MARYLAND DEPARTMENT
OF TRANSPORTATION™

2018 Status Report

Required under the

Maryland Commission on Climate Change Act

[EN §2-1305]

December 14, 2018

Table of Contents

Table of Figures

Introduction

The 2014 Executive Order (01.01.2014.14) and the 2015 Maryland Commission on Climate Change Act (Act) expanded the membership of the Maryland Commission on Climate Change (MCCC) and required it to maintain a comprehensive action plan, with 5-year benchmarks, to achieve science-based reductions in Maryland's greenhouse gas (GHG) emissions. The MCCC is also required to submit annual reports to Governor and General Assembly.

The Act also requires several state agencies, including the Maryland Department of Transportation (MDOT) to report annually on the status of programs that support the State's GHG reduction efforts. This report satisfies MDOT's requirement.

In 2016, Maryland passed a reauthorization of the Greenhouse Gas Reduction Act (GGRA), which sets the goal of reducing GHG emissions in the state by 40 percent compared to 2006 levels by 2030.

MDOT is currently updating its MDOT 2018 GGRA Draft Plan to address the requirements of the GGRA including:

- Analyzing the feasibility of GHG mitigation measures in the transportation sector; and

- Ensuring that the measures are implemented in an efficient and cost–effective manner

Throughout the development of this plan, MDOT will coordinate with MDE to ensure seamless integration of the findings into the Maryland Draft GGRA plan to be submitted to the Governor and General Assembly by December 31, 2018.

National Greenhouse Gas Emissions

When discussing Maryland's role in mitigating GHG emissions, and the transportation sector's contribution to mitigation, it is helpful to provide context by providing an understanding of total U.S. emissions

According to the latest available national data (2014), as analyzed and summarized by The World Resources Institute, 10 states were responsible for nearly half of

the country's total GHG emissions. That is nearly equal to the combined emissions of Japan,
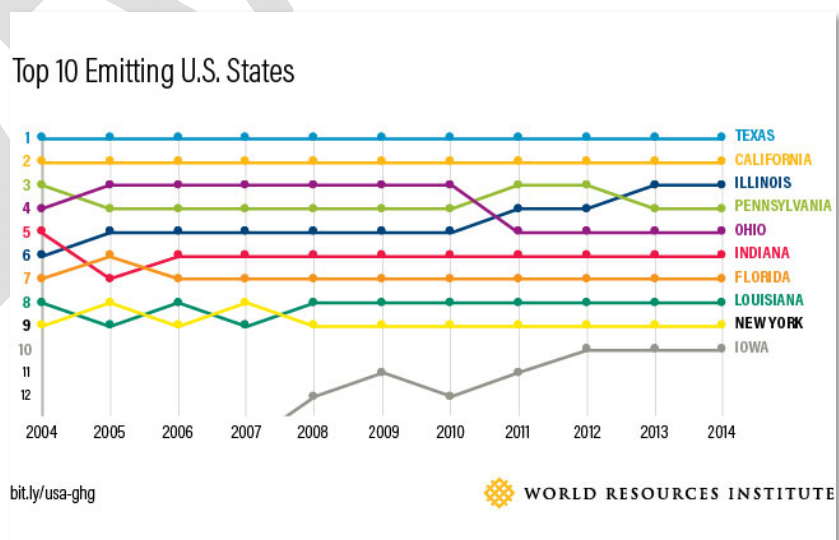
Canada and Germany. **Maryland accounts for 1.08 percent of total U.S. GHG emissions** and our transportation sector accounts for 0.41 percent of total U.S. GHG emissions.

As illustrated Figure 1, Maryland also has the distinction of being in the top 10 States in terms of GHG emissions reductions between 2005 and 2014.

Figure 1: Percent Change of U.S. State Emissions, 2014 Compare to 2005 Levels

bit.ly/usa-ghg

WORLD RESOURCES INSTITUTE
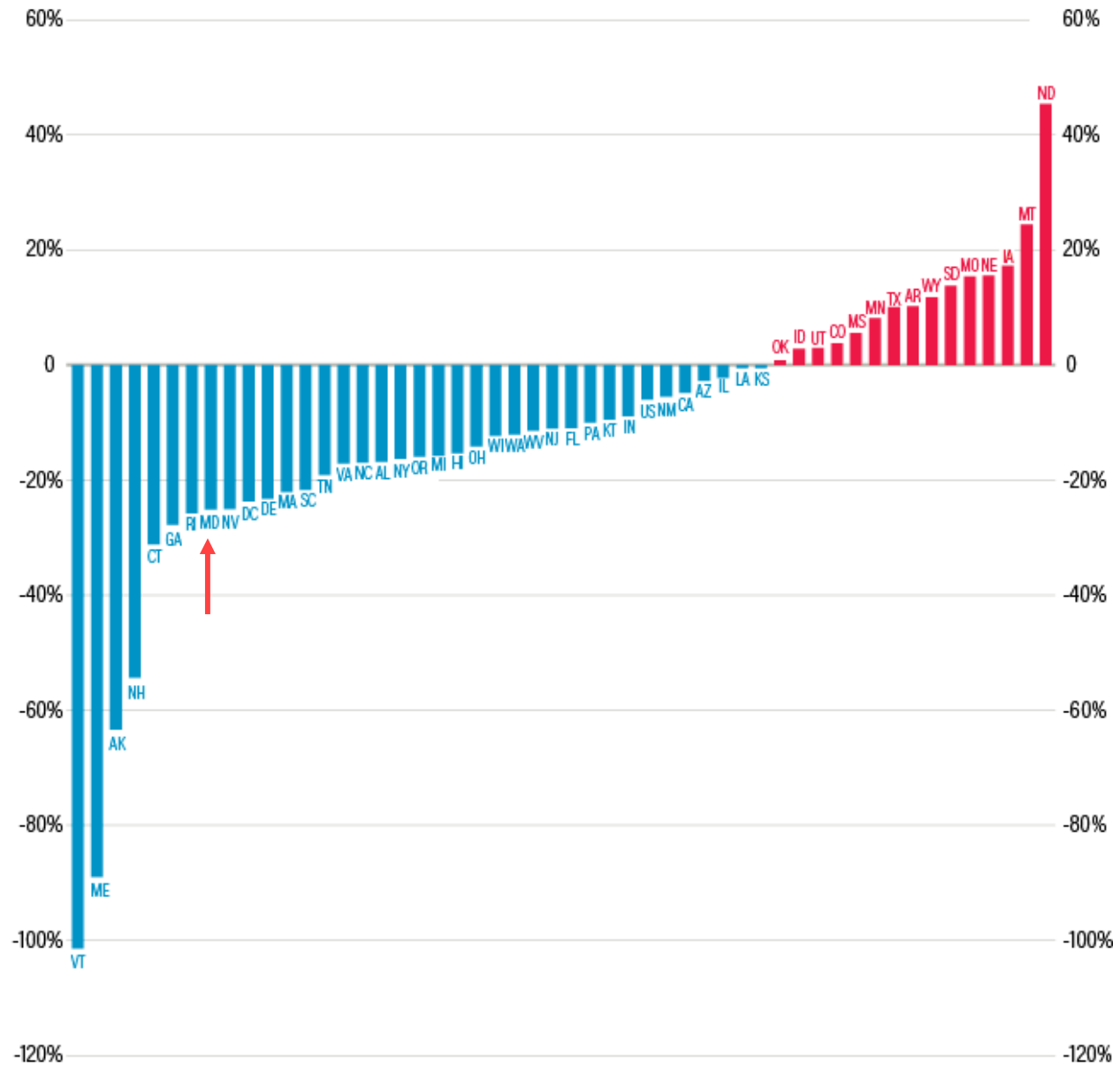
MDOTs Transportation Role

MDOT's mission communicates the importance of a customer-driven transportation system. The mission, along with the seven goals identified in the 2040 Maryland Transportation Plan (MTP), 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. MDOT developed the goals, objectives, strategies, and performance measures in the 2040 MTP through an interactive outreach process. The goals of the plan are as follows:

- Ensure a Safe, Secure, and Resilient Transportation System;
- Maintain a High Standard and Modernize Maryland's Multimodal Transportation System;
- Improve the Quality and Efficiency of the Transportation System to Enhance the Customer Experience;
- Provide Better Transportation Choices and Connections;
- Facilitate Economic Opportunity and Reduce Congestion in Maryland through Strategic System Expansion;
- Ensure Environmental Protection and Sensitivity; and
- Promote Fiscal Responsibility.

The 2040 MTP goals, objectives, and strategies are consistent with the goals and requirements of the GGRA and MCCC.

MDOT is a leader in the development, tracking, and reporting of performance measures that drive MDOT and its business units to achieve and maintain exceptional standards while meeting the transportation demands of Maryland residents and users of the transportation system. This State Agency Report draws from three sources of performance and budgetary/financial reporting systems: 1.) The Annual Attainment Report, 2.) The MDOT Excellerator, and 3.) The annually updated, six-year, Consolidated Transportation Plan (CTP).

Attainment Report: The Annual Attainment Report on System Performance assesses progress towards achieving the goals and objectives of the Maryland Transportation Plan (MTP).

Several measures within the Attainment Report are indicators for GHG emissions, such as vehicle miles traveled (VMT), transit ridership, transit service reliability, roadway congestion, traffic safety, quality of the bicycle and pedestrian environment, and regional emissions. New measures were introduced as part of the 2018 Attainment Report goals and objectives update, including the number of formal or informal telework arrangements and the number of total electric vehicles (EVs) registered in Maryland.

Figure 2 estimates total annual GHG emissions from on-road transportation in Maryland based on current vehicle miles traveled data and fleet characteristics.

Figure 2. Transportation-Related Greenhouse Gas Emissions

TARGET: 25% below 2006 emissions by 2020 and 40% below 2006 emissions by 2030*

* The MDOT selected GHG emission reduction goal is consistent with the statewide target set in the 2009 Greenhouse Gas Reduction
   Act and the subsequent 2016 Greenhouse Gas Reduction Act reauthorization.
** 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 EPAs MOVES model available at time of analysis. MOVES2014a
   is used for analysis year 2016 and 2017.
*** 2016 annual VMT revised to reflect actual MDOT SHA reported 2016 HPMS VMT.

MDOT Excellerator: In 2016, MDOT deployed the MDOT Excellerator, a performance management system which summarizes tangible results of MDOTs 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.

Like the Attainment Report, several measures within the MDOT Excellerator are indicators for GHG emissions, including: percent of tolls collected by cash, reliability of highway travel, average highway incident duration, and peak hour congested VMT highway trends. In 2018, new, GHG-specific measures, were added to Tangible Result #9 within the Excellerator, "Be a Good Steward of the Environment." MDOT is now tracking total EV registrations in Maryland as well as total publicly available electric vehicle supply equipment (EVSE). MDOT is also tracking the total GHG emissions from MDOT fuel consumption, by fuel type, and from MDOT's electricity use. Figure 3 illustrates the current trend in emissions of CO_2e from MDOT's electricity use.

Figure 3. GHG (CO₂e) Emissions from MDOT Electricity FY2014-FY2018

Chart 9.4B.2: CO2e Emissions from MDOT Electricity Use Q3 CY2013-Q2 CY2018 (Rolling 12-Month)
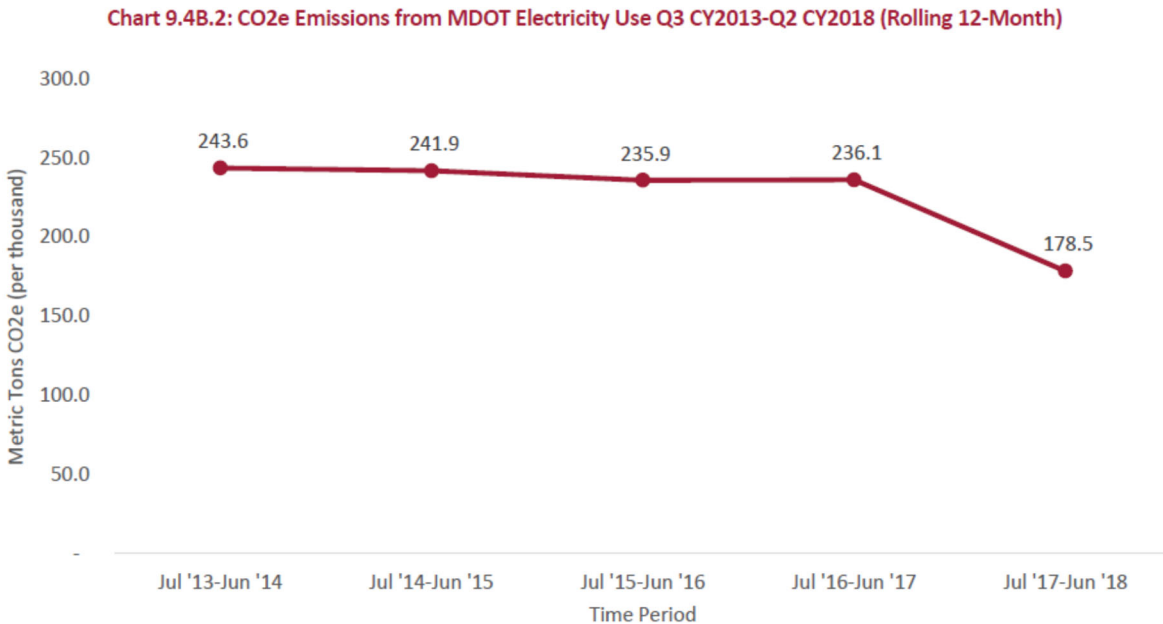
Consolidated Transportation Program: The goals of the MTP and the associated measures that illustrate Maryland's progress reflect the diversity of current and future transportation conditions, challenges, and needs. The Consolidated Transportation Program, the State's six-year capital investment program 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.

MDOT estimates that 44 percent (approximately $6.4 billion) of Maryland's total $14.8 billion six-year CTP (FY 2018 – 2023) is associated with investments that could reduce GHG emissions by 2020 and beyond. As illustrated in Figure 4, the total funding for major capital programming is roughly $8.7 billion, and MDOT is investing nearly three quarters of that funding in projects that are expected to result in GHG emissions reductions.

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 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.

Figure 4. 2018-2023 CTP GHG-Beneficial Projects in the Major Capital Program

$2,291,755
26%

$6,401,143
74%

■ GHG   ■ Non-GHG
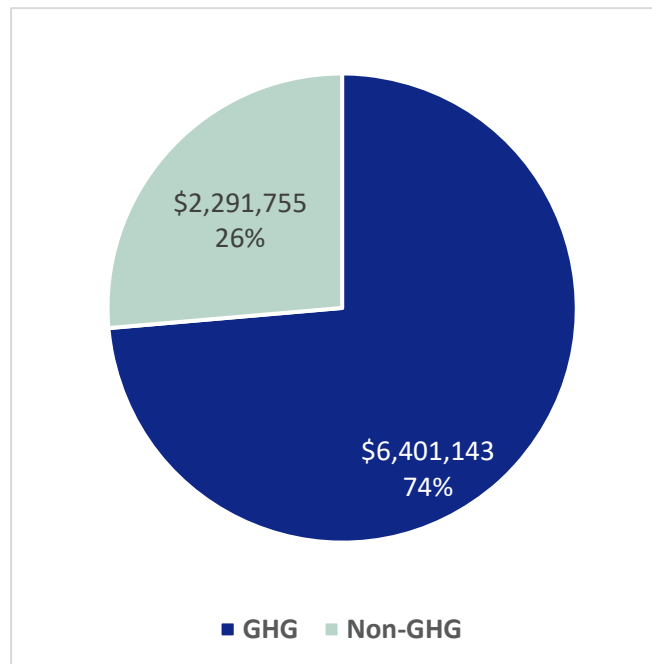
The performance of Maryland's transportation system, as well as MDOT's ability to maintain and enhance the system, is influenced by social, technological, and economic trends (including fuel prices, which have a significant impact on travel activity). Emerging trends toward a "sharing economy" in transportation, vehicle technology, fuel advancements including electric and autonomous/connected vehicles, and changing logistics and supply chain patterns will greatly impact the use of the transportation system. These trends will help 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

As of the 2015 GGRA Plan Update, the transportation sector accounted for 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).[1]

Maryland's transportation sector proportion is slightly above the nationwide average of 28 percent. This can be partially attributed 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 occur.

Within the transportation sector:

- **66 percent of emissions come from on-road gasoline vehicles** (e.g., typical passenger cars and light-duty trucks),

---

[1] Greenhouse Gas Emissions Reduction Act Plan – 2015 Update. Maryland 2006 Base Year and Projected 2020 GHG Emissions, by Sector.

- **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).

- As of 2014, Maryland's transportation sector accounted for **0.41 percent of total U.S. GHG emissions**.

MDOT's Reporting Approach

The Act requires submission of an annual report by each Department reflecting progress toward meeting the GGRA goals. MDOT's 2018 status report includes the following sections:

- **Introduction** – A general summary of MDOTs role and climate change-related planning efforts to date.

  - The introduction 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 TBU's 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) 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 Bicycle and Pedestrian Initiatives – 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"

2018 Annual Status Report Summary

The following summary highlights MDOT's recent successes and is demonstrative of MDOTs ongoing commitment to a multimodal and multifaceted approach to mitigating GHG emissions.

2018 Status Report Accomplishment Highlights	
Adaptation & Resilience	MDOT State Highway Administration (MDOT 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.
	MDOT Maryland Transit Administration (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.
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 exceeded 15,000 vehicles in 2018.
	MDOT 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.
	MDOT 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	After launching in June 2017, BaltimoreLink has been providing improved transit service to customers on a bus route as well as roughly 130,000 additional people within a ¼ mile of a bus route. As of 2018, 11 percent more jobs are accessible within 30 minutes as BaltimoreLink adds several public schools, libraries, and supermarkets to the transit network. MDOT MTA also continues to replace high-emitting diesel buses with cleaner models.
	Supported by two TIGER Grant awards from US DOT, MDOT MTA is working with Baltimore City to deliver the North Avenue Rising project and with Montgomery County to deliver the US 29 Bus Rapid Transit project. Both projects will provide enhanced and more efficient transit options in these critical corridors. As of the 2018-2023 CTP, planning and design is underway for the North Avenue Rising project while the US 29 Bus Rapid Transit project broke ground in October of 2018.
	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 TSO and MDOT 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	In the FY2018—FY2023 CTP, there is over $175 million programmed to bicycle and pedestrian investments, including ongoing support of Maryland's bikeways and bikeshare programs.

Actions and Recommendations

In MDOTs GGRA Plan 2015 Update, MDOT extensively documented transportation programs and projects that are currently supporting the 2020 GHG reduction goal, as well as potential future policies and actions to achieve GHG reductions beyond 2020.

In 2018, MDOT continued to participate on the MCCC and its working groups, including the mitigation working group (MWG). MDOT continues to be engaged in the larger, Maryland discussion surrounding climate change and has been actively contributing to the recommendations developed by the working groups, adopted by the MCCC, and contained in the MCCC's 2018 Annual Report.

MDOT assisted in refining the 24 MWG recommendations and proposed several of the recommendations, numbers 12-17, addressing emissions in the transportation sector. The recommendations reflect the need to reduce emissions by employing a multi-modal and multi-disciplinary approach including the deployment of new technologies, enhanced analysis efforts that account for equity and public health, and a focus on travel demand management / congestion reduction.

MDOT's continued modeling and analysis efforts signal that the development and adoption of transportation technologies, such as electric vehicles, across all transportation modes, will be essential to achieving Maryland's GHG reduction goals. Preserving the structure, purpose, and mission of Maryland's EVIC is imperative to the continued development, advancement, and adoption of EVs as well as the installation of critical EVSE. Maryland has a goal of 60,000 EV registrations in the State by 2020 and 300,000 by 2025. These goals represent a key component of ensuring that Maryland meets our GHG emission reduction targets.

Throughout 2018, MDOT has worked on developing a Draft 2018 GGRA Plan for the on-road transportation sector, which is focused on the 40 by 30 goal. This process included:

- Stakeholder input into 2030 strategy selection and evaluation,

- Considerations for cross-sectoral consistency in assumptions, particularly regarding land use and development,

- Alignment of statewide input and methodology with federal guidelines,

- Continued evaluation of best available statewide inputs to emission modeling processes including areas not covered by Metropolitan Planning Organization (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

Throughout 2018, MDOT continued to participate on the Adaptation and Response Working Group (ARWG) of the MCCC and to coordinate with other State agencies to develop vulnerability assessment data and resiliency plans to address the current and future impacts of climate change on the transportation network.

SHA	**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 is available in a viewer with free access for county planners and emergency services and is being integrated into asset management systems and project planning. Pilot studies were completed to determine methodology for assessing vulnerability to flooding in non-coastal locations.**
MTA	In view of more refined and up-to-date projections for sea level rise, flooding and hurricane storm surge data sets, the MDOT MTA Environmental Planning Division (EPD) is updating the climate change focused Vulnerability Plan developed in 2016. This update will utilize refined findings in the development of adaptation measures and resiliency planning. Implementation of the adaptation measures will provide security and resilience for the agency assets identified as susceptible to sea level rise, hurricane storm surge, and flooding events.
MPA	The MDOT Maryland Port Administration (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. A significant portion of the MDOT MPA's terminals and facilities are in the 100-year flood plain and subject to impacts of climate change, including frequent and severe rain events. Although it would be both disruptive to operations and cost prohibitive to attempt to raise facilities, MDOT MPA will include enhanced resiliency when undertaking new construction or rehabilitation of existing facilities. In 2017, the MDOT MPA conducted a Strategic Thinking Session to review climate change vulnerability in the context of current science and climate modeling. Because of that session, the MDOT MPA convened an inter-departmental team that regularly meets to plan and implement climate adaptation and resilience strategies.
MAA	Over the past few years, MDOT Maryland Aviation Administration (MDOT MAA) participated in the development of the Coast Smart Construction Guidance through the Coast Smart Construction Council. During the meeting process, MDOT 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.
MDTA	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.

Implementation Activity

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

MDOT SHA

- Completed MDOT SHA coastal vulnerability assessment for 14 Counties and Baltimore City. The coastal assessment includes data on 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%.

- Developed 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 pilot non-coastal flood modeling and work with hydrologists to determine preferred methodology.

- Worked with the Office of Structures, Highway Development, Planning and CHART to determine use and integration of vulnerability data into consideration for design, performance, and operations.

- Working with the Baltimore Regional Transportation Board and Hazard Mitigation Planners at the Baltimore Metropolitan Council as well as the Eastern Shore Climate Adaptation Partnership to share vulnerability data.

- Provided SLC and storm projection information and mapping to Cecil and Dorchester 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.

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

- The Environmental Planning Division (EPD) is updating MDOT MTA's Climate Change Vulnerability Assessment with the latest projections for sea level rise, flood events, and hurricane storm surge, to refine the 2016 identification of infrastructure and assets vulnerable to these events. Adaptation of the high-risk locations will be conducted through MDOT MTA's Asset Management Planning and system preservation program.

- EPD is updating the GIS dataset developed on the previous Vulnerability Assessment plan, which includes all MDOT 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 identifying vulnerable assets, the layers outline core transit routes and locations where these routes will be impacted by each of the scenarios.

- MDOT MTA will incorporate 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, and will be taken into consideration in preliminary engineering.

- MDOT MTA's infrastructure impacted by extreme weather events is inspected, maintained and replaced through the agency system preservation program. For example, MDOT MTA addressed different Light Rail locations suffering progressive erosion and stabilization problems due to rain events and washouts, such as Twin Oaks area, North Linthicum chain marker SW 309, Warren Road chain marker NE 760, and Industry Lane grade crossing chain marker NW 742.

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.

- Evaluating and improving stormwater management conveyance infrastructure

- Elevated the cruise terminal parking.

- Replacement for Dundalk Marine Terminal (DMT) Building 91C was 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 DMT C Street to prevent recurrent flooding due to frequent, severe rain events; the first was at Lot 304, DMT

- 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.

- Converted a fuel oil HVAC system at Building 91A, DMT, to a natural gas HVAC system.

- Installed emergency generators at MDOT MPA key facilities, including Security, Maintenance and Operations, to ensure continued operations during an emergency.

MDOT MAA

- MDOT MAA is the owner of Martin State Airport and can report that a tenant added a small addition to an existing building in the 10-year inundation area. There have been no other 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 MDOTs 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.

MDTA

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

MDOT MTA

- Utilizing updated information from MDOT MTA's Climate Change Vulnerability Assessment to develop and implement mitigation or adaptation measures at sites identified as a high or very high risk to MDOT MTA services.

- Developing cost estimates to complete adaptation measures in coordination with relevant state agencies, including the Maryland Emergency Management Agency.

- Integrating updated results of the Climate Change Vulnerability Assessment into the agency's Environmental and Sustainability Management System (ESMS), 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

MDOT SHA has a dedicated position to develop vulnerability studies and integrate infrastructure resiliency throughout the agency, as well as manage greenhouse gas and energy 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. MDOT SHA addresses these requirements by incorporating vulnerability data into the asset management program. MDOT SHA can use Federal Highway Administration (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. MDOT MTA has been in consultation with MEMA to identify adaptation and resiliency projects eligible for funding. MDOT MTA has also dedicated positions to develop asset management, sustainability and

resiliency plans, and coordinate their findings through the agency's Environmental and Sustainability Management System. MDOT MTA can use FTA formula funding to support this effort.

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 represent the most significant opportunity to reduce GHG emissions from the transportation sector. Accelerating progress in on-road vehicle technology, fuels, and intelligent transportation systems (ITS), which improve system efficiency, is having a measurable impact on major travel indicators and GHG emissions.

State and federal initiatives that set fuel economy standards and reduce tailpipe emissions of light-duty and medium- / heavy-duty vehicles include:

- The Maryland Clean Car Program that incorporates the California low emission vehicle (LEV) standards and zero emissions vehicle (ZEV) mandates;

- Corporate Average Fuel Economy Standards (CAFE) for light-duty model years 2008-2011;

- The National Fuel Economy Program – Phase 1 for model years 2012 to 2016; Phase 2 for model years 2017 to 2025;

- Medium/Heavy-Duty Vehicle Standards (trucks, buses, and trailers) – Phase 1 for model years 2014 to 2018; Phase 2 for model years 2018 to 2027; and

- Federal Renewable Fuels and Tier 3 Fuel Standards.

Maryland is also taking a proactive role in promoting the adoption of on-road technologies that can have live-saving benefits as well as GHG benefits. In addition to chairing EVIC, MDOT also leads a workgroup dedicated to ensuring that connected and automated vehicle (CAV) technology is deployed safely and thoughtfully on Maryland's roads.

MDOT's Coordinated Highway Action Response Team (CHART) program utilizes ITS technologies to enhance travel, reduce traffic congestion, and address capacity inefficiencies that contribute to GHG reductions. This work includes the deployment of cameras, traffic detectors, weather sensors, dynamic message signs, traffic websites, and telecommunications networks.

Implementation Milestones

- Based on the annual reporting for CHART, the program's efforts cleared more than 30,000 incidents and assisted approximately 42,000 stranded motorists on Maryland roadways. The program contributes to improved mobility, reliability and safety by efficiently responding to incidents, reducing the duration of the incident, and coordinating

ANNUAL CHART BENEFITS (REDUCTIONS)	
Delay:	43.5 million vehicle hours
Fuel:	8.2 million gallons
GHG:	75,000 metric tons
Cost:	$1.5 billion

with emergency response agencies. The effectiveness of CHART in detecting and managing

incidents provides measurable benefits in delay, fuel consumption, emissions reductions and cost savings.

- 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. 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.

- 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.

- MDOT continues to be an active participant on the American Association of State Highway and Transportation Officials (AASHTO) Committee on Environment and Sustainability, Air Quality, Climate Change and Energy Subcommittee, and the Clean Vehicles and Fuels Workgroup of the Transportation Climate Initiative (TCI).

- Maryland is emerging as a national leader in CAV technology and is building on this progress by developing CAV Strategic Plans that document opportunities, challenges, priorities, strategies and recommendations to help guide the State in planning and implementing CAV technology. In 2018, MDOT led the effort to finalize an official Maryland Vision for CAV.

Maryland's Electric Vehicle Infrastructure Council (EVIC)

MDOT continues to lead EVIC, a legislatively established body, comprised of a diverse group of stakeholders whom are dedicated to attaining Maryland's EV goals.

EVIC has made progress on several vital initiatives and we are continuing to work on removing barriers to the adoption of EVs. In 2018, Maryland's work was recognized by the Electrification Coalition, which designated Maryland as a top tier, or Tier 1, EV State when they issued their inaugural, ZEV Scorecard. Maryland was second only to California and was ranked so highly for our work on incentives, publicly available EVSE, and public outreach.

- As of 2018, Maryland now boasts over 4,500 lane miles of EV Charging Corridors under the Fixing America's Surface Transportation (FAST) Act.

- Maryland's public outreach efforts have included direct public outreach to over 3,600 Maryland citizens in 12 Counites. Our direct outreach efforts are tracked, along with the total EV registrations and publicly available charging infrastructure, on MDOT's updated EVIC website.

Figure 5 illustrates the existing electric vehicle ownership (battery EVs (BEV) and plug-in hybrid EVs (PHEV)), publicly available charging infrastructure (1,506 outlets), and the alternative fuel / EV corridors as of July 2018. Figure 6 demonstrates the continued growth of EVs in Maryland since 2012. Even as the number of registered EVs grows exponentially, attaining the State goals remains a challenge.

Figure 5. Existing Maryland Electric Vehicle Density and Charging Station Locations
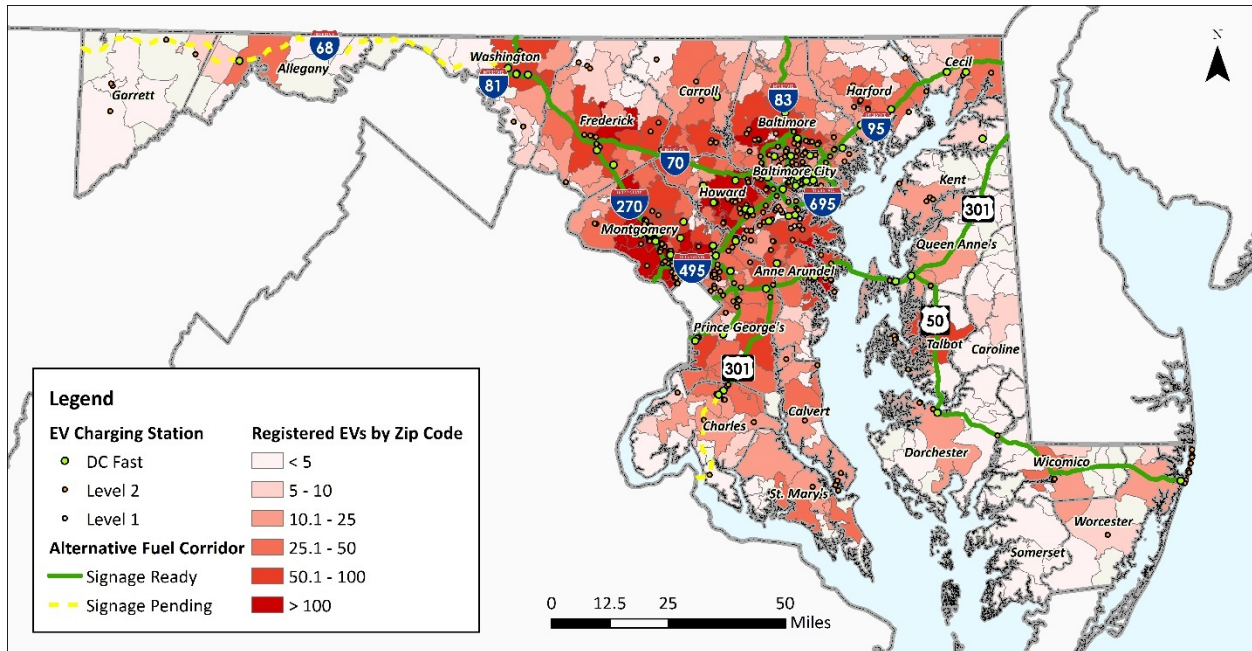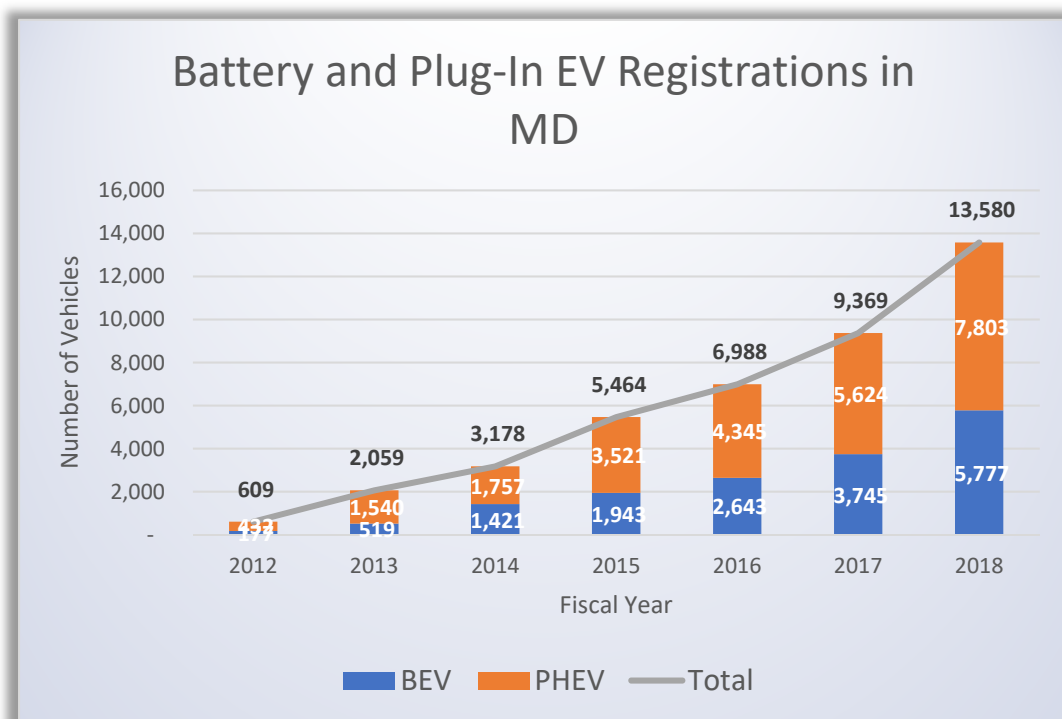

Figure 6. Existing Maryland Battery and Plug-In Hybrid Electric Vehicle Registrations

- MDOT continues to lead the way in renewable energy. In 2018, MDOT issued Master Services Agreements (MSAs) to six qualified contractors to design, construct, commission, finance, operate and maintain photovoltaic (PV) energy facilities at MDOT locations throughout Maryland. The MSAs provide MDOT with the flexibility of developing PV energy systems quickly and efficiently. The GHG benefit has increased by 10 percent over the last year and resulted in 15 metric tons of reductions. 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	3,700,000	10,234,544	Sep-11
MDTA		158,276	186,231	Apr-13
MPA (Cruise Terminal)	249.6	1,610,000	4,151,540	Aug-12
MPA (Shed 10)	505.44	2,630,000	6,970,462	Aug-12
MTA	535.39	3,510,000	9,222,403	Feb-12
SHA (Wind)	2.4	6,220	7,887	2009
Total:	1,797.73	10,257,294	30,773,067	

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.

- MDOT encourages continued research and evaluation of the GHG emission reduction potential of vehicle and infrastructure technologies, including: connected and autonomous vehicles; EVs and other ZEVs; transportation network companies/shared rides; and system operations. The evaluation effort should include consideration of safety, congestion, and equity issues including public health, economic, and workforce impacts.

- Through the State Agency Working Group of EVIC, MDOT will continue to review state fleet procurement procedures and practices and provide direction on procurement of EVs and other ZEVs, and associated charging/filling station installation guidance and targets, by October 2019.

- Ensuring that adequate infrastructure is in place for emerging technologies such as EVs and CAVs will require continued collaboration across our region and the nation. MDOT will continue to participate in regional discussions, such as the TCI Clean Vehicles and Fuels Work Group and in discussions taking place at the national level through AASHTO and the Transportation Research Board (TRB).

- 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.

- Technology enhancements in the non-road sector (construction equipment, port and airport support vehicles, locomotives, and marine engines) could result in additional GHG reductions. MDOT MPA has replaced 173 Drayage Trucks with an ongoing goal to replace 50 trucks per year. They continue to progressively pursue DERA grants to replace or repower diesel engines, marine vessels, and cargo handling equipment. MDOT MAA proactively incorporates alternative fueled buses and is adjusting their shuttle bus fleet requirements and reducing the fleet from 75 to 65 coaches.

- 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.

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 has submitted proposals and is seeking opportunities to enhance EVSE availability through the National ZEV Investment Plan and the Maryland Volkswagen Mitigation Plan.

MDOT has committed $15.8 million for FY2018 and $111.2 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 2018-2023 CTP, MDOT estimates that $330.2 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 2018-2023 CTP, there is $1.82 billion committed to MDOT 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 be 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 issued a proposed rulemaking in August 2018, *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rules for Model Years 2021-2026 Passenger Cars and Light Trucks.* This rule will roll back the national fuel economy standards for post-2020 model years to 2020 standards. This will reduce the GHG benefits as the fleet continues to turnover. By freezing at the 2020 fuel economy standard, the fleet will not meet the 54.5 mpg equivalent standard by 2025. This could result in a loss of two million metric tons of GHG benefits in Maryland alone. Many states, including Maryland, have sued EPA to block the weakening of vehicle emissions standards.

While we have made significant progress in EV adoption and the installation of EVSE, our work is not complete. We must continue to address known barriers to EV acceptance including ensuring that charging is available to those who live in urban environments, multi-unit dwellings, or in homes governed by home owner's associations.

Estimated Greenhouse Gas Reductions

As noted in the introduction section, even as VMT has increased in Maryland by over 2.9 percent in 2017 from 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 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 increasing public transit ridership, and intercity transportation initiatives that support MARC and other intercity transit services such as Amtrak, thus reducing VMT and GHG emissions.

MDOT works with MPOs and other local agencies in Maryland to implement projects aimed at advancing the multimodal transport system. These include transportation demand management programs (such as MDOT's Commuter Choice Maryland and MWCOG's 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. There is an emphasis on improving service quality and reliability, better aligning of transit service to demand, and improved transit information dissemination to customers. MDOT MTA is also focused on sustainability and in moving towards a more efficient fleet.

Public Transportation Initiatives

Program Description and Objectives

To maintain and enhance operations of the current public transportation 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, improve the operational efficiency of the system, and increase system capacity. Two results of this program are the Purple Line and BaltimoreLink transit system. Each of these projects address high priority operational and capacity goals within the densely populated Washington, DC and Baltimore metro regions. Ongoing actions include the implementation of innovative transit solutions such as transit signal prioritization, off-board payment, and grade-separated right of way.

Actions related to land use planning, including Maryland's commitment to transit oriented development (TOD), incentives for riding transit, and non-motorized 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 millions of Maryland residents, employees, and visitors. In addition, through coordination with the Northeast Corridor Commission, the Federal Railroad Administration, and Amtrak, Maryland is supporting planning 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.

MDOT 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

Support for transit investments are presented in MDOT's annual capital program, the CTP. Highlighted projects recently implemented or planned through the CTP include:

- After the signing of a $900 million Full Funding Grand Agreement and a $5.6 billion P3 contract, construction has begun in the Purple Line project corridor between Bethesda and New Carrolton. The Purple Line will include direct connections to Metrorail in four locations (serving three Metrorail lines), all three MARC Train lines, Amtrak, and local bus services. The segment between Bethesda and Silver Spring will include a parallel hiker/biker trail as well. This project will improve transit accessibility for anyone working in, living in, or visiting the Washington metro area while supporting economic development and reducing the environmental impact of transportation in the region. The

Purple Line will have 21 stations and provide direct connections to the Metrorail. It will also connect to MARC, Amtrak, and local bus services and is projected to have 74,000 daily riders by 2040.

- Following 18 months of planning and public outreach, BaltimoreLink successfully launched on June 18, 2017. Key features of this enhanced service include essential connections to job centers, and better integration between MDOT MTA transit services, such as CityLink, LocalLink, MetroLink, Light RailLink and MARC. BaltimoreLink network is providing more people with access to transit, jobs, and services in the region with an estimated 130,000 additional people within a ¼ mile access to frequent transit operating every 15 minutes or less during peak and midday periods. Eleven percent more jobs are accessible within 30 minutes and BaltimoreLink is adding a number of public schools, libraries, pharmacies, hospitals, and supermarkets to the frequent transit network.

- Improved technologies supporting MDOT MTA bus system operations and reliability including automatic vehicle locator system deployment, enhancements to MDOT MTAs Central Control Center, and improvements and expansion to camera systems for safety and security. MDOT's 2018-2023 CTP includes a total of $5.17 million for replacement of CAD/AVL systems as part of mobility improvements for FY 2018 and 2019.

- MDOT MTA's construction program is undertaking an ongoing replacement and mid-life overhaul of Light Rail, Metro, and MARC rail cars to improve passenger comfort, vehicle reliability and overall performance.

- MDOT MTA is developing a grant application and selection process for an upcoming Transit Innovation Grant aimed at incorporating innovative transit-related investments to modernize Maryland's transit options. It will be a competitive, state funded program to support locally planned, designed, and constructed or operated transit projects including transit signal prioritization schemes, separate right of way, off-board fare payments, and intelligent transportation systems.

- 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, 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 a groundbreaking for the project was held in October 2018.

- MDOT 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 $10 million from the TIGER grant compliments $14.7 million in funds committed by MDOT, $1.6 million from US DOT's Federal Highway Administration, and $1 million from 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 MTA Metro and Light Rail stations, targeted improvements at major bus stops, improved sidewalks, streetscaping, and needed roadway re-pavement along the corridor. MDOT is contributing approximately

- The Washington Metropolitan Area Transit Authority (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. Starting in FY 2020, the Governor is to include a State budget appropriation of $167 a year million from revenues available for the State capital program in the transportation trust fund as a grant to be used to pay WMATA capital costs. The Governor has authority to appropriate general funds for this purpose. The Act also calls for an increase of 3% a year of the existing WMATA funding.

- MDOT MTA and locally operated transit services (LOTS) continue to regularly update and renew their bus fleets 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 MDOT MTA's 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 MDOT 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 continues to incorporate responsive and innovative investments, such as the inclusion of a public-private partnership contract for the Purple Line and the establishment of a transit grant for innovative transit projects. Other longer-term transit investments include the MARC Growth and Investment Plan, and replacements for two major bottlenecks on the Amtrak Northeast Corridor, the Baltimore & Potomac Tunnel and Susquehanna River Bridge.

MDOT MTA has been leading ongoing and new studies since 2017, with a focus 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 (As part of the MDOT MTA bus replacement program, the delivery of 172 40-foot clean diesel buses was completed in FY 2017 and an additional 140 buses have been ordered for delivery in FY 2018 and FY 2019)), ongoing technical support to local jurisdictions and partnerships (such as MDOT and WMATA joint development agreements) to help promote and create transit oriented development 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 2018–FY 2023 CTP, including MARC maintenance and service expansion, BaltimoreLink operations, support of the WMATA in the Capital Region, and support of LOTS across Maryland.

- MDOT MTA directs funding and statewide assistance to LOTS serving each of Maryland's 23 counties, providing approximately $130.5 million in grants in FY 2018. 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 USDOTs TIGER grant program. The BaltimoreLink project also benefits from the North Avenue Rising project's $10 million grant.   Grant funding is incredibly helpful for project

implementation. For grants, such as the TIGER Grant, to be successful, MDOT must commit to provide matching funds as noted above.

- 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. This agreement provides the Purple Line with $5.6 billion of funding. Additionally, the USDOT granted a $900 million grant to match local and private funding in August 2017.

- In total, in the 2018-2023 CTP, MDOT estimates that $3.381 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 $392 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 works to provide multi-modal connections throughout the State's transportation system so that users have a variety of options including public transit. Bicycling and pedestrian modes, while they are now being measured more consistently than in previous years, should still be developed to supplement use of public transit with other non-SOV alternatives. First and last mile connectivity is an area that is constantly changing as Maryland focuses on innovative transit planning and "complete streets" functionality.

As national trends continue to show an increase in VMT and decrease in transit ridership, MDOT is working to develop solutions that address modern preferences, such as a mobile application that offers riders real-time bus tracking, or investment in travel time reduction and facility-wide comfort. These customer-oriented services and investments are intended to soften the environmental impact of transportation in the region amid shifting attitudes concerning transportation. These shifting attitudes include mainstream acceptance of ridesharing apps such as Uber or Lyft or use of carsharing services such as Zipcar. MDOT is considering the potential impacts of future transportation technologies and services, including Transportation Network Companies (TNCs) like Lyft and Uber, and CAVs, and their role in maximizing accessibility, mobility and connectivity within the larger transportation system.

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 7 shows the weekday and annual transit usage as reported by MDOT MTA and other contracted services and as presented in the 2018 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. MDOT 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 and via the Excellerator. MDOT also coordinates with employers and colleges to provide transit passes thereby reducing SOV travel, reducing vehicle emissions and congestion.

Figure 7. Maryland Transit Ridership Trends by Mode 2008-2017

FISCAL YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017*
TRANSIT RIDERSHIP–MTA DIRECT-OPERATED SERVICES (THOUSANDS)									
LOCAL BUS	75,694	74,926	78,390	79,535	80,071	75,780	78,697	75,619	69,587
BALTIMORE METRO	13,567	13,364	14,588	15,364	15,208	14,632	13,901	12,222	10,960
LIGHT RAIL	8,644	8,158	8,655	8,540	8,647	8,106	7,657	7,431	7,414
TRANSIT RIDERSHIP–CONTRACTED SERVICES AND LOTS (THOUSANDS)									
MARC	8,021	8,096	8,233	8,452	9,062	9,168	9,246	8,962	9,185
CONTRACTED COMMUTER BUS	3,974	3,859	4,097	4,290	4,187	4,017	4,034	3,928	3,866
MOBILITY PARATRANSIT & TAXI ACCESS	1,450	1,481	1,660	1,900	2,084	2,289	2,495	2,556	2,746
LOTS	45,635	45,700	40,243	40,908	40,281	42,500	39,441	38,476	39,818

* 2017 data is preliminary and subject to change.

GGRA Program Status – Pricing

Program Description and Objectives

MDOT supports multiple alternative commute programs including ride sharing, guaranteed ride home, travel demand management (TDM) and marketing, outreach and education programs, parking cash-out subsidies, transportation information kiosks, local car sharing programs, telework partnerships, parking fees, and vanpool programs, among others. These programs encourage use of alternative transportation 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 MDTA.

Implementation Milestones

Operational, management, and financial support for a broad range of TDM programs (also known as Transportation Emission Reduction Measures (TERMs))[2] is documented in the 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 MDOT). Both programs offer commuters and students 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 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.

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 access to transit and encourage ridesharing, are emerging possibilities to expand the scope of traditional TDM programs. MDOT will continue to add capacity, provide better transit access, and maintain park and ride lots, while providing information to the public to increase awareness about the possibilities of carpooling and taking transit.

> 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 DOT's surface transportation reauthorization, the FAST Act, The Surface Transportation System Funding Alternatives (STSFA) grant program[3] funds projects to test the design, implementation and acceptance of user-based alternative revenue mechanisms. The program helps to 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 piloted 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 address common challenges involved with implementing user-based fees such as public acceptance, privacy protection, equity and geographic diversity. MDOT has been monitoring the progress of these studies, future grant funding opportunities, and other emerging road pricing technologies to learn innovative

---

[2] The Secretary's office Capital Program Summary – Line 2
 http://www.mdot.maryland.gov/newMDOT/Planning/CTP/CTP_17_22/Documents/TSO.pdf
[3] http://www.fhwa.dot.gov/pressroom/fhwa1648.cfm

methods of funding the transportation system here in Maryland. Each state that received funding has conducted research regarding novel ways to collect road user fees, such as built-in electronic systems and pay-at-pump systems. Minnesota, for instance, investigated mobility as a service (MaaS) and examined trends (decline in private vehicle ownership, MaaS customers traveling less) and their potential effects on road use pricing. Research is ongoing, and MDOT will continue to examine the outcomes of this research.

Funding

MDOT sets aside nearly $26 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 FY 2018-2023 CTP identifies $63.6 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 all-electronic tolling (AET) across the entire system. This next generation tolling system will significantly enhance the capacity for handling video tolling and citations. As of the 2018-2023 CTP, engineering is underway with collection system hardware and software procurement and installation starting in FY 2018. To provide a cost savings to Maryland citizens and move closer to AET, MDTA announced the elimination of the $7.50 E-ZPass Maryland transponder fee for all new customers in May 2018.

Challenges

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 to reduce or shift trips to times when roadway capacity is less constrained. Expansion of employers offering these incentives and employees using them are associated with several 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 TOD development or other technical assistance programs can take a lead by example role as it relates to parking. Additionally, incentives can be considered to encourage alternative commuting rather than driving. MDOT is also facing a challenge of low usage of park and ride lots. Average occupancy rate of MDOT SHA statewide park-and-ride lots was at 51 percent capacity in CY 2016, down from 53 percent in CY 2015.

The significant expansion of TNCs operating in Maryland over the past couple years has 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.

MDOT continues to monitor ongoing FHWA and AASHTO studies and research on innovative financing options as a mechanism to potentially replace the Federal gas tax.

Estimated Greenhouse Gas Reductions

According to MDOT's 2018 Annual Attainment Report, calendar year 2017 saw a 214.7 million VMT decrease via various TDM projects and programs, including Commuter Choice Maryland, Commuter Connections, the Telework Partnership, various transit marketing and subsidy programs, and utilization of statewide park-and-ride facilities.

Figure 8 shows the estimated annual regional VMT reductions due to TERMS and Figure 9 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 82 percent in FY 2017, an increase of 1.8 percent over FY 2016. The 2018 Attainment Report can be found here.

Figure 8 Annual VMT Reductions Attributed to TERMs CY2009-CY2017

ESTIMATED ANNUAL REGIONAL VMT REDUCTION THROUGH TERMS

Calendar Year	Reduction in Annual VMT (Millions)
2009	647.8
2010	658.2
2011	665.0
2012	678.1
2013	677.0
2014	697.5
2015	708.2
2016	698.5
2017*	766.4

* 2017 data point has been calculated using a different methodology from years past as Commuter Choice data is not available at this time.
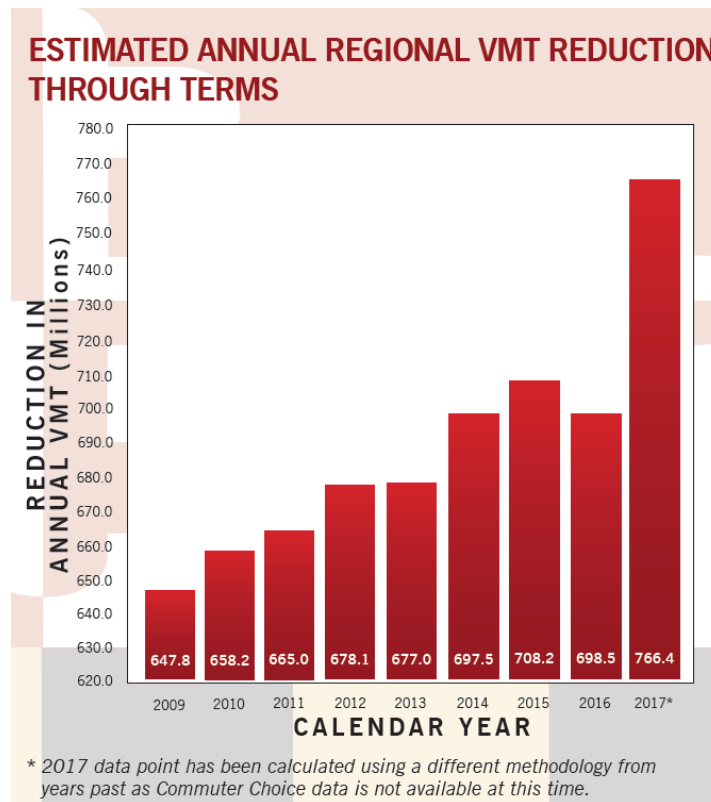
Figure 9. Reduction in VMT through Park-and-Ride Usage

MDOT MTA/MDOT SHA: REDUCTION IN VEHICLE MILES TRAVELED (VMT) THROUGH PARK-AND-RIDE USAGE

By offering park-and-ride facilities, MDOT SHA and MDOT MTA provide commuters with an alternative to driving to their destinations and supports increased carpooling and public transit ridership.

AGENCY	TOTAL SPACES	AVERAGE WEEKDAY UTILIZATION*
MDOT SHA (2017) (Estimated)	13,349 ***	6,687***
MDOT MTA (2017)	22,001	13,925
Transit Multipurpose**	33,336	22,581
Total	68,686	43,193

* 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 MDOT MTA, Amtrak, WMATA, Penn Station in Baltimore and Union Station in Washington, D.C.

*** Data is preliminary and subject to change.

FISCAL YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	275.2	266.4	257.4	261.8	264.7	219.4	235.8	230.9	214.7
MDOT MTA*	168.7	166.1	155.9	156.1	156.1	110.3	128.9	129.1	117.5
MDOT SHA**	106.5	100.3	101.5	105.7	108.6	109.1	106.9	101.8	97.2

* MDOT MTA park-and-ride lot VMT reductions are estimated based on the same assumptions used to calculate VMT reductions associated with MDOT MTA Transportation Emission Reduction Measures.
** MDOT SHA 2009 to 2016 actual data revised from previous Attainment Report.

GGRA Program Status – Bike and Pedestrian Initiatives
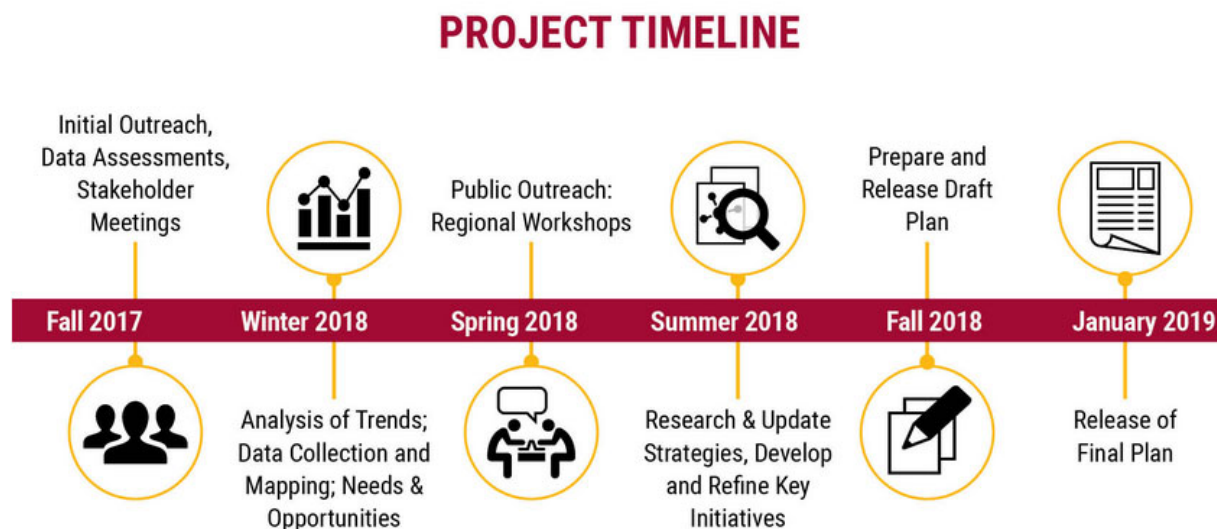
Program Description and Objectives

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 2019 Bicycle and Pedestrian Master Plan Update establishes a 20-year vision for bicycling and walking as transportation in Maryland; and provides guidance and investment strategies to support bicycling and walking in the state.

As of Fall 2018, the Bike and Pedestrian Plan is being updated in preparation for its release in January 2019 whose draft goals include expanding travel choices and improve multimodal connectivity and advance biking and walking as economic development strategy.

Figure 10. Bike/Pedestrian Plan Update Timeline

PROJECT TIMELINE

Initial Outreach, Data Assessments, Stakeholder Meetings — **Fall 2017**

Analysis of Trends; Data Collection and Mapping; Needs & Opportunities — **Winter 2018**

Public Outreach: Regional Workshops — **Spring 2018**

Research & Update Strategies, Develop and Refine Key Initiatives — **Summer 2018**

Prepare and Release Draft Plan — **Fall 2018**

Release of Final Plan — **January 2019**

The following implementation elements were identified in the 2018 GGRA plan update, consistent with the Bicycle and Pedestrian Master Plan:

- Bike sharing programs will continue being expanded in many Maryland communities, with financial and technical assistance from MDOT. Successful programs are operating in Montgomery and Howard Counties as well as in the City of College Park.

- All 83 MARC train stations managed by MDOT MTA have bike parking. Bike parking has been expanded and improved, included covered parking, where needed. Bikeshare stations have been added at 7 MDOT MTA rail stations. All MDOT MTA buses contain bike racks.

- Consider Bike Accommodations for all applicable Roadway Projects – 73 roadway capacity or bridge upgrade projects in the Consolidated Transportation Program include accommodations for bicycles and pedestrians. MDOT SHA has improved 93.9 directional miles of roadways for bicycle access in FY 17.

- Seven bike network projects were funded in FY 2019 under the Maryland Bikeways Program. Approximately 91 bikeways projects that received funding through the Bikeways Program are complete. Additional projects will be solicited through annual grant cycles.

- MDOT 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 MDOT 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.

- MDOT SHA's bicycle committee continues to improve bicycle guidance and policies for MDOT SHA roadways and MDOT TSO, with MDOT 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 on health and education.

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 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 and Prince George's Plaza Metro, with plans in development for Silver Spring, Bethesda, and the Rockville Town Center area.

MDOT has several additional activities planned for 2018 and 2019 to support increased use of active travel modes and reduced GHG emissions.

- MDOT 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 MPOs to support their efforts on bicycle and pedestrian transportation. Several planning efforts are underway in Maryland jurisdictions and in Maryland's MPOs.

- MDOT SHA has completed phase 1 of planning for a Bike Spine Network to connect major activity centers and guide the planning and construction of bicycle facilities. In phase 2, MDOT 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. The Task Force's purpose was to study and make 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.[4] The Task Force delivered its recommendations and findings to the Legislature on December 18, 2017.

Funding

Greenhouse gas-beneficial funding for bike and pedestrian projects totals $175.4 million in the FY 2018 – FY 2023 CTP. This MDOT estimate include 103 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: ADA Retrofit Program, Sidewalk Retrofit Program, Bicycle Retrofit Program, Urban Reconstruction Program, and management of the FHWA Transportation Alternatives (TA) Set-Aside funds. In September 2018, MDOT announced $17.2 million in grants for 43 projects to support improvements for bike and pedestrian connectivity across the state. It includes $1.9 million in State funds from the Maryland Bikeways Program, as well as $1.3 million in federal funding from the Recreational Trails Program, and $14 million in federal funding from the Transportation Alternatives Program.

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 $21 million to 151 local bicycle transportation projects. Grant applications are solicited and awarded on an annual basis.

Bikeshare: Bikeshare networks are being supported by MDOT throughout Maryland using a variety of funding sources. In FY2019, the Transportation Alternatives Program awarded funds to expand bikeshare in Prince George's County, building on prior year support from the Transportation Alternatives and Bikeways programs for bikeshare stations along the Bethesda Trolley Trail, Grosvenor Metro station, and the National Harbor area. Bikeshare projects are MDOT's efforts to make efficient use of limited transportation resources, by extending the reach

---

[4] http://www.mdot.maryland.gov/newMDOT/Planning/Bike_Walk/Task-Force.html

of transit through efficient bike networks – and connecting more people to destinations by providing alternatives solutions.

Recreational Trails Program: MDOT 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 2019 MDOT awarded $1,259,778 in grants, supporting 19 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 for safe routes to school and environmental mitigation. In FY 2019 $ 14,020,130 was awarded to 18 projects. These projects represented improvements in pedestrian access, canal restoration along heavily-trafficked areas, and bicycle facilities.

Challenges

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. Local entities are also more acutely aware of the challenges and opportunities that their bicycle and pedestrian infrastructure presents and can use tools and benchmarks that are available at a national level. MDOT programs and technical assistance have been geared toward helping ensure that local jurisdictions have the tools necessary to strategically improve the network.

In the [Federal Fiscal Year 2018 National Highway Safety Plan](#), MDOT documented our goal to reduce the number of non-motorized fatalities, plus serious injuries, on all roads in Maryland from 685 (2004–2008 average) to 433 or lower by December 31, 2020. To make measurable progress on these goals, State and local agencies meet on a regular basis to ensure progress on the identified action items. Beyond that, local jurisdictions have even established their own goals regarding roadway safety for all users: Montgomery County is the first county in Maryland to establish a "Vision Zero" set of guidelines.

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 11 and 12 show both metrics along with their annual (or time-bound) targets as tracked by MDOT SHA as part of the Attainment Report. MDOT 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. MDOT has exceeded its target of 59 percent of its state-owned roadway centerline miles with a BLOC of grade "D" or better by the year 2017. The 2018 Attainment Report is available [here](#).

Figure 11. Percentage of State-owned Roadway Directional Miles Within Urban Areas that have Sidewalks and Percent of Sidewalks that Meet ADA Compliance
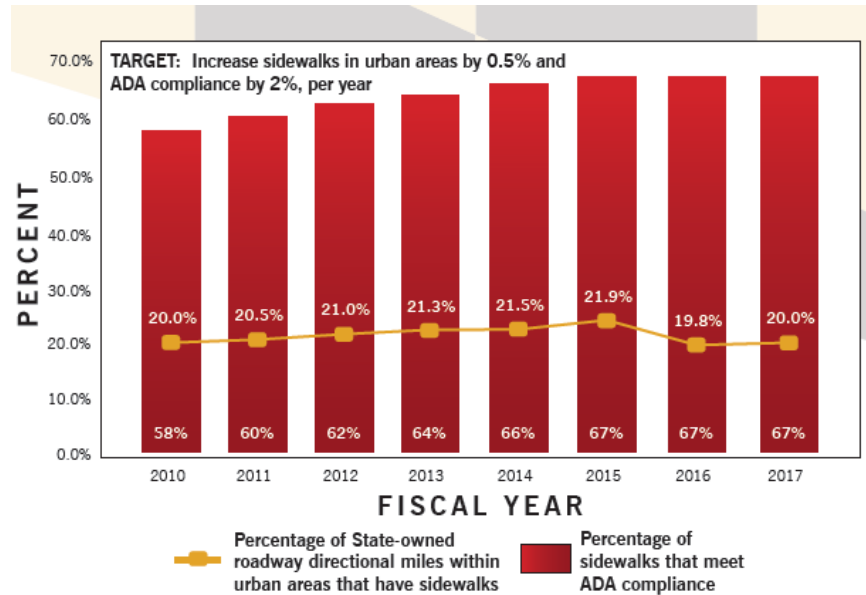
* In the future, Bike and Pedestrian Attainment Report performance measures might include Attainment Report Advisory Committee (ARAC) approved updates and modifications that result from the MDOT Bike and Pedestrian Master Plan update.

Figure 12. Percent of State-owned Roadway Centerline Miles with BLOC Level "D" or Better
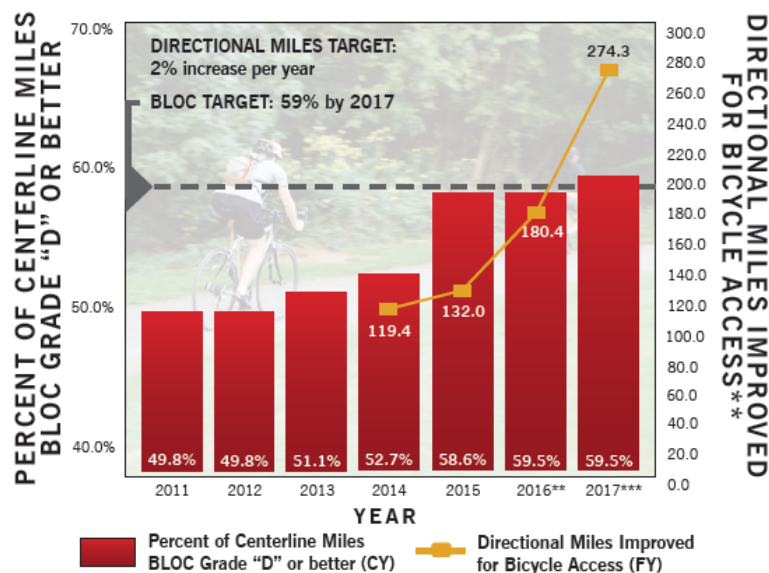
* In the future, Bike and Pedestrian Attainment Report performance measures might include ARAC approved updates and modifications that result from the MDOT Bike and Pedestrian Master Plan update. Please note that BLOC results are conservative in some cases because actual outside lane width is greater than average lane width.

** 2016 revised from previous Attainment Report.

*** 2017 BLOC data is preliminary and subject to change.