was revised from previous Attainment Report.

** 2016 data is preliminary and subject to change.

GGRA Program Status – Pricing

Program Description and Objectives

This program includes transportation travel demand management incentive programs and pricing disincentives. MDOT supports multiple commute alternative programs including ride sharing, guaranteed ride home, transportation demand program management and marketing (Commuter Connections and Commuter Choice Maryland), outreach and education programs (Clean Air Partners), parking cash-out subsidies, transportation information kiosks, local car sharing programs, telework partnerships, parking fees, and vanpool programs, among many others. These programs encourage use of alternative modes through pricing incentives (or disincentives) along with information for employers and employees. The pricing program also includes expanded and enhanced technologies for electronic toll collection on tolled facilities operated by the Maryland Transportation Authority (MDTA).

Implementation Milestones

Operational, management, and financial support for a broad range of travel demand management program (also known as Transportation Emission Reduction Measures (TERMs))⁴ is documented in the FY 2017 – FY 2022 Consolidated Transportation Program (CTP). These investments support emission reductions in air quality non-attainment and maintenance areas in Maryland through congestion mitigation, ridesharing and commuter incentive programs. Programs include the Commuter Connections program (managed by Metropolitan Washington Council of Governments) and the Commuter Choice Maryland program (managed by the Maryland Transit Administration), both which offer commuters and students (for example, via MTA College Pass and Transit Store) in the Washington and Baltimore regions access to financial incentives, ride sharing, guaranteed ride home, and traveler information to support carpooling and transit use. MDOT also supports the Telework Partnership, transit marketing and subsidy programs, and statewide park-and-ride facilities aimed at reducing single occupant vehicle (SOV) driving and encouraging ridesharing, transit, and telecommuting.

Electronic toll collection systems expedite the toll collection process, reduce delays at toll plazas, decrease emissions, and are available at all eight toll facilities across the state. GHG emissions are significantly reduced when tolls are collected electronically, due to reduced queuing and idling at toll collection plazas. In January, 2016 MDTA submitted a report to the Legislature as required by HB 389 All-Electronic Tolling (AET) Legislative Follow-Up Study that analyzes the potential of AET on MDTA's current toll facilities before further implementation activities.

Enhancement Opportunities

Expansion of Maryland's TDM program offerings, geographic scope, and incentives would require additional funding and potential legislation regarding tax credits and incentives. Other opportunities, such as expanded coordination with services such as Uber and Lyft, to enhance

⁴ The Secretary's office Capital Program Summary – Line 2
http://www.mdot.maryland.gov/newMDOT/Planning/CTP/CTP_17_22/Documents/TSO.pdf

access to transit and encourage ridesharing, are emerging possibilities to expand the scope of traditional TDM programs.

MDOT and its TDM partners will continue to expand the use of new information and communication technologies to reach more commuters and students with better traveler information and available incentives to increase program participation.

Within US DOTs surface transportation reauthorization, the FAST Act, The Surface Transportation System Funding Alternatives (STSFA) grant program⁵ will fund projects to test the design, implementation and acceptance of user-based alternative revenue mechanisms. The program will help address some of the concerns outlined in Beyond Traffic, the USDOT report issued in 2016 that examines the challenges facing America's transportation infrastructure over the next three decades, such as a rapidly growing population and increasing traffic. USDOT announced funding for eight projects in August 2016 that will pilot a variety of options to raise revenue, including on-board vehicle technologies to charge drivers based on miles traveled and multi-state or regional approaches to road user charges. The projects will address common challenges involved with implementing user-based fees such as public acceptance, privacy protection, equity and geographic diversity. MDOT will monitor the progress of these studies, future grant funding opportunities, and other emerging road pricing technologies.

Funding

MDOT sets aside nearly \$25 million in the CTP over the next six years to support the TERM programs, covering 15 counties in Maryland designated as non-attainment through the Clean Air Act. These funds are leveraged by additional Federal and local funds to deliver these programs to Marylanders.

The original AET Conversion and Prioritization Study, completed in 2014, estimated total costs to fully convert MDTAs seven legacy toll facilities to AET (not including the Intercounty Connector) between \$145 to \$177.5 million (in 2013 dollars). The FY 2017-2022 CTP identifies \$64.6 million in funding over the next six years to implement the next generation electronic tolling system which would represent the technology platform enabling a conversion to AET across the entire system (not yet funded in the CTP). This next generation tolling system will significantly enhance the capacity for handling video tolling and citations. Engineering is currently underway with collection system hardware and software procurement and installation starting in FY 2018.

In total, in the 2017-2022 CTP, MDOT estimates that \$228 million is programmed for transportation demand management program marketing and management activities (not including matching local funds) and deployment of all electronic tolling technologies.

Challenges

Travel Demand Management (TDM) offsets vehicle congestion by offering incentives for Marylanders to use public transit, carpool, walk or bicycle instead of driving alone. Other ways that roadway demand can be reduced is the promotion of telecommuting and flexible work hours

⁵ <http://www.fhwa.dot.gov/pressroom/fhwa1648.cfm>

as a way to reduce or shift trips to times when roadway capacity is less constrained. Expansion of employers offering these incentives and employees actually using them are associated with a number of business and personal cost and convenience considerations. Ensuring that information is available to employers and employees regarding program details is key to enhancing participation.

A key challenge to broader implementation and participation of TDM programs is the provision of ample and free employee parking. These decisions are traditionally led by the developer and property owners and informed by local zoning and development regulations. MDOT, through transit oriented development or other technical assistance programs can take a lead by example role as it relates to parking.

The significant expansion of transportation network companies (TNCs) operating in Maryland over the past couple years have changed the dynamic of ridesharing, guaranteed ride home, transit use, and participation in TDM programs. There are many uncertainties regarding the extent to which TNCs are competing with traditional transportation providers. Shared-use mobility, and the proliferation of travel information apps and services, presents both a challenge and opportunity for TDM programs and for local transit services.

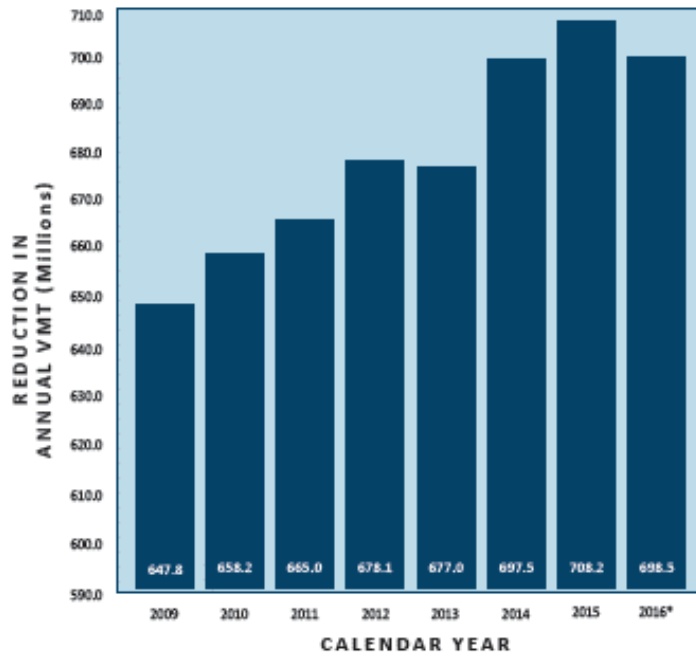
Conversion to AET brings a number of feasibility considerations including interoperability, leakage and reciprocity, business rules, account setup and conversion, and long-term policy. Note, ongoing FHWA studies and research on innovative financing options include broad policy and technical review of mileage-based road user fees as a mechanism to replace the Federal gas tax. The FAST Act commits additional resources to building the framework to eventually move in this direction.

Estimated Greenhouse Gas Reductions

According to MDOT's 2017 Annual Attainment Report, "over 698.5 million vehicle miles traveled (VMT) were reduced in CY 2016 through various Travel Demand Management (TDM) projects and programs, including Commuter Choice Maryland, Commuter Connections, the Telework Partnership, various transit marking and subsidy programs, and statewide park-and-ride facilities".

Figure 7 shows the estimated annual regional VMT reductions due to TERMS and Figure 8 presents the observed utilization of park-and-ride lots and the associated estimated VMT reductions. The Annual Attainment Report also tracks the percent of toll transactions collected electronically, estimated at 78 percent in FY 2016 as the total number of total toll transactions increased by 2.4 million, likely due to toll decreases and the new I-95 Electronic Toll Lanes. The 2017 Attainment Report is available [here](#).

Figure 7. Annual VMT Reductions Attributed to TERMS



* 2016 data is preliminary and subject to change.

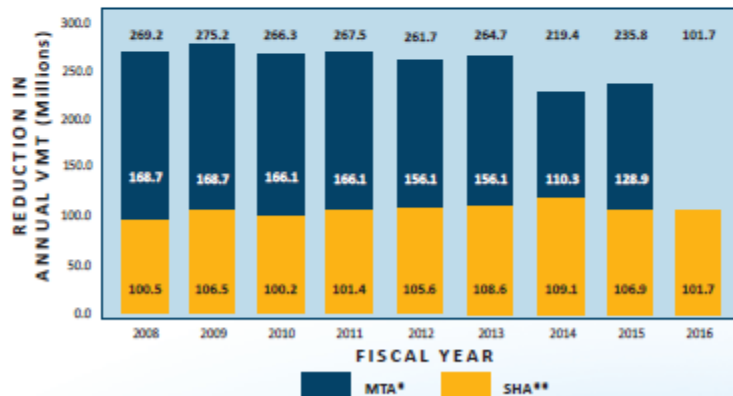
Figure 8. Reduction in Vehicle Miles Traveled Through Park-and-Ride Usage

AGENCY	TOTAL SPACES	AVERAGE WEEKDAY UTILIZATION*
SHA (2016) (Estimated)	13,500 ***	7,346 ***
MTA (2015)	24,286	15,300
Transit Multipurpose**	17,858	11,608
Total	55,644	34,254

* Facility usage fluctuates due to the economy; weather conditions; special events; emergencies; delays or shutdowns of parallel lines or modes; maintenance and repair; storage of plowed snow; increases in frequency, service and capacity; and other factors.

** Includes facilities operated by MTA, Amtrak, WMATA, Penn Station in Baltimore and Union Station in Washington, D.C.

*** Data is preliminary.



* MTA park-and-ride lot VMT reductions are estimated based on the same assumptions used to calculate VMT reductions associated with MTA Transportation Emission Reduction Measures.

**SHA 2008 to 2015 Actual data revised from previous Attainment Report.

GGRA Program Status – Bike and Pedestrian Initiatives

Program Description and Objectives

This program is part of the State's effort to reduce GHG and other tailpipe emissions from passenger vehicles by providing active transportation alternatives to vehicle use. Building connected and safe infrastructure to support additional bicycle and pedestrian travel in urban areas also increases access to and use of public transit and supports the State's goal of increasing transit ridership. In addition, MDOT continues to work together to advance bike and pedestrian friendly designs and policies to promote safety and respect of all transportation system users.

Implementation Milestones

MDOT's Bicycle and Pedestrian Master Plan (2014) lays out a 20-year vision to support cycling and walking as modes of transportation in Maryland.

The following implementation elements were identified in the 2015 GGRA plan update, consistent with the Bicycle and Pedestrian Master Plan:

- Bike sharing programs are being implemented and expanded in many Maryland communities, with financial and technical assistance from MDOT. Currently, this includes major work in Montgomery County (71 stations as of August 2017) and the College Park area (22 stations as of June 2017), as well as Baltimore City. Since launching on October 28, 2016, there have been over 38,300 trips covering 57,600 miles on the Baltimore Bike Share System using the 25 existing stations. Twenty-five (25) more stations are planned for fall 2017.
- All 83 MARC train stations managed by MTA will have bike parking by the end of 2017. Bike parking is being expanded, included covered parking, where needed. Bike Share stations have been added at 7 MTA rail stations. All MTA buses contain bike racks.
- Consider Bike Accommodations for all applicable Roadway Projects – 77 roadway capacity or bridge upgrade projects in the Consolidated Transportation Program include accommodations for bicycles and pedestrians. The State Highway Administration (SHA) added 88.3 miles of marked bike lanes in FY 17.
- Eighteen (18) bike network projects were funded in FY 2017 under the Bikeways Program. Approximately 72 bikeways projects are complete. Additional projects will be solicited through annual grant cycles.
- SHA completed 12 sidewalk projects totaling 6.5 miles of both newly constructed and reconstructed sidewalks through the Sidewalk Construction for Pedestrian Access Program. Other SHA funding programs that enhance bicycle and pedestrian safety and access as part of roadway expansion or maintenance projects, or as standalone improvements include the Sidewalk Reconstruction for Pedestrian Access Program, Urban Reconstruction Program, and Bicycle Retrofit Program.

- SHA's bicycle committee continues to improve bicycle guidance and policies for SHA roadways and MDOT, with SHA, continues to install bicycle improvements when feasible within a project's scope.
- MDOT staff continue to support the Maryland Bicycle and Pedestrian Advisory Committee (MBPAC), which was created by statute to advise all State agencies on matters pertaining to bicycling and walking. MBPAC has an active agenda that has recently focused specifically on MDOT activities.

Enhancement Opportunities

MDOT recognizes bicycle and pedestrian travel as integral elements of the broader transportation network, and supports investments in local bicycle transportation projects that provide access to transit.

MDOT held grant funding workshops on March 2, 2017 in Cambridge, MD (44 attendees); and on March 13, 2017 in Hagerstown, MD (71 attendees). The workshop included information on the Transportation Alternative Program and Recreational Trails Program, the Maryland Bikeways Program, Bicycle and Pedestrian Priority Areas (BPPA), and Bicycle/ Pedestrian System Preservation Funds. In 2017, the workshops were revised to include a technical assistance component to help build capacity at the local level for effective implementation of trail and roadway projects. Additional effort was also made to expand the reach of these workshops by making them available via webinar.

MDOT is leading implementation of the bicycle and pedestrian priority area (BPPA) program, supporting localities in designating areas and developing plans leading toward implementation of network improvements in these areas. To date, BPPA Plans have been developed for Tilghman Island with others in development for Silver Spring, Bethesda, and the Prince George's Plaza area.

MDOT has several additional activities planned for 2017 and 2018 to support increased use of active travel modes and reduced GHG emissions.

- MVA continues to update the Maryland Strategic Highway Safety Plan which includes Bicycle and Pedestrian safety as a major "Emphasis Area." Several action items are being coordinated through this effort.
- MDOT works closely with area Metropolitan Planning Organizations (MPOs) to support their efforts on bicycle and pedestrian transportation. Several planning efforts are underway in Maryland jurisdictions and in Maryland's MPOs.
- MDOT is planning to update the Bicycle and Pedestrian Master Plan in 2018.
- SHA is working on a Bike Spine Network to connect major activity centers and guide the planning and construction of bicycle facilities. SHA will work with the office of tourism to aggregate designated bicycle routes and points of interest to develop regional specific electronic and print maps to encourage bicycling in the state.

- In 2017, the Maryland General Assembly created the Task Force to Study Bicycle Safety on Maryland Highways. MDOT is providing staff support to the Task Force, which is tasked with studying and making recommendations on issues related to bicycle safety on highways, including safety, infrastructure and traffic control devices, policy implementation, public education, funding, and bicycle infrastructure design, siting, and best practices.⁶ The Task Force will deliver its recommendations to the legislature by December 31, 2017.
- The Maryland Transit Administration (MTA) has made major advances in recent years to improve bicycle accommodation on MARC Service. A major step forward is anticipated in 2017, as they implement a Bikeways Program award to configure weekday commuter trains to include accommodation for full size bicycles.

Funding

Total greenhouse gas-beneficial funding for bike and pedestrian projects totals \$322.6 million in the FY 2017 – FY 2022 CTP. This MDOT estimate include 98 funded roadway expansion projects that include pedestrian and bicycle elements, in addition to the Bikeways Program and the Transportation Enhancements program, which focus on bicycle and pedestrian projects. MDOT manages several ongoing programs that provide funding for pedestrian and bicycle improvements, including: Maryland Bike Share Program, ADA Retrofit Program, Sidewalk Retrofit Program, Bicycle Retrofit Program, Urban Reconstruction Program, and management of the FHWA Transportation Alternatives (TA) Set-Aside funds.

Bikeways Program: MDOT’s Bikeways Program supports local bicycle transportation projects, providing necessary funding to implement the Statewide Trails Plan and the Bicycle and Pedestrian Master Plan. Since its inception in FY2012, the Bikeways Program has awarded \$16 million to 130 local bicycle transportation projects. Grant applications are solicited and awarded on an annual basis.

Bike Share: Bike Share networks are being supported by MDOT throughout Maryland using a variety of funding sources. In FY 2017, the Bikeways Program supported Bike Share stations at Wheaton, Takoma Park, Bethesda, Rockville, Whiteflint, and Twinbrook. Bike Share projects are MDOT’s efforts to make efficient use of limited transportation resources, by extending the reach of transit through efficient bike networks – and connecting more people to destinations by providing alternatives solutions.

Recreational Trails Program: SHA administers this federally-funded program which provides support for the development, maintenance and implementation of trail projects in support of recreational use. In FY 2017 MDOT awarded \$1.2 million in grants supporting 48 projects across the state.

Transportation Alternatives Program: MDOT works with its partner agencies including Metropolitan Planning Organizations (MPOs) and other State and local agencies to allocate and administer federal funding through the Transportation Alternatives Program (TAP). One of the major focus areas of TAP is to enhance pedestrian and bicycle facilities, and also for safe routes to school and environmental mitigation. In FY 17 Maryland had approximately \$11 million set

⁶ http://www.mdot.maryland.gov/newMDOT/Planning/Bike_Walk/Task-Force.html

aside to award to 27 applications - 18 TAP and 9 Safe Routes to School (SRTS). For FY 18 the appropriation was for the same amount and the state received 27 applications for 17 TAP and 10 SRTS projects. In addition to the above programs, transit oriented development and bicycle and pedestrian access to transit projects represent other approaches to funding active transportation projects.

Challenges

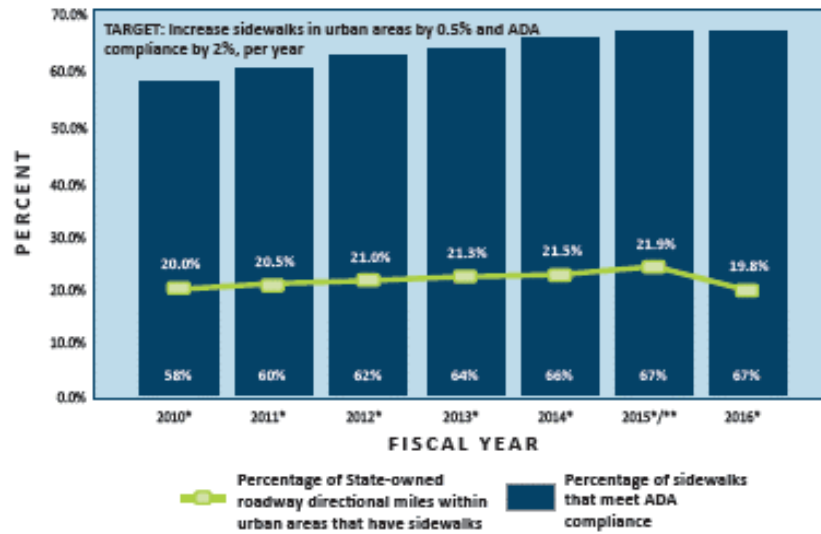
Biking and walking are becoming more popular transportation options in Maryland. At the same time, however, Maryland is seeing an unacceptable level of serious crashes involving bikes and pedestrians on our roadways. MDOT has set out an objective to reduce the five-year average number of pedestrian fatalities on all roads in Maryland from 105 in 2009-2013, to 91 or fewer by December 31, 2020 (2016-2020 average). A similar target has been established for bicycle fatalities, for which the average was 7 in 2009-2013, with a target of 6 or fewer for the 2016-2020 average. Similar targets have been set regarding serious injury statistics, and specific strategies have been set up to advance these goals at both the state and local level. State and local agencies meet on a regular basis to ensure progress on the identified action items.

Strong local partnerships are the key to improving bicycle and pedestrian infrastructure. While MDOT seeks design solutions to better accommodate cyclists and pedestrians on state roadways and transit, many of the most critical infrastructure and maintenance issues remain under local control. MDOT programs and technical assistance have been geared towards helping ensure that local jurisdictions have the tools necessary to strategically improve the network.

Estimated Greenhouse Gas Reductions

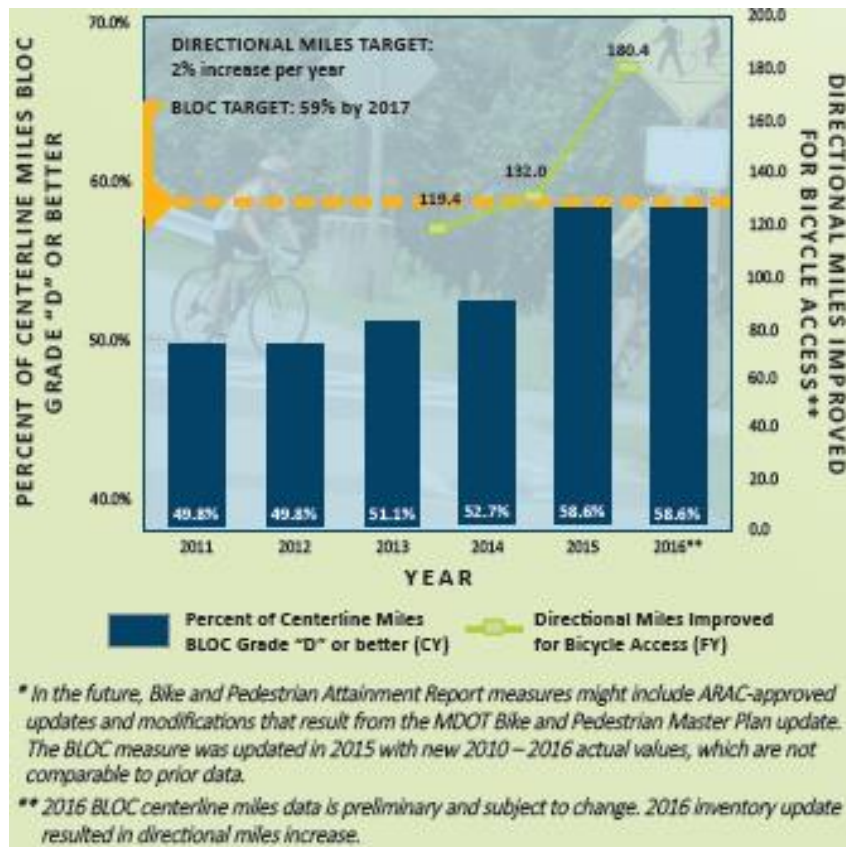
Under the goal of Community Vitality, MDOT's Annual Attainment Report documents the number of additional directional miles of bicycle lanes and shared use lanes, which steadily helps to increase the bicycle level of comfort (BLOC) on Maryland's roads. Figures 9 and 10 show both metrics along with their annual (or time-bound) targets as tracked by SHA as part of the Attainment Report. In 2016, bicycle and pedestrian trips accounted for 2.9 percent of commuter trips in Maryland, which is on the high-end of the 10-year average of 2.7 percent (per annual data from the U.S. Census, American Communities Survey). SHA has also recently updated the methodology used to measure BLOC in 2015, which resulted in a stronger promotion of bicycling as a mode of travel. The 2017 Attainment Report is available [here](#).

Figure 9. Percentage of State-owned roadway directional miles within urban areas that have sidewalks and percent of sidewalks that meet ADA compliance



* In the future, Bike and Pedestrian Attainment Report performance measures might include Attainment Report Advisory Committee (ARAC) approved updates and modifications that result from the MDOT Bike and Pedestrian Master Plan update. 2010-2016 data based on a new data collection method that cannot accurately be compared to previous years' data.
**2015 Actual values revised from previous Attainment Report.

Figure 10. Percent of State-owned roadway centerline miles with BLOC level "D" or better



* In the future, Bike and Pedestrian Attainment Report measures might include ARAC-approved updates and modifications that result from the MDOT Bike and Pedestrian Master Plan update. The BLOC measure was updated in 2015 with new 2010 – 2016 actual values, which are not comparable to prior data.
** 2016 BLOC centerline miles data is preliminary and subject to change. 2016 inventory update resulted in directional miles increase.