MARYLAND 2015 GREENHOUSE GAS REDUCTION ACT PLAN

Maryland Department of Transportation

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BACKGROUND

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 though 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 requires 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). The report details the MDOT accomplishments to date, emission trends, and programs and projects planned for implementation that will support GHG emissions reductions through and beyond 2020.

This report also provides a preview of MDOT's role as part of the Maryland Commission on Climate Change. A 2014 Executive Order and the 2015 Maryland Commission on Climate Change 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.

TRANSPORTATION SECTOR CONTRIBUTION TO STATEWIDE GHG EMISSIONS

In 2006, the transportation sector represented 33 percent of Maryland GHG emissions. Of the 33 percent, 28 percent is from on-road mobile sources (e.g., cars, buses, and trucks), and the remaining 5 percent is from non-road transportation (e.g., airplanes, boats, locomotives, and construction equipment).

MDOT programs predominantly influence 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).

TRANSPORTATION SECTOR TRENDS

Transportation trends that have a bearing on greenhouse gas emissions include travel activity, mode share, congestion, and fleet efficiency.

- **Travel Activity** – Total vehicle travel in Maryland as measured in vehicle miles traveled (VMT) remained steady from 2009 to 2014. The 2014 statewide VMT total of 56.5 billion is 0.3 percent lower than 2007 VMT. While VMT has remained steady, VMT per capita has steadily decreased. Since 2005, average annual VMT per capita has decreased by 72 vehicle miles per year, totaling a 6.3 percent reduction. This data reflects changes in traveler behavior, impacts of the recession, and increased share of compact and mixed-use development.

- **Mode Share** – Marylanders are provided a multitude of transportation choices, each with a different range of travel times and costs. The share of non-Single Occupancy Vehicle (SOV) commuting (ridesharing, transit, bike, walk, telecommute) has increased from 24 percent in 2004 to over 26 percent in 2013 (the 4th highest non-SOV mode share among all states). The increased competitiveness of alternative modes is driven by the same factors impacting VMT, as well as MDOT's commitment to enhancing access to alternative modes.

- **Congestion** – In the Washington and Baltimore regions, highway congestion and parking costs are decision factors leading commuters to telecommute or to leave their vehicles at home during the weekdays, choosing instead to use alternative modes. MDOT is strategically investing in roadway capacity and operational improvements to reduce congestion and through the Coordinated Highway Action Response Team (CHART), the Maryland511 program, and traffic management strategies, MDOT provides tools to help drivers avoid congestion. Since 2012, congestion on Maryland's interstate and major arterial facilities has remained fairly constant (typically around 25 percent of VMT in the evening peak hour operating in congested conditions).

- **Vehicle Fleet Trends** – The national fuel economy and fuel standards are having a dramatic effect on on-road transportation emissions. The implementation of National Corporate Average Fuel Economy (CAFE) Standards for light-duty vehicles (passenger cars and trucks) from 2006-2025 will result in an average miles per gallon (mpg) improvement of 118 percent between model years 2008 and 2020.

These trends are the primary contributors to GHG emissions from on-road transportation, which represents 83 percent of all transportation sector emissions. These trends are also those that transportation and local planning agencies have the greatest ability to control through policy choices. Trends in the off-road sector (primarily aviation, marine, and rail) are primarily driven by private sector decisions or public-private partnerships combined with federal engine and emission standards.

GHG EMISSIONS BASELINE AND FORECAST

The emission estimates in the report represent and update to the 2013 GGRP. The on-road emission estimates now utilize EPA's most recent emissions model, Motor Vehicle Emissions Simulator (MOVES2014). With MOVES2014, greenhouse gases are calculated from vehicle energy consumption rates and vary by vehicle operating characteristics including speed, engine size, and vehicle age.

The 2006 baseline and 2020 forecast includes emissions of carbon dioxide, methane, and nitrous oxide converted to carbon dioxide equivalents (CO_2e) that are measured in units of million metric tons (mmt) based on each pollutants global warming potential (GWP). Carbon dioxide represents about 97 percent of the transportation sector's GHG emissions.

The starting point of the GHG emissions analysis is a 2006 baseline and 2020 forecast. The 2020 forecast is also described as a "business-as-usual" (BAU) forecast – indicating that it is based on existing fleet information and VMT trends only. Completing a BAU forecast enables an accurate accounting of the emissions benefits of all programs individually (including federal fuel economy standards) compared to a do-nothing case. Two VMT growth trends were tested for the 2020 BAU: (1) a VMT growth trend of 1.8 percent annual (consistent with the 1990 to 2006 rate), and (2) a VMT growth trend of 1.1 percent annual (consistent with the 1990 to 2013 rate). The statewide emission totals for the 2006 baseline and the two 2020 BAU forecasts are presented in **Table ES.1**

Table ES.1 – Maryland 2006 and 2020 Transportation Sector GHG Emissions			
GHG Emissions ($mmtCO_2e$)	2006 Baseline	2020 BAU	2020 Adjusted-BAU
Light Duty Vehicles	23.34	30.77	28.38
Medium/Heavy Duty Trucks & Buses	7.38	9.36	8.63
Total On-Road	30.72	40.13	37.01
Off-Road	4.34	4.13	4.13
TOTAL GHG Emissions	**35.06**	**44.26**	**41.14**
Emission Reductions ($mmtCO_2e$) Associated with VMT Growth Scenario			**3.12**
Note: VMT growth rate and the 2020 BAU Adjusted uses a 1.1% annual VMT growth rate.			

TRANSPORTATION SECTOR CONTRIBUTION TO MARYLAND'S CLIMATE GOALS

Transportation projects and programs (including Federal programs and MDOT-funded projects and programs) are assigned to the following categories consistent with the 2013 GGRP: Transportation Technologies, Public Transportation, Pricing Initiatives, and Other Innovative Transportation Programs. This report documents the activities, funding, and estimated GHG reduction within each of these categories.

Transportation Technologies

Motor Vehicle Emissions and Fuel Standards – The programs presented in the figure below are included as greenhouse gas emissions reduction strategies for the Maryland transportation sector through 2020. The Maryland Clean Car Program implements California's low emissions vehicle (LEV) standards to vehicles purchased in Maryland starting with model year 2011. There are three national programs in place that strengthen the fuel economy standards for light duty cars and trucks and overlap the Maryland Clean Car Program. Beyond the light duty vehicle standards are national medium and heavy vehicle standards as well as federal fuel standards.

Light-duty vehicle (passenger cars and trucks) standards

- The existing CAFE standards for vehicle model years 2008 to 2011
- The National Program for model years 2012 to 2016 as finalized in the May 7, 2010 joint rulemaking by US DOT and EPA
- The National Program covering model years 2017 to 2025 light-duty vehicles as announced in the August 28, 2012 joint rulemaking by the US National Highway Traffic Safety Administration (NHTSA) and US Environmental Protection Agency (EPA) (published October 15, 2012)
- The Maryland Clean Car Program that incorporates the California emission standards beginning with model year 2011

Medium/Heavy-duty vehicle (trucks and buses) standards

- Fuel efficiency and greenhouse gas standards for model years 2014 to 2018 medium and heavy-duty vehicles (published September 15, 2011)
- Pending approval, the fuel efficiency and greenhouse gas standards for medium and heavy-duty vehicles for model year 2018 and beyond

Fuel standards

- Tier 3 vehicle and fuel standards beginning with model year 2017 (published April 28, 2014)
- The Federal Renewable Fuel Standard Program (RFS2), which mandates the use of 36 billion gallons of renewable fuel annually by 2022 (published March, 2010)

*The aggregate GHG reductions from fuel economy and technology improvements across all vehicle types plus federal renewable fuel standards total **5.57 mmtCO$_2$e** from projected 2020 emissions.*

On-Road, Airport, Port and Freight/Freight Rail Technologies – This group of strategies include on-road technologies such as CHART, airport and port initiatives to improve operations and reduce emissions, and freight programs to eliminate bottlenecks in Maryland's truck and rail freight systems.

On-Road Technology:	Airport Initiatives:
• **Total FY 2015 – FY 2020 CTP GHG Beneficial Funding:** $1.33 billion • **Example Projects:** CHART, Intelligent Transportation Systems, Signal Synchronization, Passenger Information	• **Total FY 2015 – FY 2020 CTP GHG Beneficial Funding:** $12.08 million • **Example Projects:** Alternative fueled vehicles, solar installations
Port Initiatives:	**Freight and Freight Rail Initiatives:**
• **Total FY 2015 – FY 2020 CTP GHG Beneficial Funding:** $38.60 million • **Example Projects:** Rail Access to Fairfield Marine Terminal, Dray Truck Replacement Program	• **Total FY 2015 – FY 2020 CTP GHG Beneficial Funding:** $411.26 million • **Example Projects:** Upgrade Truck Weigh Facilities, I-70 (Frederick County), I-81 (Washington County), I-695 (Baltimore County), Canton Railroad (Baltimore City)

*The aggregate GHG reductions from transportation technologies total **1.07 mmtCO$_2$e** from projected 2020 emissions.*

Electric and Low-Emission Vehicle Initiatives – During the 2011 Maryland Legislative session, the General Assembly passed legislation creating an Electric Vehicle Infrastructure Council (EVIC), which developed a final action plan, delivered in 2012, to reach an ambitious goal of 60,000 plug-in electric vehicles (PEVs) on the road in Maryland by 2020, or 2.3 percent of the State's passenger vehicle fleet.

*The aggregate GHG reductions associated with achieving the 2020 EVIC goal total **0.25 mmtCO$_2$e** from projected 2020 emissions.*

Transportation Plans and Programs

To account for the emission benefits of funded transportation plans and programs through 2020, Metropolitan Planning Organization (MPO) future regional demographic and land use projections and the impacts of planned transportation projects (highway and transit) in regional fiscally constrained plans were assessed. The average annual VMT growth rate through 2020 decreases from 1.1 percent (2020 Adjusted-BAU) to 0.5 percent when accounting for these plans (a total difference of 4.9 billion VMT in 2020, or a 7.5 percent reduction). Beyond the emissions benefit of the modeled plans and programs are emissions benefits from transportation emissions reduction measures (TERMs) implemented by MDOT and the MPOs to support use of alternative modes and to address Clean Air Act requirements.

This change in VMT from the plans and programs is translated to GHG emissions and, along with the TERMS, are organized into the following policy options: Public Transportation, Pricing Initiatives, and Other Innovative Transportation Programs.

Public Transportation Initiatives – MDOT's public transportation initiatives to reduce GHG emissions are led by the Maryland Transit Administration which, as part of providing public transportation to Marylanders, seeks to increase transit ridership, optimize the efficiency of transit services, and reduce emissions from transit vehicles. The MTA's ongoing activities to reduce GHG emissions include directly providing transit services, supporting locally operated transit services, procuring more fuel efficient and lower emission vehicles, and implementing capital projects to promote transit use. In addition, MDOT provides funding for WMATA rail capital and operations, Metrobus, and ADA paratransit services in the Maryland suburbs of Washington, D.C.

MDOT is working with multistate and regional partners to implement strategies to reduce congestion by providing alternatives to passenger vehicle use for intercity passenger travel – both for work and leisure trips. This includes expansion and enhancement of intercity passenger rail service (including MARC and AMTRAK) and intercity bus services as well as improved connections between air, rail, intercity bus, and local transit systems.

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$3.61 billion*
Example Projects: *Purple Line, Corridor Cities Transitway, Bus Rapid Transit Studies on US 29, MD 355, and MD 586 (Montgomery and Howard Counties)*

The aggregate GHG reductions associated with public transportation initiatives total ***1.77 mmtCO$_2$e*** *from projected 2020 emissions.*

Pricing Initiatives – Electronic toll collection systems, which are available at all eight toll facilities across the state, expedite the toll collection process and reduce delays at toll plazas. GHG emissions are significantly reduced when tolls are collected electronically, due to reduced queuing and idling at toll collection plazas. Pricing initiatives also include transportation demand management strategies that provide financial incentives for ridesharing and transit use.

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$287.05 million*
Example Projects: *High-Speed Toll Collection, I-95 Express Lanes, Intercounty Connector, Transportation Emission Reduction Measures (including funding for ridesharing programs like Commuter Choice Maryland and Commuter Connections)*

The aggregate GHG reductions associated with pricing initiatives total ***1.99 mmtCO$_2$e*** *from projected 2020 emissions.*

Bicycle and Pedestrian Initiatives – MDOT has worked to encourage walking and bicycling by improving pedestrian and bicycle accommodation along state highways, improving access to transit, and supporting local efforts to encourage walking and biking. MDOT manages several ongoing programs that provide funding for pedestrian and bicycle improvements, including: Maryland Bikeshare Program, Maryland Bikeways Program, ADA Retrofit Program, Sidewalk Retrofit Program, Bicycle Retrofit Program, Community Safety and Enhancement Program, and management of the FHWA Transportation Alternatives Program (TAP).

Total FY 2015 – FY 2020 CTP GHG Beneficial Funding: *$160.1 million*
Example Projects: *MD 589, Racetrack Road – Shared use path, MD 117/Clopper Road – Shared Use Path (Montgomery County), Purple Line – Shared Use Path (Montgomery County), BRAC-Related Intersection Improvements (Anne Arundel, Harford, and Prince George's Counties)*

The aggregate GHG reductions associated with bicycle and pedestrian initiatives total ***0.07 mmtCO$_2$e*** *from projected 2020 emissions.*

SUMMARY

The transportation sector exceeds the 2013 GGRP initial reductions and achieves over 80 percent of the 2013 GGRP enhanced reductions that were representative of unfunded strategies. The total reduction in 2020 of **13.83 mmtCO$_2$e represents a 31 percent reduction from the 2020 BAU (see Figure ES.1)**.

Figure ES.1 – 2020 Transportation Sector GHG Emissions

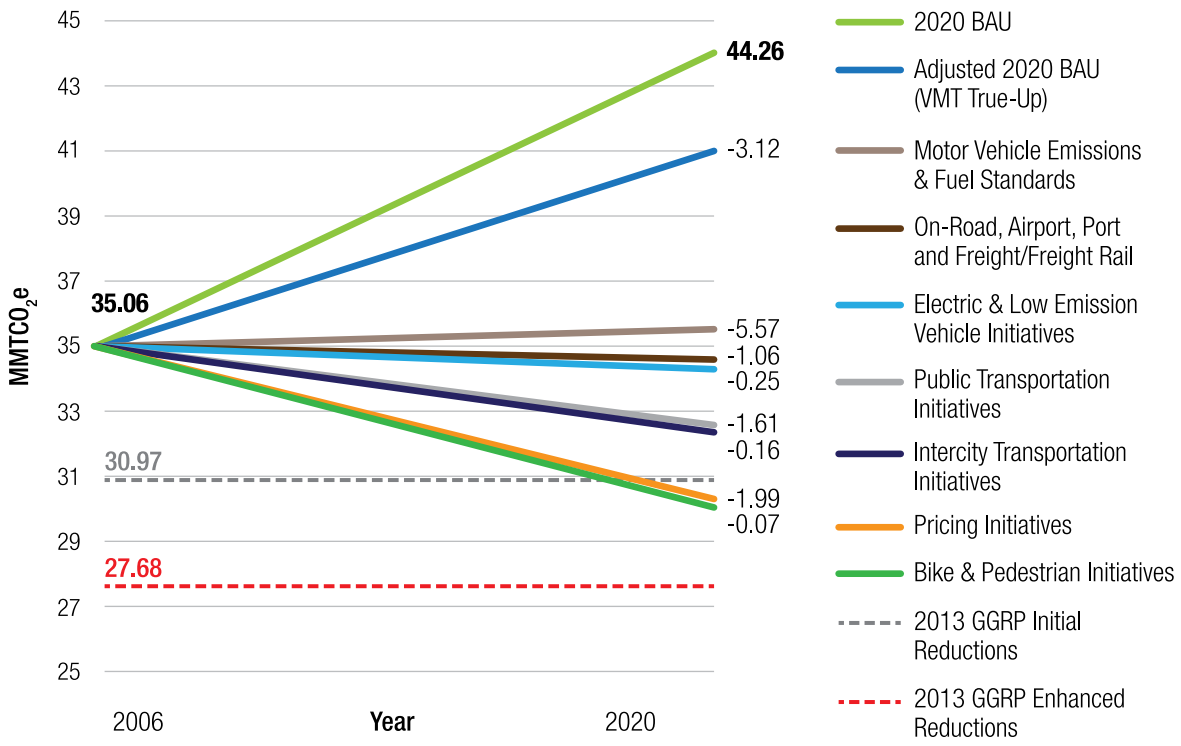


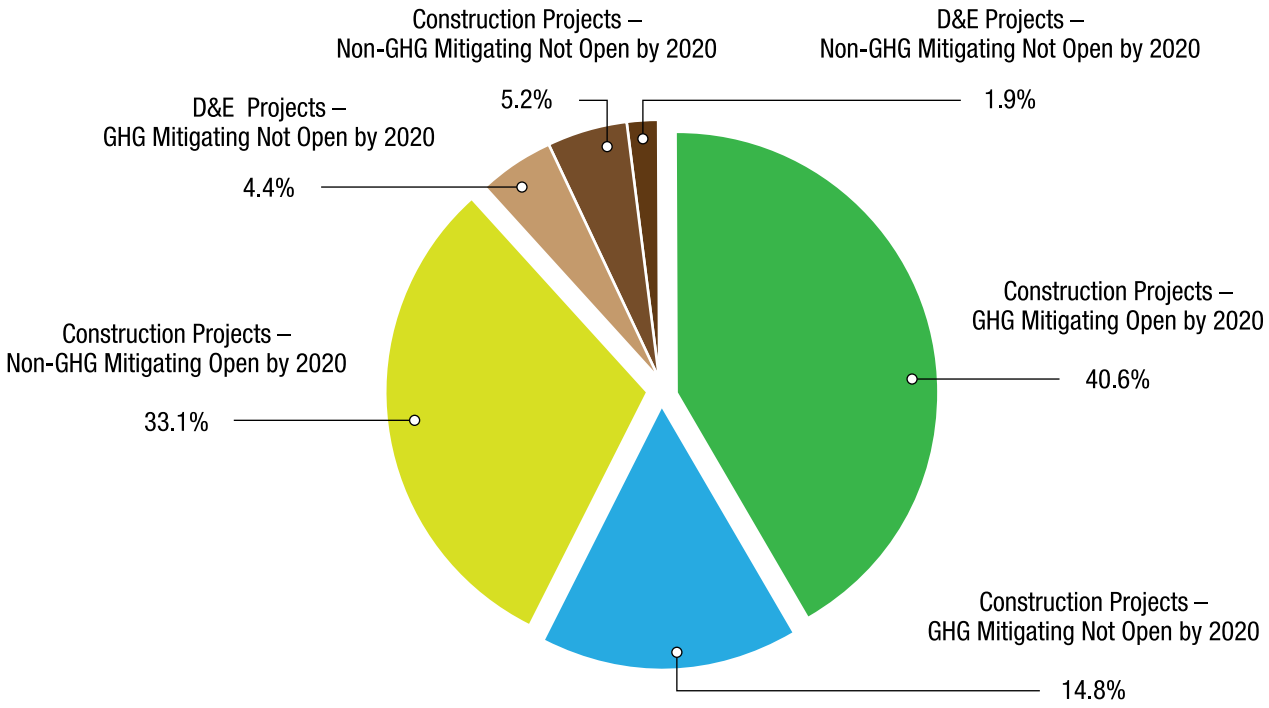
Table ES.2 – 2020 GHG Emissions Summary by Scenario and Policy Option

Scenario / Policy	2020 GHG Emissions Reduction	2020 Total GHG Emissions (mmt CO$_2$e)
2020 BAU	–	44.26
2020 Adjusted-BAU	3.12	41.14
Transportation Technologies (Motor Vehicle Emission and Fuel Standards, On-Road, Airport, Port, Freight/Freight Rail Technologies, Electric and Low-Emission Vehicle Initiatives)	6.88	34.26
Public Transportation Initiatives (including Intercity Transportation)	1.77	32.49
Pricing Initiatives	1.99	30.50
Bicycle and Pedestrian Initiatives	0.07	30.43

The process for reviewing the transportation sector's contribution toward meeting Maryland's GHG emission reduction goals included a detailed review of all projects and programs funded in the FY 2015 – FY 2020 Consolidated Transportation Program (CTP). Figure ES.2 presents the share of CTP funding by GHG and non-GHG projects, and the project planned opening (pre or post-2020) in the construction and development and evaluation (D&E) programs. The total 6-year CTP funding associated with the projects and programs within Figure ES-2 total $10.447 billion. The FY 2015 – FY 2020 CTP totals $14.434 billion. The difference ($3.987 billion) is associated with system preservation and minor project programs within the CTP (not reviewed as part of this report).[1] Some facts on projects costs in the CTP relevant to this report include:

- All GHG mitigating projects (independent of opening year) represent **60 percent** of the total CTP funding in the construction and D&E program.
- GHG mitigating projects open by 2020 represent **41 percent** of the total CTP funding in the construction and D&E program.
- There were **266 line items** reviewed in the construction and D&E program, with **159 line items** deemed to support GHG mitigation. GHG mitigating projects directly support reducing VMT, alleviating congestion, or improving vehicle or infrastructure efficiency. The **$6.247 billion** in the CTP for these projects and programs represent **43 percent** of the total cost of the CTP.

Figure ES.2 – CTP Program Summary - GHG Beneficial Project Cost Share (Construction + Development and Evaluation Program Only)



Appendix B provides detailed documentation of each CTP line item included in this analysis. The analysis excludes all previously spent and planned spending on the Red Line and maintains the Purple Line cost as documented in the FY 2015 – FY 2020 CTP.

[1] *All funding totals referencing the FY 2015 – FY 2020 CTP exclude all costs associated with implementation of the Red Line. The funding analysis will be updated once the FY 2016 – FY 2020 CTP is final in winter 2016.*

1.0 INTRODUCTION

In response to the threat and growing concern with climate change, the Maryland Commission on Climate Change (MCCC or the Commission) was established in April 2007. The original Commission included 16 Maryland agency heads, six General Assembly members, local government officials, and representatives from the private sector and non-governmental organizations. The Commission released a plan of action for addressing climate change in August 2008.

In 2009, the State of Maryland adopted the Greenhouse Gas Emission Reduction Act of 2009 (GGRA). Starting in 2009, MDOT began working with stakeholders to develop a comprehensive approach to reduce GHG emissions from the transportation sector through 2020 and beyond. In 2011, MDOT finalized the MDOT 2012 Implementation Plan and subsequently worked with the Maryland Department of Environment (MDE) and other state partners to support development of the 2013 Greenhouse Gas Reduction Act Plan (GGRP).

This Plan presents MDOT's blueprint for reducing GHG emissions from the transportation sector through 2020, including information on the specific emission benefits and costs of each program. It serves as MDOTs contribution to development of the 2015 GGRP Update.

1.1 BACKGROUND

Greenhouse Gas Reduction Act and Maryland Commission on Climate Change

The GGRA requires MDE to work in cooperation with State agencies to develop a Plan to achieve a 25 percent reduction in GHGs from a 2006 baseline by 2020 that creates jobs and improves the economy.

The GGRP initial suite of strategies (February 2012) were determined to be insufficient in meeting the reduction target and a number of strategy and program enhancements were added for inclusion in the 2013 GGRP. MDE worked with state partners to review opportunities for including enhancements within the Plan in order to achieve the 2020 goal. The MDOT 2012 Implementation Plan (i.e. the Green Book) served as an input to the 2013 GGRP and was attached as an Appendix.

Per the GGRA, in 2015, MDE is required to submit a report to the Governor and General Assembly including the following topics:

1. The State's progress toward achieving the 25 percent reduction;
2. New and emerging GHG emission reduction technologies;
3. An analysis of overall costs and benefits to the State's economy, public health, and environment of the GHG emission reduction plan;
4. The need for adjustments to the level of required GHG emission reductions and additional control programs; and
5. The status of any federal GHG emission reduction program and any transition by the State from the Regional Greenhouse Gas Initiative to a comparable federal cap-and-trade program.

In 2016, the General Assembly will review the progress report and determine whether to continue, adjust, or eliminate the requirement to achieve a 25 percent reduction by 2020.

In parallel to the efforts supporting the requirements of the GGRA, MCCC is charged with advising the Governor and General Assembly on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change and maintaining and strengthening the State's existing Greenhouse Gas Reduction Plan. Commission priorities include building broader partnerships with federal, State and local governments, and the private sector to reduce greenhouse gas emissions. In addition, prepare for the likely impacts of climate change in Maryland, better communicating and educating Marylanders about the urgency of the challenge and options to address it, and establishing action plan goals and timetables for implementation.

The MCCC, originally created by a 2007 Executive Order, was strengthened by a 2014 Executive Order and 2015 legislation with requirements to expand the Commission membership and maintain a comprehensive action plan, with 5-year benchmarks, to achieve science-based reductions in Maryland's greenhouse gas emissions.

The Commission is supported by a Steering Committee and four working groups. These working groups represent diverse stakeholder interests and bring broad perspective and expertise to the Commission's work. These working groups represent diverse stakeholder interests including the agricultural community, Maryland businesses, and environmental advocates, who bring broad perspective and expertise to the Commission's work.

1.2 MDOT'S MISSION AND ROLE IN ADDRESSING CLIMATE CHANGE

MDOT's unified mission statement: The Maryland Department of Transportation is a customer-driven leader that delivers safe, sustainable, intelligent, and exceptional transportation solutions in order to connect our customers to life's opportunities.

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.

The Annual Attainment Report on System Performance serves as an annual statewide report on "Transportation System Performance" exploring how MDOT and its modal agencies have worked together in the past year and assessing progress towards achieving 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.

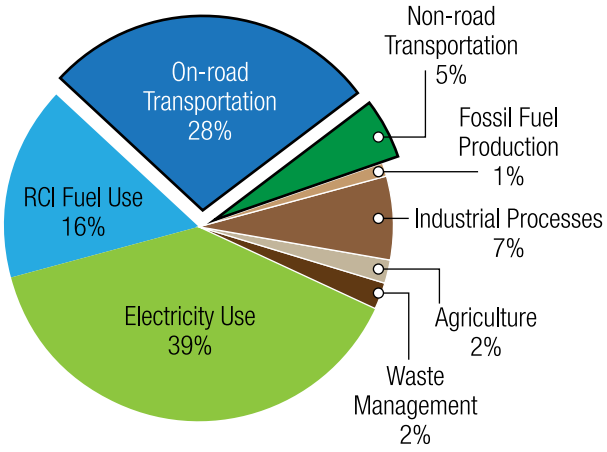
These goals reflect the diversity of current and future transportation conditions, challenges, and needs. The Consolidated Transportation Program (CTP), the State's six-year capital investment program for transportation, identifies funding for specific road, bridge, transit, aviation, port, pedestrian 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.

The Role of Transportation in Maryland GHG Emissions

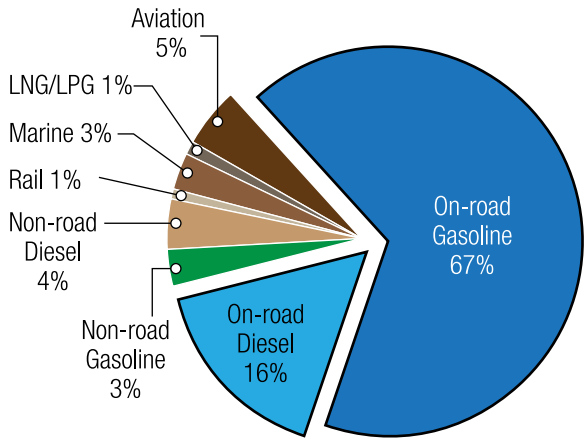
In 2006, transportation represented 33 percent of Maryland GHG emissions (**Figure 1.1**). Of the 33 percent, 28 percent is from on-road mobile sources (e.g., cars, buses, and trucks), and the remaining 5 percent is from non-road transportation (e.g., airplanes, boats, locomotives, and construction equipment).

Within the transportation sector, 67 percent of emissions come from on-road gasoline vehicles (e.g., typical passenger cars and light-duty trucks) and 16 percent of emissions come from on-road diesel vehicles (e.g., delivery trucks, combination trucks, and buses). The remaining 17 percent is a split of aviation (5 percent), marine (1 percent), rail (1 percent), non-road gasoline and diesel (7 percent), and liquefied natural gas (LNG) vehicles and off-road equipment (1 percent).

Figure 1.1 – 2006 Transportation Sector GHG Emissions



Maryland's transportation sector proportion of total emissions is above the nationwide average of 28 percent. This is mainly attributable to the extensive pass-thru transportation in Maryland, resulting in a higher emissions impact proportional to Maryland's economy.



MDOT programs have the ability to 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).

MDOT Approach – Past and Present

To develop an implementation plan for the transportation sector, MDOT established a collaborative process starting in 2009 comprised of seven Working Groups and a Coordinating Committee to provide guidance and oversight. The Working Groups helped define a total of 72 potential transportation strategies which were then trimmed down to 44 strategies and prioritized for more detailed analysis. In 2010 and early 2011, MDOT carefully assessed the emission benefits and costs of each strategy, as well as the contribution of existing funded projects and programs contained in MDOTs CTP and Maryland's Metropolitan Planning Organization (MPO) Transportation Improvement Program (TIPs) and Long-Range Transportation Plans (LRTPs). This all led to the development of the MDOT 2012 Implementation Plan, finalized in April 2011.

In 2012 and 2013, MDOT worked with MDE to update GHG emission reduction estimates, costs, economic impacts, policy descriptions, and enhancements to support the 2013 Greenhouse Gas Reduction Plan.

In 2014 and 2015, MDOT reviewed the GHG emission estimates from the 2013 GGRP based on new modeling tools, updates to the CTP based on new State transportation funding, new Federal vehicle technology and fuel standards, and emerging social, economic, and environmental issues impacting transportation in Maryland.

1.3 PURPOSE AND PROCESS OF THIS PLAN

Goals and Objectives

The goal of this Plan update is to present the progress the transportation sector has made in reducing GHG emissions and the actions being planned and implemented through 2020 to support Maryland in meeting the goals of the GGRA. To meet this goal, the Plan will:

- Present the transportation sector's accomplishments since 2009;
- Discuss broad trends impacting vehicle miles traveled, vehicle technology, and fuel use;
- Identify specific actions along with their costs and benefits within each GGRP policy option being implemented or planned for implementation through 2020; and
- Assess the transportation sector's contribution to the 2020 emission reduction goal.

Technical Approach

Much has changed since the emission and cost analysis conducted in 2011 through 2013 for the transportation sector. The 2015 technical approach adapts the previous analysis, data, and assumptions to the current reality for the transportation sector. Beyond the GGRA's 2015 legislative requirement, the topics that are motivating updates to the technical approach include:

1. Release and updates of EPA MOVES2014 model which includes enhanced data and assumptions reflecting updated mobile source emission characteristics, and refined information on final Federal fuel economy and GHG emissions standards, as well as the Tier 3 vehicle and fuel standards. MDOT also has updated the technical approach to better align with the organization of the 2013 GGRP.
2. Continuation of Maryland's transportation planning, programming, and implementation process. Actions that have moved the process forward include finalization of the Maryland Transportation Plan in 2013 and passage of the Transportation Infrastructure Investment Act of 2013. In addition, recent major project completions (e.g. the Intercounty Connector and I-95 Express Toll Lanes), investment priority changes, a continued uncertain federal funding environment, and emergence of new programs have changed the funding outlook and structure of greenhouse gas beneficial projects in the CTP.

3. Revisions to the approach for forecasting VMT growth. Vehicle miles traveled in Maryland has continued to remain steady, with minimal increase annually since 2010 - and total statewide VMT remains below the high-point in 2008.

4. Changing the organization of the MDOT Plan to align more directly with the GGRP.

Interagency Coordination

Planning, implementation tracking, and emissions analysis within the transportation sector requires MDOT to coordinate regularly with MDE and other state and regional partners.

- MDOT works with its modal agencies and the Washington Area Metropolitan Transit Authority (WMATA) to detail internal operations and initiatives that are currently generating GHG emission reductions and may lead to greater reductions over the long-term.

- MDOT coordinates with Maryland's metropolitan planning organizations (MPOs) to support short and long-range transportation planning, and the transportation conformity process.

- MDOT chairs the Electric Vehicle Infrastructure Council (EVIC), working with MDE and Maryland Energy Administration (MEA), as well as other public and private stakeholders to plan and develop policy regarding electric vehicles.

- MDOT also works with the Maryland Department of Planning (MDP) and the Smart Growth Subcabinet regarding land use decisions and their connection to travel demand. Coordination with MDP includes planning to support transit oriented development (TOD).

1.4 REPORT ORGANIZATION

The Plan update is presented in the following four sections, Section 2 – Transportation Sector Trends, Section 3 – 2006 Baseline and 2020 Business-as-Usual Forecast, Section 4 – Transportation Sector Contribution to Maryland's Climate Change Goals, and Section 5 – 2020 Transportation Sector Findings. Section 5 also provides an initial perspective on next steps for the transportation sector regarding long-range goals and strategies – referenced as a key action item for the MCCC in 2015.

2.0 TRANSPORTATION SECTOR TRENDS

Transportation trends that have a bearing on greenhouse gas emissions include:

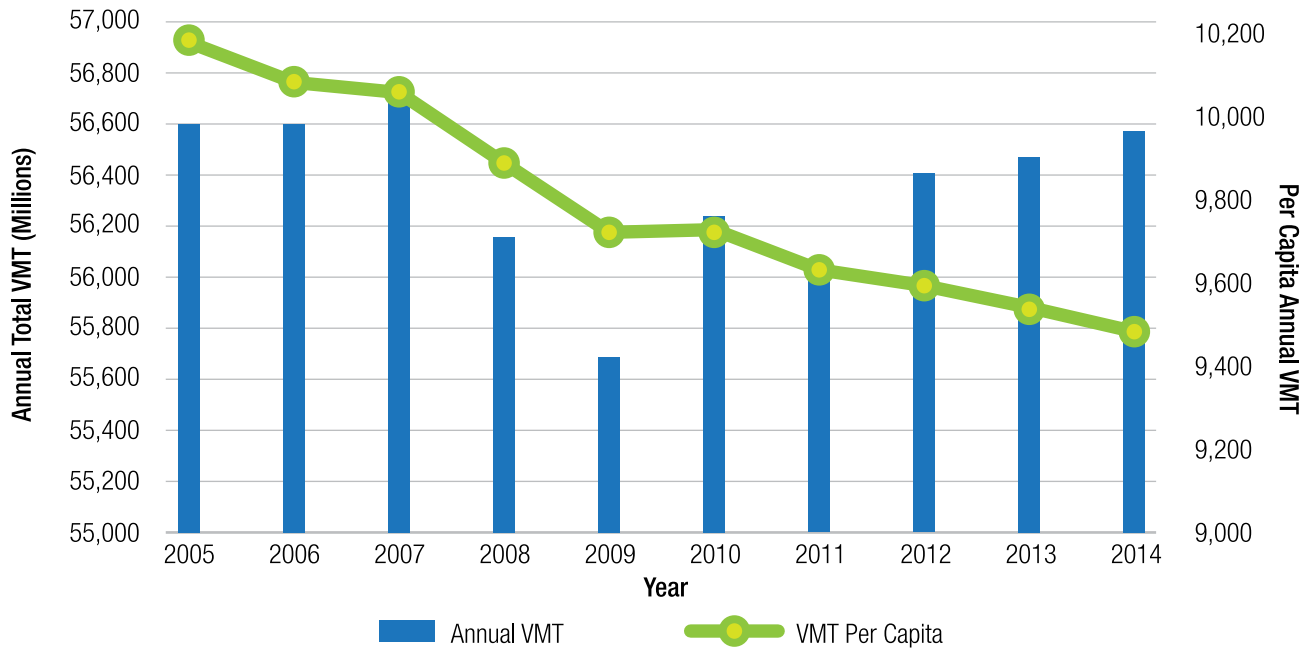
1. Travel Activity (VMT, VMT per capita)
2. Mode Share (passenger/freight; and efficiency)
3. Congestion (system performance)
4. Vehicle Fleet Trends

Maryland on-road travel peaked in 2007 with 56.8 billion annual VMT. In 2014, total annual Maryland VMT was estimated at 56.5 billion.

Travel Activity - Total vehicle travel in Maryland as measured in vehicle miles traveled (VMT) remained steady from 2009 to 2014. The 2014 statewide VMT total of 56.5 billion is 0.3 percent lower than the 2007 VMT. In 2006, the average annual VMT growth rate was 1.8 percent statewide (based on a trend looking back to 1990). Based on actual VMT data through 2014, this annual VMT growth rate (again looking back to 1990) has decreased to 1.1 percent.

While VMT has remained steady, VMT per capita has steadily decreased. As illustrated in **Figure 2.1**, annual VMT per capita has steadily decreased since 2005 as population growth has outpaced VMT. Since 2005, average annual VMT per capita has decreased by 72 vehicle miles per year, totaling a 6.3 percent reduction. Over the same period (2005 to 2014), Maryland's population has grown by 6.7 percent.

Figure 2.1 – Annual Vehicle Miles Traveled (VMT) and VMT per Capita



The travel activity trend reflects multiple factors, many of which are outside of MDOT's control:

- Change in traveler behavior, including more people accessing alternative transportation. This trend was in part spurred by evolving social attitudes on vehicle ownership (especially in the millennial generation), increased competitiveness of other modes relative to driving alone (particularly in the face of volatile fuel prices), and a growing immigrant population in Maryland with different and diverse travel needs.

- The recession, which manifested itself in transportation through higher and volatile fuel prices, higher than average unemployment, and lower growth in cargo movement – all acted to slow growth in VMT. For example, total tonnage moved decreased in 2009 through 2011 compated to a high in 2008, with growth recently rebounding in 2012 through 2014.

- An increasing share of new development in Maryland is occurring as compact or mixed-use, which typically shows lower levels of VMT per household.

- The number of registered vehicles increased by 6 percent from 2005 to 2014 (a little less than the increase in population).

Mode Share – Marylanders are provided many transportation choices each with different travel times and costs. Maryland travel options reflect the following characteristics:

- The share of non-auto commuting (transit, bike, walk, telecommute) has increased from 14 percent in 2004 to over 16 percent in 2013. When including carpooling as an alternative mode, Maryland is one of the top five states in terms of the highest share of commuters who use an alternative mode when commuting to work, 26 percent, compared to the national average, 23 percent, according to the U.S. Census Bureau American Community Survey (ACS).

- Maryland has also continued to lead the nation in bicycle and pedestrian use, offering commuters bike sharing and a growing statewide network of high quality bicycle facilities and programs that provide them new forms of mobility and connections between modes.

Maryland has consistently been ranked in the top 10 of the League of American Bicyclists Bike Friendly States ranking.

Congestion – In the Washington and Baltimore regions, highway congestion and parking costs are decision factors leading commuters to telecommute, or to leave their vehicles at home during the weekdays, choosing instead to use alternative modes such as ridesharing, transit, bicycling and walking. Through CHART, the Maryland511 program, intelligent and advanced traffic management system, MDOT provides tools to help drivers avoid congestion. Since 2012, congestion on Maryland's interstate and major arterial facilities has remained fairly constant (typically around 25 percent of VMT in the evening peak hour operating in congested conditions).

Vehicle Fleet – The national fuel economy and fuel standards are having a dramatic effect on on-road transportation emissions. The implementation of National Corporate Average Fuel Economy (CAFE) Standards for light-duty vehicles from 2006-2025 will result in around a doubling of average miles per gallon between model years 2008 and 2020.

Figure 2.2 illustrates the dramatic decline in light-duty vehicle (LDV) greenhouse gas emission factors by vehicle type for each model year between 2006 and 2020. **Figure 2.3** illustrates the relatively modest decline in heavy-duty vehicle (HDV) emission factors over the same period. This disparity will have implications through 2020 as evidenced by **Figure 2.4**. Figure 2.4 illustrates that even though the HDV fleet represents only 8 percent of VMT in 2020, 26 percent of the on-road emissions can be attributed to HDVs. Since much of the HDV emissions are from vehicles that are traveling thru Maryland, emissions from these sources cannot be easily influenced except through federal standards and initiatives.

Figure 2.2 – Light Duty Vehicle Emission Factors

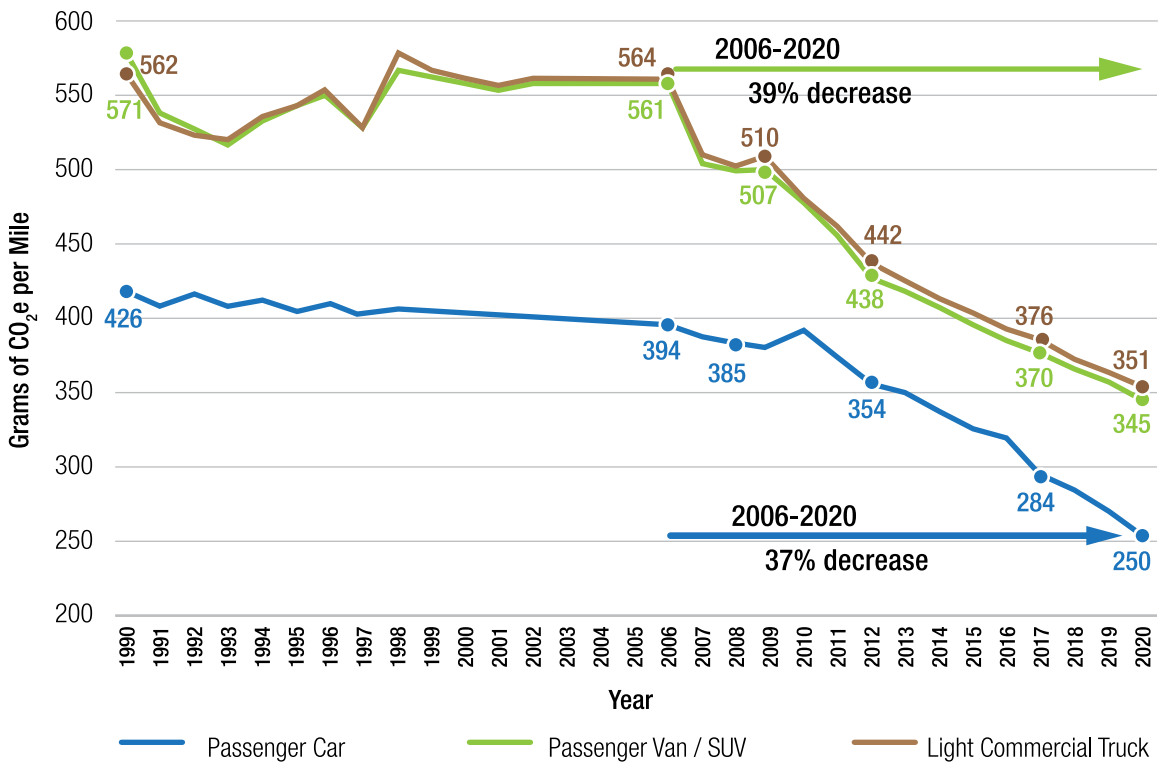


Figure 2.3 – Heavy-Duty Vehicle Emission Factors

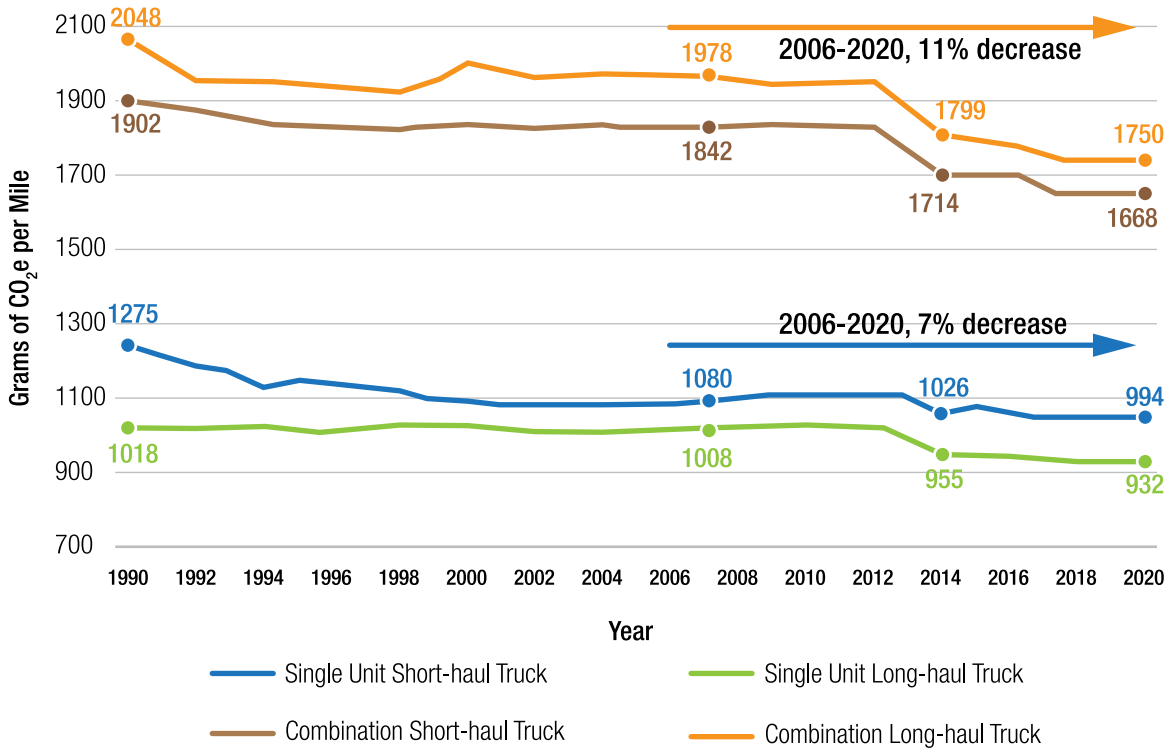
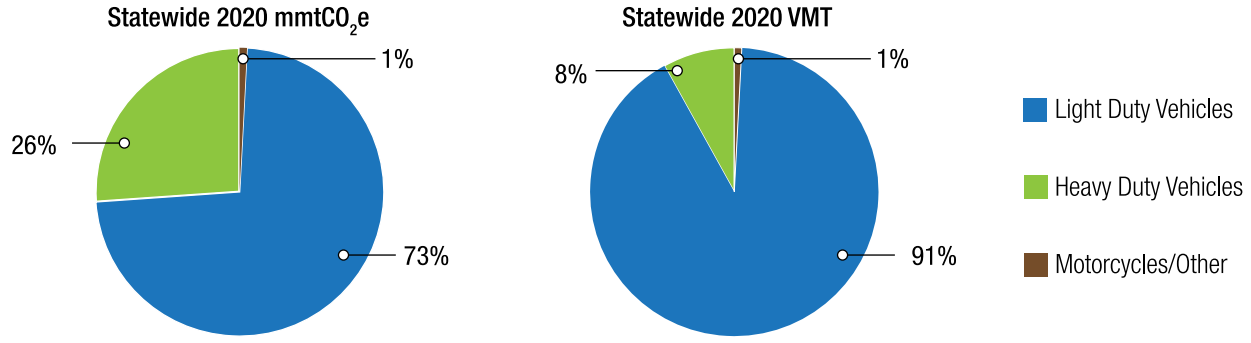


Figure 2.4 – Maryland Statewide Emissions and VMT by Vehicle Type



These trends are the primary contributors to GHG emissions from on-road transportation, which represents 83 percent of all transportation sector emissions. These trends are also those that transportation and local planning agencies have the greatest ability to control through regulation, policy, and investment decisions. Trends in the off-road sector (primarily aviation, marine, and rail) are primarily driven by private sector decisions or public-private partnerships combined with federal engine and emission standards.

3.0 2006 BASELINE AND 2020 BUSINESS-AS-USUAL (BAU) FORECAST

The transportation sector 2006 baseline inventory and 2020 BAU forecast includes emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) converted to carbon dioxide equivalents (CO_2e) that are measured in units of million metric tons ($mmtCO_2e$) based on each pollutants global warming potential (GWP). Carbon dioxide represents about 97 percent of transportation sector GHG emissions. The inventory includes on-road and off-road sources as defined by the Energy Information Administration (EIA).

Emission estimates for the on-road portion of the inventory requires use of EPA's latest emissions model, MOVES2014 (Motor Vehicle Emissions Simulator) released in October 2014. The inventory results represent an update to 2013 Greenhouse Gas Reduction Act Plan dated October 2013. The previous inventory efforts were performed with EPA's earlier version of the emission factor model MOVES2010a. The MOVES2014 model includes new data, new emissions standards, and new functional improvements and features over the earlier version. With MOVES, greenhouse gases are calculated from vehicle energy consumption rates and vary by vehicle operating characteristics including speed, engine size, and vehicle age. The off-road portion of the inventory uses emission rates and data from EPA's latest State Greenhouse Gas Inventory Tool (SIT).

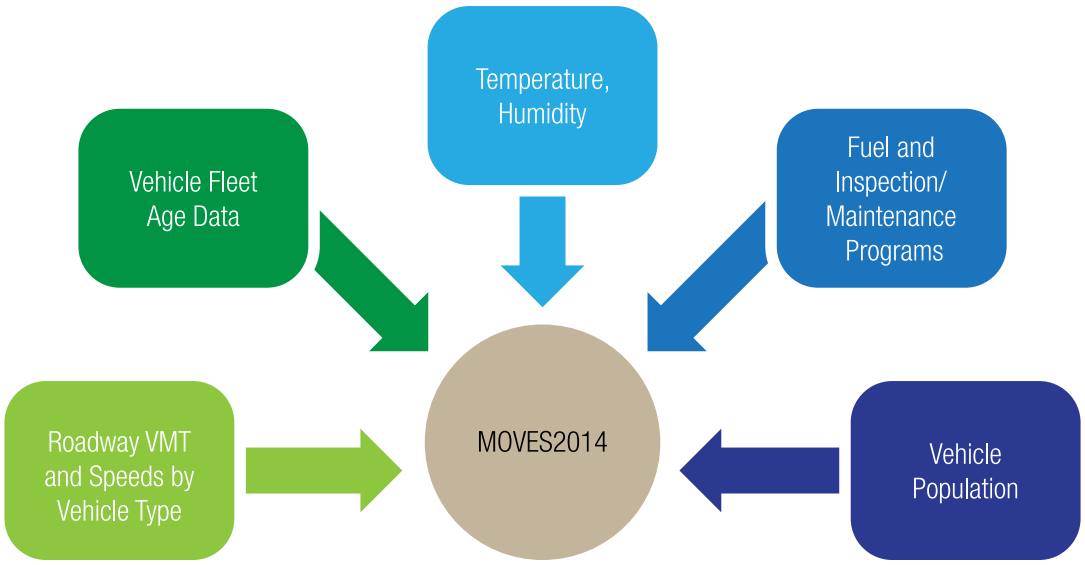
The inventory includes the revised 2006 base year and 2020 BAU forecast based on traffic count data (VMT-based) from the Maryland State Highway Administration (SHA). A more detailed description of the 2006 baseline and 2020 BAU forecast GHG emissions inventory update process can be found in **Appendix A**.

ON-ROAD ANALYSIS PROCESS

The data, tools and methodologies employed to conduct the on-road vehicle GHG emissions inventory were developed in consultation with MDE and are consistent with EPA guidance. MOVES2014 incorporates all existing CAFE standards in place in 2014 plus: 1) medium/heavy duty vehicle greenhouse gas standards for model years 2014-2018, 2) light duty greenhouse gas standards for model years 2017-2025, and 3) Tier 3 vehicle and fuel standards for model years 2017-2025.

As illustrated in **Figure 3.1**, the MOVES2014 model is integrated with local traffic, vehicle fleet, environmental, fuel, and emission control strategy data to estimate statewide emissions.

Figure 3.1 – Emissions Calculation Data Process



The modeling assumptions and data sources are consistent with other statewide criteria pollutant inventories developed by MDOT and MDE as required by EPA. The process represents a "bottom-up" approach to estimating statewide GHG emissions based on available roadway and traffic data. A "bottom-up" approach provides several advantages over simplified "top-down" calculations using statewide fuel consumption. These advantages include:

- Better addressing potential issues related to the location of purchased fuel. Vehicle trips with trip ends outside of the state (e.g. including "thru" traffic) create complications in estimating GHG emissions. For example, commuters living in Maryland may purchase fuel there but may do much of their traveling in Washington D.C. The opposite case may include commuters from Pennsylvania working in Maryland. With a "bottom-up" approach, emissions are calculated for all vehicles using the transportation system.

- Allowing for a more robust forecasting process based on historic trends of VMT or regional population and employment forecasts and their relationship to future travel. For example, traffic data can be forecasted using growth assumptions determined by the MPO through their analytic (travel model) and interagency consultation processes.

Traffic Volume and VMT Forecasts

For the 2006 baseline, the traffic data was based on roadway segment data obtained from the Maryland State Highway Administration (SHA). Two scenarios of 2020 VMT were developed based on combination of data sources as highlighted below and summarized in **Table 3.1**.

- ***2020 BAU*** – For the 2020 BAU scenario, the forecasts were determined based on historic trends of 1990-2006 highway performance monitoring system (HPMS) VMT growth. The average statewide annualized growth rate through 2020 for this scenario is 1.8 percent.

- *2020 Adjusted-BAU* – To evaluate the greenhouse gas emissions impacts from the vehicle fuel economy improvements, the 2020 traffic volumes and VMT forecasts were adjusted based on historic trends of 1990-2013 HPMS VMT growth. Extending the historical data set from 2006 to 2013 resulted in an average statewide annualized growth rate for this scenario of 1.1 percent. The resulting VMT summary is provided in **Table 3.2**.

Table 3.1 – Maryland VMT Forecasts and Annual Growth Rates

County	2020 BAU (1990-2006 HPMS)	2020 Adjusted-BAU (1990-2013 HPMS)
Allegany	1.3%	0.7%
Anne Arundel	2.0%	1.2%
Baltimore	1.3%	0.9%
Calvert	2.5%	1.6%
Caroline	1.3%	0.7%
Carroll	1.9%	1.1%
Cecil	2.4%	1.9%
Charles	2.2%	1.3%
Dorchester	0.9%	0.2%
Frederick	2.5%	1.6%
Garrett	1.4%	0.6%
Harford	1. 9%	1.5%
Howard	3.2%	2.3%
Kent	0.5%	-0.6%
Montgomery	1. 6%	0.9%
Prince George's	1.7%	1.1%
Queen Anne's	2.2%	1.1%
Saint Mary's	2.1 %	1.4%
Somerset	0.9%	0.0%
Talbot	1.8%	1.0%
Washington	2.1%	1.1%
Wicomico	1. 6%	1.0%
Worcester	1. 4%	1.1%
Baltimore City	0.8%	0.2%
Statewide	**1.8%**	**1.1%**

The 2020 BAU analysis, originally conducted in 2009, forecast VMT growth through 2020 based on the 1990 to 2006 trend.

The 2020 Adjusted-BAU analysis, conducted in 2014, forecast VMT growth through 2020 based on the 1990 to 2013 trend. Estimated 2014 Maryland VMT is lower than 2006 VMT - 8 years of no VMT growth results in this change of VMT growth rates.

Table 3.2 – Maryland 2006 and 2020 BAU VMT Forecasts

Annual VMT (millions)	2006 Baseline	2020 BAU	2020 Adjusted-BAU
Light Duty	51,823	64,826	59,888
M/Heavy Duty Truck & Bus	4,795	6,018	5,554
TOTAL VMT (in millions)	**56,618**	**70,844**	**65,442**

OFF-ROAD ANALYSIS PROCESS

Off-road GHG emission analyses rely on the emission factors and methodologies provided in EPA's State Inventory Tool (SIT) released December 1, 2014. The Mobile Combustion Module of the SIT tool was used to estimate CH_4 and N_2O emissions from aviation, boats and vessels, locomotives, and other non-highway sources.

Forecasting Assumptions

Consistent with the 2013 GGRP off-road methodology, the Projection Tool module of the SIT model was used to estimate 2020 GHG emissions. The Projection Tool allows users to create a simple forecast of GHG emissions based on historical activity data or data obtained from publicly available forecasts (i.e., Census reports, the Energy Information Administration's Annual Energy Outlook).

TRANSPORTATION SECTOR INVENTORY AND FORECAST RESULTS

The 2006 baseline and 2020 BAU GHG emissions forecast are summarized in **Table 3.3**.

Table 3.3 – Maryland 2006 and 2020 Transportation Sector GHG Emissions			
GHG Emissions ($mmtCO_2e$)	2006 Baseline	2020 BAU	2020 Adjusted-BAU
Light Duty Vehicles	23.34	30.77	28.38
Medium/Heavy Duty Trucks & Buses	7.38	9.36	8.63
Total On-Road	30.72	40.13	37.01
Off-Road	4.34	4.13	4.13
TOTAL GHG Emissions	**35.06**	**44.26**	**41.14**
Emission Reductions ($mmtCO_2e$) Associated with VMT Growth Scenario			3.12

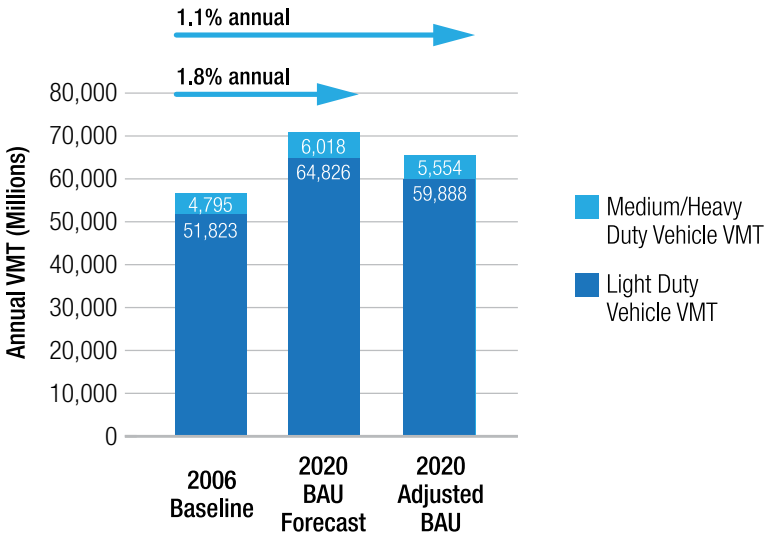
- The 2020 BAU forecast is based on historic trends of 1990-2006 HPMS VMT growth and is consistent with the methodology used in MDOT's Green Book (2011). Even with the consistency in growth assumptions and data, the baseline and BAU represented here are higher, for both on-road and off-road emissions, than they were in 2011. The transition to the new MOVES2014 model and updates to the SIT model have resulted in an increase of 2.36 $mmtCO_2e$ (7 percent) in 2006 and 2.57 $mmtCO_2e$ (6 percent) in the 2020 BAU.

- The 2020 BAU forecast assumes effectively the same on-road vehicle fleet that was in-place in 2020. The reason this approach is taken is that it enables an analysis in 2020 of the comparative GHG emission benefits of each vehicle standard against a constant BAU. It is recognized that the BAU is not a "realistic" outcome in 2020 – it is simply a baseline point to initiate the analysis of GHG mitigation strategies.

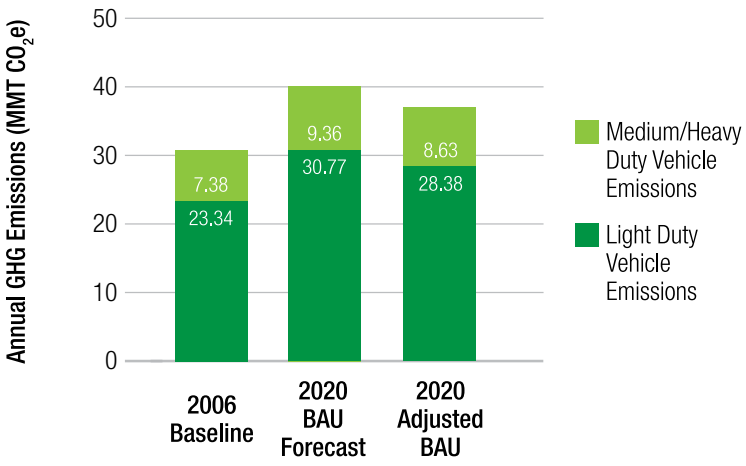
- Since the Green Book was created, new VMT data has become available, as presented in **Table 3.1** and **Figure 3.2**. There is a 3.12 mmtCO_2e emissions benefit associated with the VMT "true-up."

- **Figure 3.2** provides a graphical comparison of the 2006 Baseline and 2020 BAU scenarios for on-road vehicles, noting the differential in VMT growth rates and VMT and emission growth by vehicle type.

Figure 3.2 – Inventory and Forecast Results Summary



The split between light-duty and medium/heavy duty vehicle remains constant across all scenarios (92% to 8%).



The emissions share of medium and heavy duty vehicles is much higher than the VMT share (24% of the inventory as opposed to 8%). On average the emission intensity of these vehicles is 3.5x greater than light duty vehicles.

4.0 TRANSPORTATION SECTOR CONTRIBUTION TO MARYLAND'S CLIMATE GOALS

4.1 THE IMPACTS OF PLANS / PROGRAMS / ADOPTED LAND USE

Transportation Plans and Programs

To account for the benefits of funded transportation plans and programs through 2020, MPO forecast travel and land use data were employed where available. For rural counties not included in a MPO or regional travel demand model domain, HPMS historical growth rates were used. The VMT growth rates in this scenario incorporate the impacts of future regional demographic projections from each county, cooperatively developed by the MPOs for modeling purposes, and the impacts of planned transportation projects (highway and transit) in the regional Transportation Improvement Programs (TIPs). The average statewide annualized growth rate through 2020 for this scenario is 0.5 percent and is illustrated in **Table 4.1**. **Table 4.2** illustrates the resulting VMT.

Table 4.1 – Maryland VMT Forecasts and Annual Growth Rates

County	2020 BAU (1990-2006 HPMS)	2020 Adjusted-BAU (1990-2013 HPMS)	MPO Modeling (Plans/Programs/ Adopted Land Use)
Allegany	1.3%	0.7%	0.7%
Anne Arundel	2.0%	1.2%	0.4% (BMC)
Baltimore	1.3%	0.9%	-0.3% (BMC)
Calvert	2.5%	1.6%	0.9% (MWCOG)
Caroline	1.3%	0.7%	0.7%
Carroll	1.9%	1.1%	1.5% (BMC)
Cecil	2.4%	1.9%	2.0% (WILMAPCO)
Charles	2.2%	1.3%	0.9% (MWCOG)
Dorchester	0.9%	0.2%	0.2%
Frederick	2.5%	1.6%	0.8% (MWCOG)
Garrett	1.4%	0.6%	0.6%
Harford	1.9%	1.5%	0.0% (BMC)
Howard	3.2%	2.3%	2.2% (BMC)
Kent	0.5%	-0.6%	-0.6%
Montgomery	1.6%	0.9%	0.6% (MWCOG)
Prince George's	1.7%	1.1%	0.6% (MWCOG)
Queen Anne's	2.2%	1.1%	1.1%
Saint Mary's	2.1%	1.4%	1.1% (MWCOG)
Somerset	0.9%	0.0%	0.0%
Talbot	1.8%	1.0%	1.0%
Washington	2.1%	1.1%	0.2% (HEPMPO)
Wicomico	1. 6%	1.0%	1.0% (SWMPO)
Worcester	1. 4%	1.1%	1.1%
Baltimore City	0.8%	0.2%	-1.2% (BMC)
Statewide	**1.8%**	**1.1%**	**0.5%**

Table 4.2 – Maryland 2006 and 2020 BAU and Plans & Programs VMT Forecasts				
Annual VMT (millions)	2006 Baseline	2020 BAU	2020 Adjusted-BAU	2020 Plans & Programs Forecast
Light Duty	51,823	64,826	59,888	55,400
Medium/Heavy Duty Trucks & Buses	4,795	6,018	5,554	5,141
TOTAL VMT (in millions)	**56,618**	**70,844**	**65,442**	**60,541**

The 2020 adjusted-BAU and the 2020 Plans and Programs transportation sector GHG emissions forecasts are summarized in **Table 4.3**.

Table 4.3 – Maryland 2006 and 2020 Transportation Sector GHG Emissions		
GHG Emissions ($mmtCO_2e$)	2020 Adjusted-BAU	2020 Plans & Programs
Light Duty Vehicles	28.38	26.37
Medium/Heavy Duty Trucks & Buses	8.63	8.02
Total On-Road	37.01	34.39
Off-Road	4.13	4.13
TOTAL GHG Emissions	**41.14**	**38.52**
Emission Reductions ($mmtCO_2e$) Associated with Plans & Programs		2.62

Utilizing a composite emissions factor, in 2006, a reduction of 1.84 billion VMT was required to reduce GHG emissions by 1 $mmtCO_2e$. As vehicles become cleaner, and the federal fuel economy standards begin to take hold, that figure increases in 2020 to 2.12 billion VMT required to reduce GHG emissions by 1 $mmtCO_2e$.

2020 VMT would have to be reduced by 3.5% to achieve a 1 $mmtCO_2e$ reduction in on-road transportation emissions.

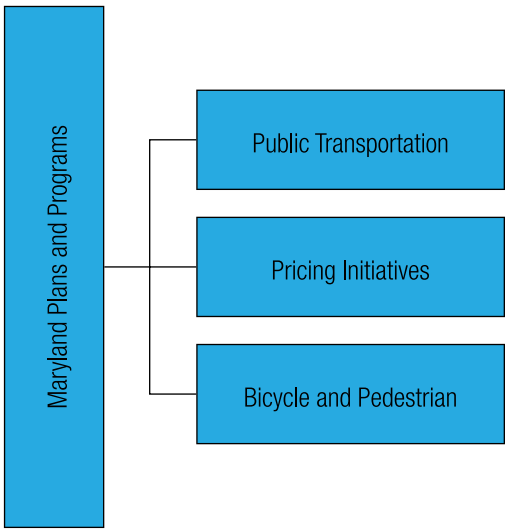
Transportation Emission Reduction Measures

Since Clean Air Act Amendments of 1990 (CAAA), MPOs and state departments of transportation perform air quality analyses in nonattainment areas to ensure that transportation plans and programs conform to the mobile emission budgets established for criteria pollutants such as NOx, VOCs, CO and particulates in the State Implementation Plans (SIP). As a result, MPO's and DOT's identified transportation emissions reduction measures (TERMs) that provide criteria pollutant emission-reduction benefits. These measures are assessed in conformity documentations and include specific information on the costs and expected air-quality benefits.

The criteria pollutant reductions from most of these strategies are included in the BRTB, MWCOG, HEPMPO, and WILMAPCO air quality conformity processes. For these strategies, reductions in VMT or fuel consumption as estimated by BRTB, MWCOG, MDOT and MDE are adjusted to reflect 2020 conditions and converted to GHG emission reductions. For the strategies where a prior analysis has not been completed, observed data on the benefits of these strategies in other locations or research reports were utilized to determine potential 2020 benefits (see Appendix C for all TERM assessment approaches).

Organizing Plans and Program Benefits into GGRP Policy IDs

The 2013 GGRP organized transportation sector GHG mitigation strategies into four sets of policy options: **E – Transportation Technologies, F – Public Transportation, G – Pricing Initiatives**, and **H – Other Innovative Transportation Programs**. The costs and emission benefits of the transportation plans and programs and TERMs are primarily assigned into policies F, G, and H.2 (Bicycle and Pedestrian) as described in the following sections. GHG emission benefits within the other policies are typically not included directly in the MPO modeling approaches supporting the emission benefits discussed above.



4.2 TRANSPORTATION TECHNOLOGIES [E]

4.2.1 Motor Vehicle Emissions and Fuel Standards [E.1]

State and federal initiatives that affect fuel economy standards significantly contribute to the 2020 transportation sector GHG reductions. The technology advances are designed to improve vehicle fuel economy and reduce average GHG emissions per mile. The standards are phased-in by vehicle model year (MY) starting with MY 2008.

Light-duty vehicle (passenger cars and trucks) standards
• The existing CAFE standards for vehicle model years 2008 to 2011 • The National Program for model years 2012 to 2016 as finalized in the May 7, 2010 joint rulemaking by US DOT and EPA • The National Program covering model years 2017 to 2025 light-duty vehicles as announced in the August 28, 2012 joint rulemaking by the US National Highway Traffic Safety Administration (NHTSA) and EPA (published October 15, 2012) • The Maryland Clean Car Program that incorporates the California emission standards beginning with model year 2011
Medium/Heavy-duty vehicle (trucks and buses) standards
• Fuel efficiency and greenhouse gas standards for model years 2014 to 2018 medium and heavy-duty vehicles (published September 15, 2011) • Pending approval, the fuel efficiency and greenhouse gas standards for medium and heavy-duty vehicles for model year 2018 and beyond
Fuel standards
• Tier 3 vehicle and fuel standards beginning with model year 2017 (published April 28, 2014) • The Federal Renewable Fuel Standard Program (RFS2), which mandates the use of 36 billion gallons of renewable fuel annually by 2022 (published March, 2010)

The effects of the above proposed programs are included as potential greenhouse gas emissions reduction strategies for the Maryland transportation sector by 2020 and were analyzed in the MOVES2014 model.

4.2.2 Maryland Clean Car Program [E.1.A]

The Maryland Clean Car Program implements California's low emissions vehicle (LEV) standards to vehicles purchased in Maryland starting with model year 2011. There are three promulgated national programs in place that strengthen the fuel economy standards for light duty cars and trucks and effectively overlap with the Maryland Clean Car Program. They include (as noted in the blue circles in the below figure):

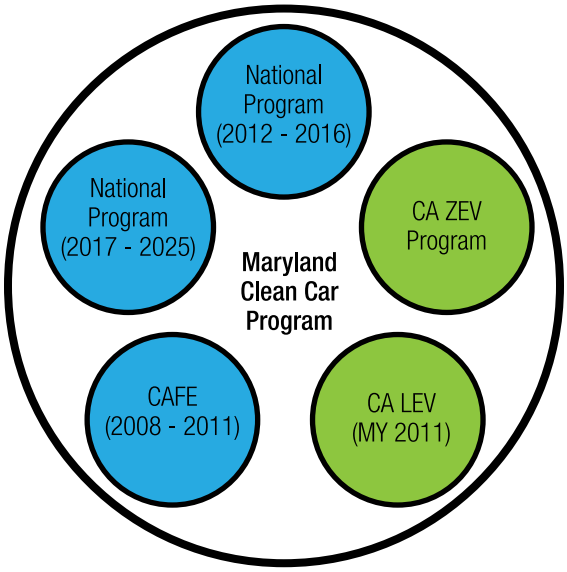
- **CAFE Standards (Model Years 2008-2011)** – Vehicle model years through 2011 are covered under existing CAFE standards that will remain intact under the new national program.

- **National Program (Model Years 2012-2016)** – The light-duty vehicle fuel economy for model years between 2012 and 2016 are based on the May 7, 2010 Rule "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule" (EPA-HQ-OAR-2009-0472-11424). Fuel economy improvements begin in 2012 until an average 250 gram/mile CO_2 standard is met in the year 2016. This equates to an average fuel economy near 35 mpg.

- **National Program Phase 2 (Model Years 2017-2025)** – The light-duty vehicle fuel economy for model years between 2017 and 2025 are based on the October 15, 2012 Rule "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards" (EPA-HQ-OAR-2010-0799). The new fuel economy improvements apply to model years 2017 to 2025. The standards are projected to result in an average 163 gram/mile of CO_2 in model year 2025. This equates to an average fuel economy of 54.5 mpg.

The above programs are included in the MOVES2014 vehicle energy consumption rates. The difference between the MOVES default modeling runs and the adjusted emission rates scenario provide the GHG emission reductions for the CAFE and National Program fuel economy standards. The details of the adjustments to the MOVES2014 vehicle energy consumption rates table are provided in Appendix A.

There are components of the Maryland Clean Car Program not completely covered by the federal standards (as noted in the green circles in the figure to the right). These adjustments include aspects of the California LEV standard starting in model year 2011 that exceeded the federal standards in place at the time. In addition, the California ZEV program (also included in Maryland Clean Cars) includes goals for the percent of the electric vehicles in the fleet mix starting from model year 2011.



4.2.3 Corporate Average Fuel Economy (CAFE) Standards 2008-2011 [E.1.B]

The benefits for the 2008-2011 CAFE standards are included above in the Maryland Clean Car Program (E.1.A).

4.2.4 National Medium and Heavy Vehicle Standards [E.1.C]

EPA and NHTSA adopted the first ever program to reduce greenhouse gas emissions for medium- and heavy-duty vehicles on September 15, 2011 – "Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles" (EPA-HQ-OAR-2010-0162). The new rulemaking adopted standards for three main regulatory categories: combination tractors, heavy-duty pickups and vans, and vocational vehicles. The categories were established to address specific challenges for manufacturers in each area.

- For combination tractors, the final standard will phase in annually through 2017 and achieve from a 9 to 23 percent reduction in CO_2 emissions and fuel consumption from affected tractors over the 2010 baselines.
- For heavy-duty pickup trucks and vans, separate standards have been established for gasoline and diesel trucks, with phase in starting in the 2014 model year, achieving up to a 10 percent reduction for gasoline vehicles and a 15 percent reduction for diesel vehicles by the 2018 model year (12 and 17 percent respectively if accounting for air conditioning leakage).
- For vocational vehicles, the final standards achieve from a 6 to 9 percent reduction in CO_2 emissions and fuel consumption by the 2018 model year over the 2010 baseline.

Proposed Phase 2 National Medium and Heavy Vehicle Standards (2018 and Beyond)

EPA and NHTSA are proposing new standards for four categories of medium and heavy-duty vehicles: combination tractors, heavy-duty pickups and vans, vocational vehicles and trailers to reduce greenhouse gas emissions and improve fuel efficiency through model 2018 and beyond. The proposed rulemaking for these standards are Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2 (published July 13, 2015).

- For Class 7 and 8 combination tractors, the agencies are proposing engine and vehicle standards that begin in the 2021 model year and complete by 2027 model year. The new standards would achieve up to 24 percent lower CO_2 emissions and fuel consumption by 2027, compared to the Phase 1 standards.
- For heavy-duty pickup trucks and vans, new standard will reach a 16 percent reduction in CO_2 emissions and fuel consumption by 2027 model year compared to the Phase 1 standards.
- For vocational vehicles, the agencies are proposing engine and vehicle standards that begin in the 2021 model year. The fully phased-in standards would achieve up to 16 percent lower CO_2 emissions and fuel consumption by 2027 model year compared to the Phase 1 standards.
- For trailers, the proposed standards, when fully phased-in 2027, would achieve up to 8 percent lower CO_2 emissions and fuel consumption compared to an average model year 2017 trailer.

4.2.5 Federal Renewable Fuel Standards (E.1.C)

Renewable Fuels and Fuel Assumptions

The EPA issued the Renewable Fuel Standard Program (RFS2) final rule in March 2010, which mandates the use of 36 billion gallons of renewable fuel annually by 2022. Based on an approach utilized by the Metropolitan Washington Council of Governments (MWCOG), the use of renewable fuels will represent a 2 percent reduction in total mobile CO_2 emissions in 2030. For this analysis, a 1 percent overall reduction in 2020 on-road emissions was assumed to result from the implementation of the renewable fuel standard.

Tier 3 Vehicle and Fuel Standards

The Tier 3 vehicle and fuel standards program for model year 2017 and beyond are based on the April 28, 2014 Rule "Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards" (EPA-HQ-OAR-2011-0135). The rule establishes more stringent vehicle emissions standards and will reduce the sulfur content of gasoline from current average level of 30 ppm to 10 ppm beginning in 2017. The gasoline sulfur standard will make emission control systems more effective for both existing and new vehicles, and will enable more stringent vehicle emission standards. The ve hicle standards will reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles for VOC, NOx, CO and PM.

Motor Vehicle Emissions and Fuel Standards Results

The GHG reductions from the fuel economy and technology improvements for light duty vehicles (including the 2008-2011 CAFE Standards, 2012-2016 National Fuel Economy Standards, 2017-2025 National Program Phase 2, the Maryland Clean Car Program, and the Tier 3 program), the 2014-2017 National Medium and Heavy Vehicle Standards, and the proposed Phase 2 National Medium and Heavy Vehicle Standards reduce projected 2020 GHG emissions by 5.57 $mmtCO_2e$ as shown in **Table 4.4**.

Table 4.4 – Maryland 2020 Vehicle Technology GHG Emissions Reductions

GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
E.1	**Motor Vehicle Emissions & Fuel Standards**	**7.72**	**7.72**	**5.57**
E.1.A	Maryland Clean Car	4.33	4.33	5.06
E.1.B	CAFE 2008-2011	2.27	2.27	NA
E.1.C	National Medium and Heavy Duty Standards	0.88	0.88	0.28
E.1.D	Federal Renewable Fuel Standards	0.24	0.24	0.23

Note: The 2013 GGRP estimated GHG emission reductions in 2020 from funded programs (Initial) and unfunded programs (Enhanced). This 2015 Plan only focuses on currently funded programs through 2020. The difference in reductions is primarily attributed to the use of a new model, MOVES2014.

4.2.6 On-Road, Airport, Port and Freight/Freight Rail [E.2]

This policy option includes transportation technologies enabling more efficient operation of Maryland's roadways. It also includes airport, port, and freight technologies that both reduce emissions through replacing or enhancing vehicles and equipment and enhance the efficiency of operations through capacity or system operation improvements.

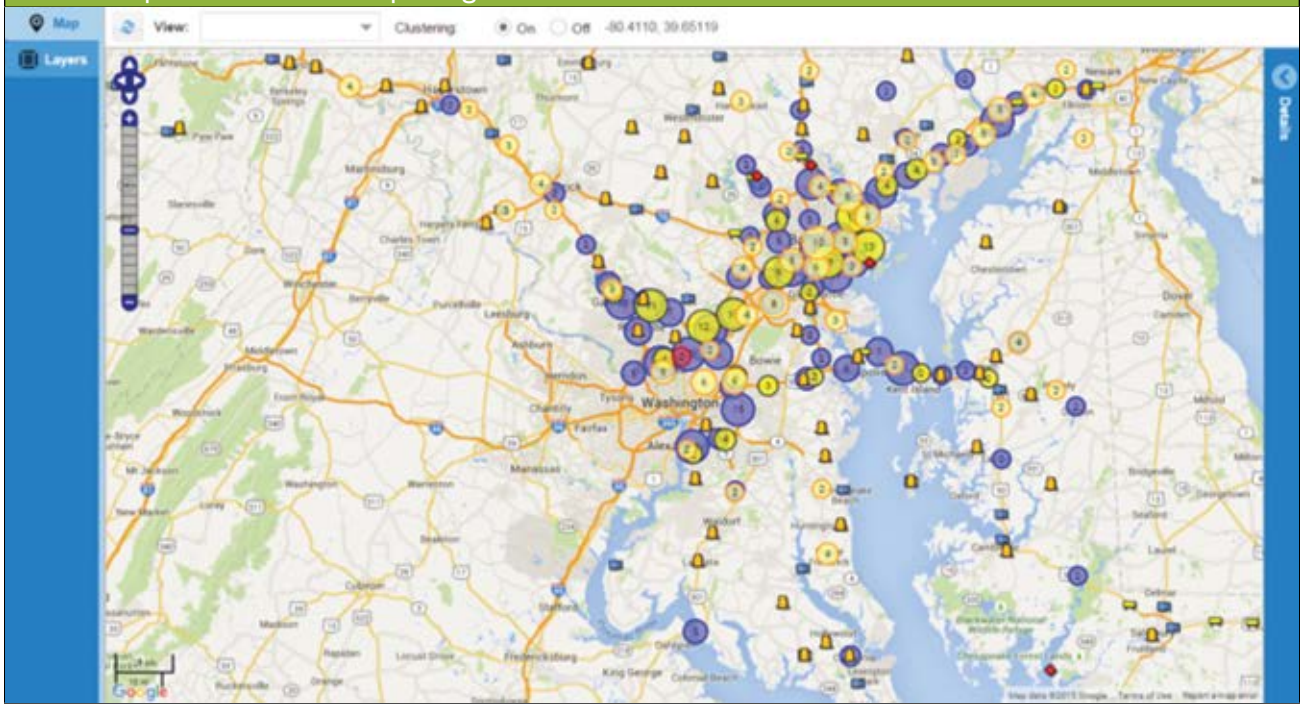
4.2.7 On-Road Technology [E.2.A]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$1.33 billion*
Example Projects: *CHART, ITS, Signal Synchronization, Real-Time Passenger Information*

Transportation technology initiatives are significant contributors to on-road mobile emissions reductions and are an important element of MDOT's efforts to reduce GHGs. Projects and programs include advanced traffic management and intelligent transportation systems, traffic operational or capacity improvements, real-time traveler information, teleworking, and engine replacements. Examples of recent and ongoing MDOT accomplishments are listed below.

- CHART (Coordinated Highways Action Response Team) is the highway incident management system of the State Highway Administration (SHA). CHART has five major functions: traffic monitoring, incident response, traveler information, traffic management, and severe weather and emergency operations.

Example CHARTWeb depicting current traffic camera locations and work zones/closures.



  - In 2013, CHART saved motorists and commercial carriers $1.16 billion in user costs and reduced delay on Maryland roadways by 32.7 million vehicle hours. This included supporting police and traffic control at more than 20,000 incidents.

  - The FY 2015-2020 CTP includes $113.8 million to maintain and enhance CHART services throughout Maryland. This includes ongoing expansion of Maryland's network of traffic cameras, dynamic message signs, weather pavement sensors, speed sensors, and service patrols to help keep travelers' safe and traffic moving.

- Traveler information services have expanded across all modes through the Maryland 511 traveler information system. The system provides travel information via the web or through a mobile-app on State-maintained roadways, including travel time, incident or work zone lane closures weather reports, and connections to transit, airport, and tourism information. The system has recently been enhanced to provide information on truck parking locations.

- Maryland Transit Administration (MTA) is in the process of procurement for Bus Communications System Upgrades which includes a state-of-the-art on-board bus equipment and fixed end system. This technology enables broader deployment of Real-Time Passenger Information Systems on Local Bus, Light Rail and Baltimore Metro services, which will allow customers to check next bus or train arrival times through their phone or other device as well as on LED signs at rail station platforms. The bus communications system also helps MTA obtain a more accurate picture of local bus performance, allowing for better decision making and service monitoring.

- Congestion relief – SHAs ongoing approach to managing congestion includes:

  – Implementing low cost geometric improvements on the arterial system.

  – Continue working on long-term multimodal solutions that enhance safety, mobility and reliability of the arterials including some Bus Rapid Transit (BRT) projects, particularly in major corridors in the Baltimore and Washington regions.

  – Continue signal retiming and optimization program to improve arterial operations. Synchronizing and retiming signals in response to traffic flows through a given corridor reduces delays to motorists, improves safety, and increases person throughput. SHA has 249 signal systems across the State that includes 1,524 signals. The signal systems are reviewed and adjusted on a three to five year basis with an objective of reducing delay by 5 percent or more.

  – Continue to develop short-term congestion management solutions (geometric improvements, incident management, special event planning, Intelligent Transportation Strategies (ITS)) to improve traffic operations on its freeways/ expressway systems. In February, 2015, SHA and the Baltimore Metropolitan Council (BMC) received a $200,000 grant from FHWA to develop a proof of concept for Integrated Corridor Management in the I-95, U.S. 1, and MD 295 corridors between MD 32 and I-695.

- Focus on the incorporation of strategies that improve reliability of the transportation system; SHA will look at implementing Transportation Systems Management and Operations (TSM&O) strategies to improve mobility and reliability.

- In 2012, SHA initiated development of the State Highway Annual Mobility Report that documents congestion and reliability issues using observed traffic data and connects these issues to planned SHA projects and programs.

- SHA recently made public their Mobility and Economy Dashboard to identify successes, challenges, and strategies being utilized to improve the transportation services SHA delivers to Marylanders and the traveling public.

- Telework is an arrangement which allows employees to work from a remote location, while maintaining communication with managers, colleagues, and customers. MDOT funded a program administered by BMC - Teleworkbaltimore.com - that provides free online resources and consultant support to help employers in the Baltimore region start or expand a formal telework program. Telework is one component of MDOT funding and coordination of multiple travel demand management (TDM) strategies in the Baltimore and Washington regions to support commute alternatives to driving alone. The remainder of Maryland's TDM strategies are highlighted in the pricing policy option.

- SHA and MTA on-road vehicle fleets (including buses) replacement schedules and policies have increased the share of alternative fueled vehicles in the Maryland's vehicle fleet, leading to reductions in fuel consumption and GHG emissions. In addition, anti-idling policies for these fleets have also reduced fuel consumption. For example, total fuel usage of the SHA light-duty fleet has decreased by nearly 110,000 gallons since 2009 (a 13 percent reduction). The details of MTA and WMATA fleet replacement strategies are documented in the public transportation policy option.

- The diesel vehicle emissions control program specifically targets the vehicles most likely to emit black carbon. The Program affects any diesel-powered vehicle with a gross vehicle weight rating of over 10,000 pounds traveling on Maryland's highways. Enforcement is carried out by the Maryland State Police and the Maryland Transportation Authority Police (MTAP), who can require any heavy-duty diesel vehicle to submit to a smoke emissions test.

4.2.8 Airport Initiatives [E.2.B]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$12.08 million*
Example Projects: *Alternative and Bi-fuel Vehicles, Alternative Fuel Usage on Power Units, Solar Installations*

The Maryland Aviation Administration (MAA) operates Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall) and Martin State Airport, a general aviation/reliever airport northeast of Baltimore. In 2011, an energy audit conducted for the Maryland Aviation Administration (MAA) evaluated the potential emissions impact of reductions in consumption of electricity and conventional vehicle fuel at the Baltimore/Washington International Airport (BWI). These reductions would result in lower GHG emissions through the utilization of more energy efficient technologies and fuel conservation measures. Examples of actions MAA has taken as part of their energy performance program include:

- Currently there are 20 alternative fuel and bi-fuel vehicles in the State's airport maintenance fleet that use an on-site quick-fill CNG fueling station at BWI. MAA also now uses only CNG buses as shuttles for BWI's new Consolidated Rental Car Facility.

- In 2012, BWI Marshall worked with Pepco Energy Services to install a 505 kW solar photovoltaic system on the top level of the Daily Garage. The system is tied directly to the airports electrical system and was designed to produce over 600,000 kilowatt hours of electricity reliably each year for the next 20 years.

- BWI Marshall Airport installed electric vehicle charging stations during the spring of 2011. The eight charging stations, located in the Daily Garage and the Hourly Garage, allow travelers to charge their electric vehicles.

- Approximately 30 percent of MAA vehicles currently use alternative fuels.

- MAA maintains a Reforestation Master Plan and Forestry Management Plan that comply with multi-agency regulations and specify areas set aside for forest conservation and retention.

- Transit access to BWI Marshall Airport has continued to improve. The initiation of ICC Commuter Bus service from Montgomery County in 2011 and ongoing and planned enhancements to the BWI Rail station provide improved options beyond existing MTA local bus and light rail, Howard County transit, and WMATA express bus service to Greenbelt.

4.2.9 Port Initiatives [E.2.C]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$38.6 million*
Example Projects: *Rail Access to Fairfield Marine Terminal, Dray Truck Replacement Program*

Cargo is the lifeblood of the Port of Baltimore. As one of the nation's top ports for total cargo tonnage and overall dollar value of cargo, the Port of Baltimore is also one of the most diverse ports in the United States. The key commodities handled at the Port's public marine terminals include autos, roll on/roll off, containers, forest products, and project cargo. The Port of Baltimore includes seven State-owned public terminals that are managed by the Maryland Port Administration (MPA) plus many privately owned terminals.

Total general cargo at MPA's public terminals reached 9.6 million tons in FY 2014

Source: USDOT Freight Analysis Framework.

MDOT is working with the Maryland Port Administration and Ports America Chesapeake, the operator of Seagirt Marine Terminal, to investigate the feasibility of introducing operational efficiencies and/or incentive programs to retain and grow intermodal container business through the Port of Baltimore.

MPA was awarded a USDOT TIGER grant in 2014. The project, now fully funded in the FY 2015 - FY 2020 CTP has three portions: provide rail access to Fairfield Marine Terminal; widening and straightening the navigation channel to Seagirt Marine Terminal; and filling the Fairfield Basin to develop seven acres of new land for cargo storage. The scope of the contract has increased to accomplish similar additional work at the Fairfield (Beverley Slip) and South Locust Point terminals (Fruit Slip). In aggregate, these improvements will allow for more efficient cargo movement, both for rail access as well as terminal access for ocean going ships. Total funding for the project is $38.6 million, with $10 million from the US Department of Transportation.

The Maryland Port Administration (MPA) has implemented an Environmental Management System, as well as other initiatives to reduce the environmental footprint associated with the Port of Baltimore. The MPA's emission reduction strategies for GHGs and other air pollutants includes use of cleaner diesel fuel port fleet vehicles, use of electric operated equipment, reduced truck emissions through turn time efficiency improvements, idle reductions / requirements, and dray truck replacements.

- Since 2009, MPA has created 44 acres of wetlands and wildlife habitat. These areas have the opportunity to sequester carbon emissions.

- The Clean Diesel Program (2009-2011), supported retrofitting, repowering, and replacing of 79 port-related vehicles and pieces of equipment. Analysis of program emission reductions indicate an annual reduction of 375.4 tons CO_2 and a potential lifetime reduction in diesel fuel consumption of 502,065 gallons.

- To improve operational efficiencies, MPA and its tenants are reviewing truck gate efficiencies and implementing technologies, such as RFID which allows for continuous flow of trucks after security screening and reduces idling times.

- MPA maintains a cargo handling emissions inventory. The 2012 survey compared to the 2006 survey showed a 32 percent reduction in total tons of CO_2.

- On behalf of its member and affiliate agencies, the I-95 Corridor Coalition submitted a successful application to USDOT and has attained designation of the M-95 Marine Highway Corridor. The corridor includes a series of waterways/crossings/connections within the Coalition's region, which includes the Port of Baltimore.

- The Port continues to use grant and other funds to update equipment including engine repowers, anti-idling devises, vehicle replacements and electrification of gantries.

As part of MPAs GreenPort initiative, MPA is working with private and public partners and stakeholders on the following GHG beneficial activities.

- The Dray Truck Replacement Program, which replaces older dray trucks with newer models that meet EPA engine standards. The program is funded by federal and state grants/funding with a 50 percent match by truckers. Approximately 100 dray trucks have been replaced since the launch of this program in February 2012, with funding for another 30 trucks. The MPA is continuing to seek funding for this program.

- MPA is committed to the purchase of environmentally-friendly vehicles and equipment, such as flex-fuel vehicles, hybrid vehicles and equipment, and a certified clean-idle sweeper. This includes the required use of ultra-low sulfur biodiesel fuel in the MPA's diesel-powered vehicles, cranes, and equipment.

- To improve operational efficiencies, MPA and its tenants are reviewing truck gate efficiencies and implementing technologies, such as RFID; this allows for continuous flow of trucks after security screening and reduces idling times.

- MPA has developed a five-year environmental strategy which includes the following for air quality and energy improvement: evaluate terminal operations for further improvement in efficiency and emission reductions; continue the Dray Truck Replacement Program; determine feasibility of the "capture" technology and alternative marine power for vessels docking at MPA terminals; implement MPA "Green Fleet" program including engine repowers, anti-idling technology, and vehicle replacements; survey locomotives to define opportunities for reducing emissions; and, evaluate feasibility of fuel cell usage at marine terminals.

- MPA is continuing to work on planning and policy activities with partner agencies on the I-95 Corridor Coalition on the M-95 Marine Highway Corridor as designated by USDOT.

4.2.10 Freight & Freight Rail Programs [E.2.D]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$411.26 million*
Example Projects: *Upgrade Truck Weigh Facilities, Virtual Weigh Stations, I-70 Frederick County), I-81 (Washington County), I-695 (Baltimore County), Canton Railroad (Baltimore City)*

Maryland's economy and environment benefits when goods movement is safe, efficient, and reliable over the State's freight network. Unpredictable congestion and delays lower the reliability of delivery times, which leads to costlier freight movement, greater fuel consumption, and more criteria pollutant and greenhouse gas emissions.

Maryland roadways handled 529 million tons and $816 billion worth of freight in 2012.

Maryland railroads carried nearly 90 million tons and $5.4 billion worth of freight in 2012.

Source: USDOT Freight Analysis Framework.

Ensuring that the network of highways and railways are ready to handle the current level and anticipated growth of goods movement is a priority of MDOT. MDOT is working to implement multimodal freight mobility solutions, advance supply chains through transportation improvements, and expand freight transportation options throughout the state. With freight activity projected to double by 2030, the multimodal transportation system will come under increasing pressure. The goal of investing in freight related projects is to help improve Maryland's economy by making the goods movement system more efficient, reliable, and safe.

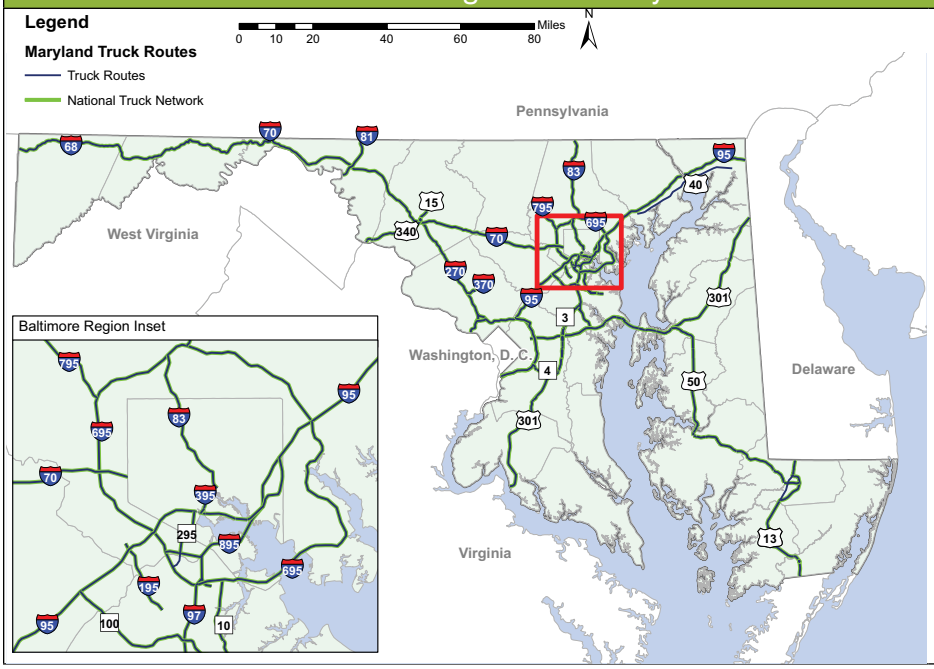
These initiatives also can reduce the emissions intensity of multimodal and intermodal freight transportation. Plans and programs being undertaken by MDOT include freight projects in various stages of development from concept to construction:

- Highway improvement, maintenance, and capacity projects include strategic bottleneck relief projects on Maryland's Truck Route System, Intelligent Transportation Systems (ITS) applications for protecting roadways from damage, and increasing access to safe and efficient locations for breaks for long-haul truck drivers.
- Education, testing and licensing programs have been implemented for highway freight operations to ensure compliance with applicable Federal and State regulations.
- Partnerships with short line, switching, and Class I railroads are beneficial for increasing capacity and improving operations to provide alternatives for Maryland shippers. Strategies deployed in Maryland include the installation of Auxiliary Power Units (APUs) on diesel locomotives and retrofits or replacement of old, diesel-powered equipment, like switch-yard locomotives, with new hybrid locomotives.
- MDOT released its Strategic Goods Movement Plan that contains specific policy recommendations and provides guidance for development of freight programs at the Port, on rails, highways, and in the air. The Plan identifies areas where MDOT needs to make transportation investments to move goods efficiently and safely.

On-Road Freight

While goods move along Maryland's entire roadway network, the majority of freight by both weight and value utilizes the Maryland Truck Route System (**Figure 4.1**).[2] The Maryland Truck Route System is approximately 900 miles long and includes all Interstate segments in Maryland (481 miles), six segments of the US highway system (320 miles), and eight segments of the Maryland State highway network (99 miles).

Figure 4.1 – Maryland Truck Routes[3]



The FY 2015 – FY 2020 CTP includes 24 unique projects totaling $411.2 million to eliminate bottlenecks and enhance efficiency of freight movement on Maryland's Truck Routes. Eight of these projects, totaling $392.6 million, are planned to be open to traffic by 2020. The remaining projects include primarily studies and engineering activities, with construction identified post-2020.

The FY 2015 – FY 2020 CTP, includes project development and construction activities to improve traffic flow and remove bottlenecks on a number of these facilities, including:

- US 50 and MD 3 in Anne Arundel and Prince George's Counties
- US 301 in Queen Anne's County
- Multiple segments of I-695
- Portions of I-70 in Washington, Frederick, and Howard Counties
- I-95/I-495
- I-81 in Washington County
- I-270 in Montgomery County
- US 40 in Harford County

[2] *2035 Maryland Transportation Plan*

[3] *The routes shown in this figure are those designated as part of the National Truck Network, authorized under the Surface Transportation Assistance Act (STAA) of 1982. Trucks may travel on any road in Maryland, except where expressly prohibited, for local deliveries and pick-up.*

MDOT has partnered with MDE and the Maryland Energy Administration (MEA) on the Maryland Freedom Fleet Voucher. The program provides financial assistance for the purchase of new and converted alternative fueled commercial motor vehicles registered in the state of Maryland. The ongoing I-95 South Welcome Center truck parking expansion project is providing 61 truck parking spaces, with 25 percent of these spaces designated as "idle free". This means that only trucks with auxiliary power units are allowed to park in these spots.

In addition, the Maryland Transportation Authority (MDTA) and State Highway Administration (SHA) are upgrading truck weigh facilities on I-95, the Bay Bridge, and Hatem Bridge and are also installing ten virtual weigh stations that will enhance enforcement and reduce delays.

Rail Freight

Maryland's rail network consists of approximately 1,152 miles of track and is comprised of two Class I freight railroads, four Class III short line freight carriers, one switching/terminal railroad, and one passenger railroad. Four of these railroads, CSX, Norfolk Southern (NS), Maryland and Delaware Railroad (MDDE), and Amtrak own 76 percent of the entire network. The other 24 percent of the rail network consists of short lines, rail operating within the Port of Baltimore, and track banked by MDOT for future use.

CSX is developing the National Gateway to link Mid-Atlantic ports with the Midwest, focusing on double-stack clearance between Chambersburg, PA and mid-Atlantic ports. The NS Crescent Corridor will connect New York and New Jersey with the Southeast and includes a major intermodal terminal in Greencastle, PA, just north of Hagerstown. Both of these initiatives remove critical capacity bottlenecks on rail networks within the mid-Atlantic region, leading to potential shifting of long-haul truck movements to rail within Maryland. Maryland is continuing to work with both CSX and NS on both initiatives, including ongoing discussions regarding options to address the Howard Street tunnel bottleneck for CSX access to the Seagirt Marine Terminal.

The National Gateway and Crescent Corridor collectively will improve the capacity and operations of freight rail through the mid-Atlantic region over the coming decades. From a greenhouse gas perspective, the impact to long-haul truck VMT in Maryland could be significant (for example, NS estimates that improvements could help remove over 858,000 trucks from Maryland roadways annually).

The CTP includes $3.7 million in MDOT funding to support the Canton Railroad Company with engineering and construction of the Kane Street Yard in eastern Baltimore City. The Kane Street Yard will enhance access between the Port of Baltimore and CSX and NS railroads, improving the capacity of switching services offered by the Canton Railroad.

Three major projects are included in the CTP to improve the capacity and shared operations of freight and passenger trains on the Northeast Corridor including BWI Station enhancement project, the Susquehanna River Bridge, and the B&P Tunnel. These projects are described within the intercity transportation initiatives policy option.

The following strategies are examples of other ongoing Maryland initiatives to reduce the emissions impact of freight rail transport throughout Maryland.

- Auxiliary Power Units (APUs) for Existing Locomotives – APUs are being installed on diesel locomotives to reduce the need for long idling periods. APUs eliminate emissions of GHGs and other air pollutants and conserve fuel by shutting down the main engine at idle regardless of weather conditions or operating location.

- Technology Advances for Non-highway Vehicles – The State continues to analyze opportunities to incentivize retrofits or promote replacement of old, diesel-powered non-highway engines, like switch-yard locomotives, with new hybrid locomotives. The State also looks for opportunities to conduct outreach to private operators, such as Amtrak, CSX, Norfolk Southern, and Canton Railroad. For example, CSX, as a member of Maryland's Green Registry, has committed to reducing the GHG emission intensity of CSX operations between 6 and 8 percent below 2011 levels by 2020.

- Rail Freight Capacity Improvements – The FY 2015 – FY 2020 CTP includes funding to maintain and enhance the capacity of Maryland owned freight rail, including freight bridge and grade crossing rehabilitation. This funding primarily supports rehabilitation of rail lines, ensuring more reliable access for operators.

On-Road, Airport, Port and Freight / Freight Rail Results

The GHG reductions from the on-road, airport, port and freight / freight rail technologies policies reduce projected 2020 GHG emissions by 1.06 mmtCO_2e as shown in **Table 4.5**.

Table 4.5 – Maryland 2020 On-Road, Airport, Port and Freight GHG Emissions Reductions

GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
E.2	**On-Road, Airport, Port and Freight/Freight Rail**	**0.38**	**0.62**	**1.07**
E.2.A	On-Road Technology	Included in E.2.A	Included in E.2.A	1.00
E.2.B	Airport Initiatives	Included in E.2.A	Included in E.2.A	0.04
E.2.C	Port Initiatives	Included in E.2.A	Included in E.2.A	0.03
E.2.D	Freight and Freight Rail Programs	Included in E.2.A	Included in E.2.A	Truck freight included in E.2.A, rail freight benefits not assessed

Note: The 2013 GGRP estimated GHG emission reductions in 2020 from funded programs (Initial) and unfunded programs (Enhanced). This 2015 Plan only focuses on currently funded programs through 2020.

4.2.11 Electric and Low-Emitting Vehicle Initiatives [E.3]

Initiatives to encourage the use of electric and other low and zero-emitting vehicles are part of the State's efforts to reduce emissions of GHGs and other air pollutants from mobile sources by providing alternatives to conventional internal combustion engine vehicles. Maryland has assumed a leadership role in facilitating the deployment of electric vehicles (EVs) and EV charging infrastructure in the State. EVs include plug-in all-electric vehicles, called battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs).

During the 2011 Maryland Legislative session, the General Assembly passed legislation creating an Electric Vehicle Infrastructure Council (EVIC), which was approved by the Governor in May 2011. MDOT chairs the EVIC, working with MDE and Maryland Energy Administration (MEA), as well as other public and private stakeholders to plan and develop policy regarding electric vehicles. The EVIC was tasked with developing, evaluating and recommending strategies to facilitate the successful integration of electric vehicles and electric vehicle infrastructure into Maryland's existing transportation infrastructure. The final report, delivered in 2012, outlined an action plan to reach an ambitious goal of 60,000 plug-in electric vehicles (PEVs) on the road in Maryland by 2020, or 2.3 percent of the State's passenger vehicle fleet. As PEVs begin to comprise a larger share of Maryland's fleet, they have the potential to reduce oil dependence, reduce GHG emissions, and improve local air quality, increase support for renewable energy and support the creation of green jobs.

- There are approximately 5,000 EVs currently owned and operated by Maryland households.
- Within Maryland, currently there are 610 EV chargers spread across 269 locations. This infrastructure includes:
  - 32 chargers installed at MDOT locations since 2011
  - 45 installed at University System of Maryland locations since 2011
  - 26 Washington D.C. Fast Charge stations in 20 locations, supplementing 10 existing.
- Maryland offers individuals who purchase or lease a qualifying plug-in electric vehicle a one-time excise PEV tax credit of up to $3,000 while funds last. Even local businesses get a break if they qualify; the tax break is also good for up to 10 company vehicles. The excise tax credit expires June 30, 2017.
- Drivers of approved plug-in electric vehicles can use Maryland's high occupancy vehicle (HOV) lanes at all times, even if they are traveling solo.
- The goal of the EVIP is to aid in the development of a DC Fast Charging Network in Maryland. MEA issued multiple grants in 2014 to applicants for installation of a network of DC fast charging stations in Maryland. A total of 21 stations were awarded grants in 2014.

The GHG emission benefits associated with this strategy were calculated using EPA MOVES model vehicle population data, VMT, and emission rates for passenger cars and trucks and light commercial trucks. The implementation of this enhancement is expected to result in emission benefits of 0.25 $mmtCO_2e$ in 2020 as outlined in **Table 4.6**.

Table 4.6 – Maryland 2020 Vehicle Technology GHG Emissions Reductions					
MOVES Source Type	Number of EVs	Annual Mileage/ Vehicle	Annual VMT	Annual CO_2e Emission Rate	Total GHG Emissions Benefit ($mmtCO_2e$)
Passenger Car	27,839	12,241	340,775,124	335.75	0.11
Passenger Truck	24,289	9,608	233,357,780	431.50	0.10
Light Commercial Truck	7,872	9,755	76,792,065	435.99	0.03
Totals	**60,000**	**10,849**	**650,924,969**	**381.90**	**0.25**

4.3 PUBLIC TRANSPORTATION [F]

4.3.1 Public Transportation Initiatives [F.1]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$3.61 billion*
Example Projects: *Purple Line, Corridor Cities Transitway, Bus Rapid Transit Studies on US 29, MD 355, and MD 586 (Montgomery and Howard Counties)*

MDOT's public transportation initiatives to reduce GHG emissions are led by the Maryland Transit Administration, which as part of providing public transportation to Marylanders generally seeks to increase transit ridership, optimize the efficiency of transit services, and reduce emissions from transit vehicles. The MTA's ongoing activities to reduce GHG emissions include directly providing transit services, supporting locally operated transit services, procuring more fuel efficient and lower emission vehicles, and implementing capital projects to promote transit use. In addition, MDOT provides funding for WMATA rail capital and operations, Metrobus, and ADA paratransit services in the Maryland suburbs of Washington, D.C. This ongoing support has large GHG benefits given WMATA's significant annual ridership, which was 345 million in 2013.[4]

Commuting by public transportation, rather than driving alone in a private vehicle, allows an individual to reduce his or her annual CO_2 emissions by an estimated 4,800 pounds per year.[5] These potential GHG reductions are significant given the 114 million transit rides that the MTA provided in 2014. The MTA also directs funding and statewide assistance to the locally operated transit systems (LOTS) serving each of Maryland's 23 counties, awarding approximately $113.8 million in federal and State grants in 2014. The LOTS provided 42.5 million transit trips in 2014, contributing to GHG reductions in communities across the state.

[4] *WMATA. Metro Facts. http://www.wmata.com/about_metro/docs/Metro%20Facts%202014.pdf?*

[5] *Science Applications International Corporation. Public Transportation's Contribution to U.S. Greenhouse Gas Reduction. September 2007.*

The FY 2015 - FY 2020 CTP includes project development and implementation of new services to increase public transportation ridership, including:

- ***Purple Line*** – A 16-mile double track light rail line that will operate between Bethesda in Montgomery County and New Carrollton in Prince George's County. The new east-west light rail line will have 21 stations and provide direct connections to WMATA's Metrorail, MARC, Amtrak, and local bus services. Projected ridership is 69,000-74,000 daily riders by 2040.

- ***Corridor Cities Transitway (CCT)*** – A 15-mile bus rapid transit line between Shady Grove Metrorail Station and the former COMSAT facility in Montgomery County. Phase I of the CCT, nine miles from Metropolitan Grove to Shady Grove, is actively underway, while Phase II, a six mile extension from Metropolitan Grove to the COMSAT facility in Clarksburg, will be developed in the future, pending additional transportation funding. The projected ridership on the two bus rapid transit routes planned for the CCT is 35,900 daily trips in 2035.[6]

- ***Southern Maryland Rapid Transit*** – High-capacity bus transit services in the 19 mile-long US 301/ MD 5 corridor from White Plains in Charles County to the Branch Avenue Metrorail Station in Prince George's County. The number of transit commuting trips in the corridor is projected to increase by 65 percent between 2010 and 2040, from 6,200 to 10,200 daily trips.

- ***Bus Rapid Transit*** – High frequency, all-day bus service in three major corridors: US 29, MD 355, and MD 586. BRT in the US 29 corridor (Colesville Road and Columbia Pike) is being studied from Silver Spring Metro Station to Burtonsville (Montgomery County) and from Burtonsville to downtown Columbia (Howard County). BRT is also being examined on MD 355 (Wisconsin Avenue, Rockville Pike, and Frederick Road), from Bethesda Metro Station to Clarksburg, and on MD 586 (Veirs Mill Road), from Rockville Metro Station to Wheaton Metro Station.

The MTA is implementing several projects through 2020 to increase the attractiveness and convenience of public transportation and to expand system capacity, including:

- ***Bus Network Improvement Program (BNIP)*** – Identifying improvements to local bus and express bus services that will reduce overcrowding, improve on time performance and travel speed, and decrease passenger trip times.

- ***Southern Maryland Commuter Bus Initiative*** – Developing new park and ride lots in Dunkirk and Waldorf to promote the use of commuter bus services.[7]

[6] *MTA. CCT Description of Project. http://www.cctmaryland.com/*

[7] *MTA Office of Planning. "Project Update and Open House June 2015." June 2015.*

- ***Transit Centers in Silver Spring and Takoma/Langley Park*** – Promoting transit use by facilitating safe and convenient transfers between multiple transit providers and modes including the Purple Line. WMATA forecasts that weekday Metrorail boardings in Silver Spring will nearly double between 2012 and 2030, serving 27,000 weekday boardings in 2030.[8] Takoma/Langley Crossroads is the largest non-Metrorail station transfer point in the D.C. region, and the new transit center will serve 12,000 passengers daily.[9]

In addition to developing and improving transit services, MDOT actively promotes transit oriented development (TOD) designed to increase transit ridership. Progress continues to be made across the State's 16 designated TOD locations. There are currently eight sites undergoing active development, along with the 2014 groundbreaking of the Annapolis Junction Town Center, a mixed-use development at the Savage MARC Station in Howard County, and the new Maryland Department of Housing and Community Development (MDHCD) headquarters at the New Carrolton MARC Station in Prince George's County.

Several of the MTA projects described above also incorporate TOD, which simultaneously supports goals to increase transit ridership and promote local economic development. For example, MDOT assessed TOD opportunities for each station along the Purple Line back in 2003 to ensure that the transit facilities were designed to support existing development and promote future growth.[10] The CCT will provide transit service to planned mixed use TODs in Montgomery County that support residential, employment, and educational activities. Privately funded TOD planned at the Silver Spring Transit Center, including two residential towers and a 200-room hotel, is anticipated to generate 4,200 additional daily transit trips – a 7 percent increase over the projected baseline ridership at the transit center.[11]

MTA also reduces GHG emissions by purchasing new or replacement transit vehicles that are more fuel efficient and produce fewer emissions. MTA's bus replacement program targets vehicles in operation for more than 12 years, resulting in 85 percent of MTA's current fleet using cleaner alternatives to conventional diesel. About half of the MTA's current fleet consists of hybrid-electric buses, which operate fully on electric power below 12 miles per hour. The MTA has sixty clean diesel buses scheduled for delivery in 2015. The more affordable cost of clean diesel buses compared to hybrid buses translates to faster replacement of old, less fuel efficient vehicles and the ability to increase transit services sooner.

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[8] *WMATA Office of Planning. Silver Spring Station Capacity Analysis Study. April 2014.*

[9] *MTA. Takoma-Langley Crossroads. http://mta.maryland.gov/takoma-langley*

[10] *MDOT. Purple Line Transit-Oriented Development Assessment. January 2003.*

[11] *Montgomery County Department of General Services, Division of Building Design & Construction. Paul S. Sarbanes Silver Spring Transit Center.*

In addition to MDOT's ongoing activities, WMATA's environmental initiatives also impact GHG emissions in Maryland. WMATA's approach to reducing GHG emissions is similar to MDOT's – increase transit ridership and procure cleaner vehicles – with the addition of strategies to expand the use of renewable energy and increase energy efficiency. WMATA's efforts to maximize transit ridership include operating eight-car trains during peak periods, completing core station improvements to relieve crowding and facilitate transfers, and continuing Metrobus service improvements.

WMATA's capital projects to reduce GHG emissions include procuring hybrid-electric buses to replace old diesel buses, installing on-site solar power, and upgrading garage lighting to use high efficiency LED systems. WMATA is also working to reduce GHG emissions by securing renewable power contracts and implementing a system-wide rollout of equipment that captures and reuses braking energy on Metrorail. WMATA's TOD program currently supports 105 million square feet of new development, either under construction or proposed around its Metrorail stations, which will boost transit ridership and encourage further decreases in vehicle miles driven.[12]

4.3.2 Intercity Transportation Initiatives [F.2]

MDOT is working with multistate and regional partners to implement strategies to reduce congestion and mobile emissions, including GHGs, by providing alternatives to passenger vehicle use for intercity passenger travel – both for work and leisure trips. This includes expansion and enhancement of intercity passenger rail service (including MARC and AMTRAK) and intercity bus services as well as improved connections between air, rail, intercity bus, and regional or local transit systems.

- ***High Speed Intercity Passenger Rail Grants*** – Supports engineering and NEPA documentation for Amtrak's Susquehanna River Bridge and B&P Tunnel replacement. Both of these projects are critical components of NEC FUTURE – a comprehensive planning study being led by the Federal Railroad Administration (FRA) to define, evaluate, and prioritize future investments in the Northeast Corridor (NEC). As part of NEC FUTURE, the FRA is preparing a Tier 1 Environmental Impact Statement (EIS) to assess the potential effects of the Tier 1 EIS Action Alternatives (Action Alternatives) on the built and natural environment.

- ***MARC*** – Multiple ongoing enhancements as identified in the MARC Growth and Investment Plan include: planned/ongoing expansions at the BWI MARC/Amtrak station and the West Baltimore Station; procurement of eight new diesel locomotives and repowering six locomotives to support continued reliable MARC operation and comply with EPA air quality emissions standards; and, ongoing track and signal improvements to improve reliability.

The GHG benefits of investments in the NEC to Maryland are dependent on the full scope of potential improvements from Washington to Boston. Given the scope of improvements identified in each Action Alternative, a realistic timeline for full implementation of the improvements under consideration is 2040.

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[12] *WMATA Office of Planning Sustainability. Metro Sustainability Report 2015.*

Public Transportation Results

The GHG reductions from the public transportation policies reduce projected 2020 GHG emissions by 1.77 mmtCO_2e as shown in **Table 4.7**.

Table 4.7 – Maryland 2020 Public Transportation Initiatives GHG Emissions Reductions				
GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
F	**Public Transportation Initiatives**	**2.00**	**2.89**	**1.77**
F.1	Public Transportation Initiatives	2.00	2.89	1.61
F.2	Intercity Transportation Initiatives	Included in F.1	Included in F.1	0.16

Note: The 2013 GGRP estimated GHG emission reductions in 2020 from funded programs (Initial) and unfunded programs (Enhanced). This 2015 Plan only focuses on currently funded programs through 2020.

4.4 PRICING INITIATIVES [G]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$287.05 million*
Example Projects: *High-Speed Toll Collection, I-95 Express Lanes, Intercounty Connector*

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 2014, the Maryland Transportation Authority (MdTA) reported collecting approximately 74 percent of all tolls electronically.

- In 2011, MDTA reported collecting approximately 63 percent of all tolls electronically. In FY 2014, the system is at 74 percent due to the addition of the Intercounty Connector (ICC) which is 100 percent electronic toll collection.
- MDTA installed electronic toll lanes (high-speed) at the Fort McHenry Tunnel and Key Bridge toll plazas.
- MDTA opened the I-95 Express Lanes in December 2014, which is 100 percent electronic toll collection.
- MDTA is conducting a follow-up All-Electronic Tolling and Prioritization Study which is legislatively required, with a report due to the General Assembly in January 2016.
- MDTA is coordinating with BWI Marshall to allow payment of parking through E-ZPass® accounts at the hourly and daily garages.

The GHG emission benefits associated with this strategy were calculated using EPA MOVES model based emission factors and vehicle population percentages, i.e., light-duty vehicles and heavy-duty vehicles represent approximately 89 and 10 percent of the fleet, respectively. Tolling estimates in 2020 were based on annual growth in the total number of tolls collected and the number of tolls collected electronically from 2006-2014 (MDOT 2015 Annual Attainment Report). It was assumed that the tolls collected electronically result in a reduction of 1-1.5 minutes of idling. The implementation of this policy is expected to result in additional emission benefits of 1.49 mmtCO_2e in 2020.

Pricing Initiatives Results

The GHG reductions from the pricing policies reduce projected 2020 GHG emissions by 1.99 mmtCO_2e as shown in **Table 4.8**. The emission reduction includes the benefits of transportation demand management programs (ridesharing, guaranteed ride home, transit passes) included in MDOTs funding of TERMs within the Baltimore and Washington regions.

Table 4.8 – Maryland 2020 Pricing Initiatives GHG Emissions Reductions				
GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
G	Pricing Initiatives	0.43	2.30	1.99

4.5 OTHER INNOVATIVE TRANSPORTATION STRATEGIES/PROGRAMS [H]

4.5.1 Evaluating the GHG Emissions Impacts of Major New Transportation Projects [H.1]

Under prior phases to develop MDOTs Climate Action Plan, working groups (including MDOT, modal agency, and MPO staff) identified three potential implementation strategies for this policy: (1) participate in framing national policy, (2) evaluate GHG emissions through the NEPA process, and (3) evaluate GHG emissions through statewide and regional planning processes.

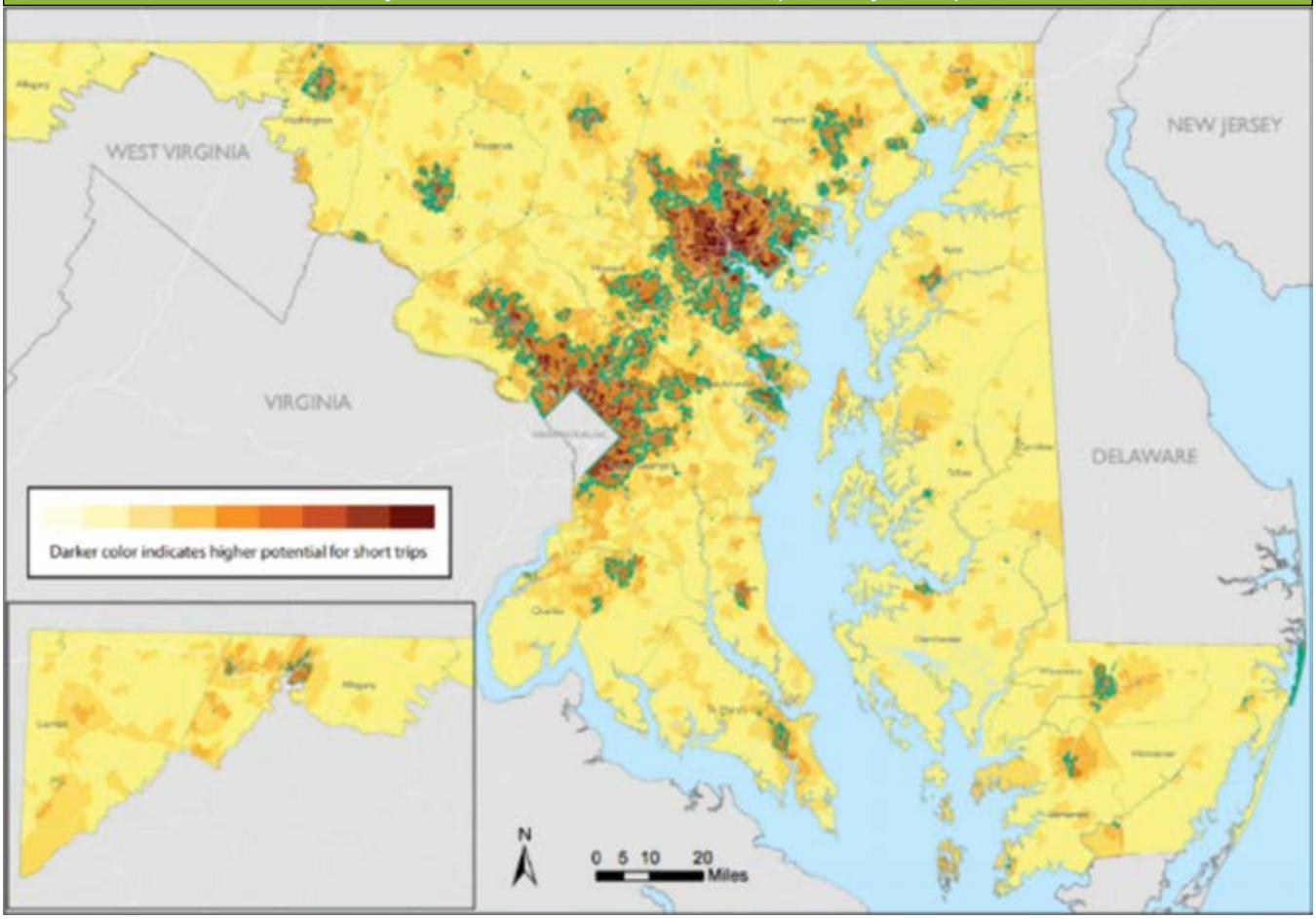
With the development of the GGRA Plan, MDE assumed responsibility for this policy option as the lead agency. MDOT and Maryland's MPOs are continuing to participate in discussions with MDE and other stakeholders regarding the future direction of this policy option.

4.5.2 Bicycle and Pedestrian [H.2]

Total FY 2015 – FY 2020 CTP GHG Beneficial Project Funding: *$160.1 million*
Example Projects: *MD 589, Racetrack Road--Shared –use path, MD 117/Clopper Road—Shared Use Path (Montgomery County), Purple Line—Shared Use Path (Montgomery County), BRAC-Related Intersection Improvements (Anne Arundel, Harford, and Prince George's Counties)*

Greenhouse gas emissions are reduced when motor vehicle trips are substituted by walking and biking trips. Communities where walking and bicycling are viable alternatives to driving are also more livable and provide more opportunities for regular physical activity, an important factor for maintaining good health. The Maryland 20-Year Bicycle and Pedestrian Plan presents MDOTs goals, objectives, and strategies to improve biking and walking opportunities for all users (see example of opportunity areas in **Figure 4.2**).

Figure 4.2 – Short Trip Opportunity Areas identified in Maryland Twenty-Year Bicycle & Pedestrian Master Plan (January 2014).



Between 2009 and 2015, MDOT has worked to encourage walking and bicycling by improving pedestrian and bicycle accommodation along state highways, improving access to transit, and supporting local efforts to encourage walking and biking. Significant developments included:

- *Adoption of the SHA Roadway Repaving Policy (2011-2012)* – The SHA Roadway Repaving Policy requires SHA to evaluate resurfacing projects to determine if existing lane or shoulders can may be modified to provide additional space for bicycle accommodations, or if additional signing or markings are appropriate to increase driver awareness of cyclists.

- *Adoption of the SHA Complete Streets Policy (2012)* – Working in concert with the SHA Roadway Repaving Policy, the SHA Complete Streets Policy requires "that all SHA staff and partners consider and incorporate complete streets criteria for all modes and types of transportation when developing or redeveloping our transportation system."

- *Creation of the Maryland Bikeshare Program (2011)* – The Maryland Bikeshare Program provides reimbursable grant funding to Maryland communities to establish or to expand bikesharing programs. Ongoing awards for the Bikeshare Program supports implementation of bikesharing systems in

Montgomery County, Baltimore City, the City of College Park, and University of Maryland/City of College Park and feasibility studies of potential bikeshare stations in the City of Frederick, Howard County and Prince George's County/City of Greenbelt.

- **Creation of the Maryland Bikeways Program (2012)** – The Maryland Bikeways Program provides technical assistance and grant funding for small- to mid-size planning, design and construction projects (generally $25,000 - $100,000) that maximize bicycle access and fill missing links in the state's bicycle system. The program has provided $12.25 million for 97 projects across the state since 2012.

- **Update of Bicycle Policy and Design Guidelines (2015)** – SHA updated its Bicycle Policy and Design Guidelines document in 2015, updating the previous version which was adopted in 2013. The 2015 Design Guidelines incorporated new research and best practices to enhance the safety and comfort of pedestrians and bicyclists.

A person who substitutes a 2.5 mile automobile trip to and from work with a bicycle trip saves approximately 1,046 lbs. of CO_2 equivalents per year.

If just 1% of Maryland's 18 and over population makes this choice, Maryland could save approximately 20,970 metric tons of CO_2 equivalents per year.

In addition to the new programs and policies listed above, MDOT manages several ongoing programs that provide funding for pedestrian and bicycle improvements, including:

- The Transportation Alternatives Program (TAP), is a federally-funded grant program that provides funding for projects that enhance the cultural, aesthetic, historic, and environmental aspects of the intermodal transportation system, including pedestrian and bicycle improvements. The TAP program replaced the Transportation Enhancements (TE) program when MAP-21 was enacted in 2012. Since 2009, the TE and TAP programs have provided $64.7 million in state and federal funds to 18 pedestrian and bicycle projects. While integrated into TAP at the federal level, SHA administers the following as stand-alone programs:

  - Recreational Trails Program (SHA), a federally-funded grant program to assist with the development and maintenance of smaller scale motorized and non-motorized trail, trailhead and restoration projects.

  - Safe Routes to School (SHA), a federally-funded program to encourage and enable students in grades K-8 to walk and bicycle to school. Since 2012, grants for Safe Routes to School infrastructure projects have been awarded through the Transportation Alternatives Program.

- Maryland Highway Safety Office Grant (MVA), a federally funded program to reduce the number of motor vehicle-related crashes, deaths, and injuries on Maryland highways. As of 2014, pedestrian safety is a top safety priority for this program.

- ADA Retrofit Program (SHA), a state-funded program to upgrade existing sidewalks, curb ramps, intersection driveway entrances along state roadways to be compliant with the Americans with Disabilities Act.

- Sidewalk Retrofit Program (SHA), a state-funded program to construct missing sidewalk segments along state roadways to fill gaps within the pedestrian network. The missing segment must be located in an Urban Area (as defined by the Census).

- Bicycle Retrofit Program (SHA), a state-funded program to provide bicycle improvements on state roadways.

- Community Safety and Enhancement Program, a state-funded program to support highway reconstruction and improvements along SHA roadways within urban centers that promote safety and economic development.

The FY 2015-2020 CTP includes 99 funded projects with pedestrian and bicycle elements.
Example projects include:

- The MD 589, Racetrack Road project in Worcester County, which includes a shared use path and sidewalks.

- The MD 320, Piney Branch Road project in Montgomery County, which includes a new pedestrian bridge over Sligo Creek.

- The MD 117, Clopper Road project in Montgomery County, which includes a shared-use path on the south side and wide curb lanes to accommodate bicycles.

- The Takoma/Langley Park Transit Center project in Prince George's County, which includes pedestrian crossing safety measures and new sidewalks.

- The Purple Line project in Montgomery and Prince George's Counties, which includes reconstruction a shared-use path between Silver Spring and Bethesda and connections to the Capital Crescent Trail.

- Numerous BRAC-related pedestrian and bicycle access improvements in Anne Arundel, Harford, and Prince George's Counties.

Other Innovative Transportation Strategies Results
The GHG reductions from the pricing policies reduce projected 2020 GHG emissions by 0.07 mmtCO_2e as shown in **Table 4.9**.

Table 4.9 – Maryland 2020 Other Innovative Transportation Strategies GHG Emissions Reductions

GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
H	**Other Innovative Transportation Strategies**	**Included in F**	**Included in F**	**0.07**
H.1	Evaluating the GHG Emissions of Major New Transportation Projects	Included in F	Included in F	NA
H.2	Bike and Pedestrian Initiatives	Included in F	Included in F	0.07

Note: The 2013 GGRP estimated GHG emission reductions in 2020 from funded programs (Initial) and unfunded programs (Enhanced). This 2015 Plan only focuses on currently funded programs through 2020.

5.0 2020 TRANSPORTATION SECTOR FINDINGS

5.1 TRANSPORTATION SECTOR CONTRIBUTION TO MARYLAND'S CLIMATE CHANGE GOALS

The revised transportation sector GHG reduction estimates are based on updated planning assumptions and the new MOVES2014 modeling results. **Table 5.1** and **Figure 5.1** compare the 2013 initial and enhanced emission reductions (using prior modeling tools and assumptions) to the funded 2015 reductions (using the tools and assumptions documented above).

Table 5.1 – 2020 Transportation Sector Emission Reductions Summary

GGRA Policy ID	GGRA Plan Policy Name	2013 (Initial)	2013 (Enhanced)	2015 (Funded)
	Forecasted VMT Related Reduction (True-Up)	2.78	2.78	3.12[1]
E.1	Motor Vehicle Emissions & Fuel Standards	7.72	7.72	5.57
E.1.A	Maryland Clean Car	4.33[2]	4.33	5.06[4]
E.1.B	CAFE 2008-2011	2.27	2.27	NA
E.1.C	National Medium and Heavy Duty Standards	0.88[3]	0.88	0.28[5]
E.1.D	Federal Renewable Fuel Standards	0.24	0.24	0.23
E.2	On-Road, Airport, Port and Freight/ Freight Rail	0.38	0.62	1.06
E.2.A	On-Road Technology	Included in E.2.A	Included in E.2.A	1.00
E.2.B	Airport Initiatives	Included in E.2.A	Included in E.2.A	0.04
E.2.C	Port Initiatives	Included in E.2.A	Included in E.2.A	0.03
E.2.D	Freight & Freight Rail Programs	Included in E.2.A	Included in E.2.A	Included in E.2.A
E.3	Electric & Low Emitting Vehicle Initiatives	0.00	0.27	0.25
F.1	Public Transportation Initiatives	2.00	2.89	1.61
F.2	Intercity Transportation Initiatives	Included in F.1	Included in F.1	0.16
G	Pricing Initiatives	0.43	2.30	1.99
H.2	Bike & Pedestrian Initiatives	Included in F.1	Included in F.1	0.07
	TOTAL	13.29	16.58	13.83

[1] *The "True-Up" represents a reforecasting of the 2020 BAU based on actual VMT through 2014.*

[2] *The Maryland Clean Car Program includes the National Fuel Economy (2012-2025) Program.*

[3] *2014-2018 National Medium and Heavy Duty Vehicle Standards.*

[4] *The Maryland Clean Car Program includes the Maryland Clean Car, Tier 3 (fuels only), and 2007-2025 National Fuel Economy Programs.*

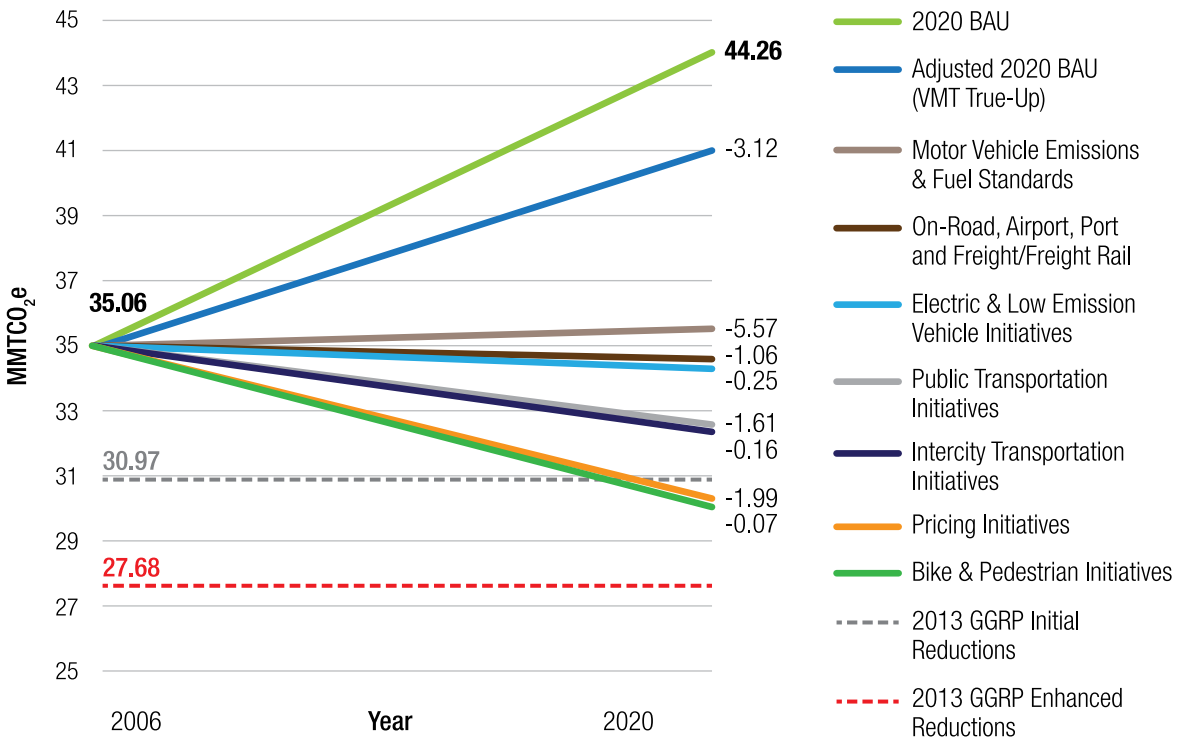
[5] *2014-2018 and proposed 2019-2025 National Medium and Heavy Duty Vehicle Standards.*

The differences between the 2013 Initial, 2013 Enhanced, and 2015 Funded results in **Table 5.1** are attributed to changes in the modeling approach (new tools and methods), changes in vehicle and fuel standards, and changes to MDOTs Consolidated Transportation Program. The columns are provided for high-level comparison purposes only and assist in a better understanding of what emission reduction the transportation sector can reasonably expect to achieve by 2020.

Some highlights of the resulting emission estimates:

- The transportation sector exceeds the 2013 GGRP initial reductions and achieves over 80 percent of the 2013 GGRP enhanced reductions that were representative of unfunded strategies.
- The total reduction in 2020 of 13.83 mmtCO2e represents a 31 percent reduction from the 2020 BAU. In other words, the combination of Federal and State GHG beneficial strategies reduces potential GHG emissions from the transportation sector in 2020 by almost a third.
- Maryland specific projects and programs and Federal policy has made notable progress in mitigating GHG emissions since 2006. After increases in GHG emissions in 2006 through 2009, GHG emissions from transportation sector gradually decreased from 2011 to 2014, resulting in emissions approximately 4 percent lower in 2014 than 2006 (according to MDOT's 2015 Annual Attainment Report, pg. 40).
- GHG emission reductions compared to 2006 are estimated to continue to increase at an accelerating rate through and beyond 2020. These continuing decreases are due to the growing benefit of Federal fuel economy standards that are spread across a greater share of the vehicle fleet and the continued implementation of transportation plans and programs that improve the operation of the transportation system and offer travelers more choices.

Figure 5.1 – Forecasted VMT Related Reduction (True-Up) to Adjusted 2020 BAU (VMT True-Up)



5.2 TRANSPORTATION SECTOR COSTS

The process for reviewing the transportation sector's contribution toward meeting Maryland's GHG emission reduction goals included a detailed review of all projects and programs funded in the FY 2015 – FY 2020 Consolidated Transportation Program (CTP). The review focused on the construction and development & evaluation (D&E) programs within the CTP and excluded the system preservation program.

This review helped appraise the extent of funding committed to projects or project components that have a GHG emissions reduction potential. The following criteria has been applied in selecting projects with GHG mitigation potential:

- The project enables a shift of passengers or cargo to a more energy efficient mode of travel;
- The project improves operational efficiency – through enhanced technology or strategic operational or capacity improvements;
- The project supports reducing or managing travel activity; and,
- The project provides incentives or expands infrastructure associated with fuel or vehicle technology programs.

The review focuses primarily on projects with a potential direct impact on GHG emissions (eg. the primary objective of the project is consistent with the four criteria above). Many projects, particular maintenance or rehabilitation projects may indirectly result in GHG emission reductions because they enable more reliable operation of the transportation system (for example Baltimore Metro rail car rehabilitation or a bridge replacement). These projects are not included in the analysis.

There are some special considerations in this review for roadway projects. These include:

- Bicycle & pedestrian infrastructure included in a roadway capacity project description (where the project otherwise is not considered to mitigate GHG emissions, for example a bridge replacement featuring a new accommodation for a sidewalk or bike lane). For these projects, only the share of the total 6-year project funding attributable to bike/pedestrian components is related to GHG mitigation. In some cases within the CTP, the cost attributable to the bike/pedestrian component is documented. Where that is not the cases, MDOT assumed a typical share of bike and pedestrian components of total planning, design, and construction costs (approximately 1 percent).
- In the case of roadway capacity expansion projects, projects were deemed to have a GHG reduction potential if a specific congestion benefit was explained in the description. Another criteria used to assess if a roadway capacity expansion project would qualify as a GHG mitigating project is if its location is within a Priority Funding Area (PFA). This proxy helps to identify congestion mitigation projects targeting urban bottlenecks. These projects have greater potential for reducing emissions associated with delay versus increasing VMT associated with increased capacity. In total, 86 SHA projects were identified that meet this criteria, 35 which are planned for completion by 2020.

Table 5.2 presents a total funding summary (from all sources) by GGRA Plan policy by project phase. **Table 5.3** presents a total funding summary by opening date (pre-2020 versus post-2020).

Table 5.2 – 2015 – 2020 Consolidated Transportation Program Summary - GHG Beneficial Project Costs (1000's)					
GGRA Plan Policy Name	GGRA Policy ID	Planning & Engineering Costs	Right-0f-Way Costs	Construction Costs	Total Costs
On-Road Technology	E.2.A	$252,821	$328,928	$751,707	$1,333,456
Airport Initiatives	E.2.B	$1,395	$-	$10,682	$12,077
Port Initiatives	E.2.C	$-	$-	$38,605	$38,605
Freight & Freight Rail Programs	E.2.D	$28,721	$44,128	$338,412	$411,261
Electric & Low Emitting Vehicle Initiatives	E.3	$-	$-	$500	$500
Public Transportation Initiatives	F.1*	$125,073	$278,488	$3,208,775	$3,612,336
Intercity Transportation Initiatives	F.2	$92,328	$1,100	$298,480	$391,908
Pricing Initiatives	G	$2,922	$1,994	$282,131	$287,047
Bike & Pedestrian Initiatives	H.2	$7,400	$-	$152,731	$160,131
TOTAL		**$510,660**	**$654,638**	**$5,082,023**	**$6,247,321**

Source: Maryland Department of Transportation, FY 2015 – FY 2020 Consolidated Transportation Program.

**Note: Excludes all previously spent and planned spending on the Red Line. Maintains Purple Line cost documented in the CTP.*

Table 5.3 – 2015 – 2020 Consolidated Transportation Program Summary - Open by 2020 GHG Beneficial Project Costs (1000's)				
GGRA Plan Policy Name	GGRA Policy ID	Total Costs Open by 2020	Percent of Total Cost	Total Costs Open post-2020
On-Road Technology	E.2.A	$1,000,740	75%	$332,716
Airport Initiatives	E.2.B	$12,077	100%	$-
Port Initiatives	E.2.C	$38,605	100%	$-
Freight & Freight Rail Programs	E.2.D	$392,611	95%	$18,650
Electric & Low Emitting Vehicle Initiatives	E.3	$500	100%	$-
Public Transportation Initiatives	F.1*	$2,043,412	57%	$1,568,924
Intercity Transportation Initiatives	F.2	$305,027	78%	$86,881
Pricing Initiatives	G	$286,749	100%	$298
Bike & Pedestrian Initiatives	H.2	$157,192	98%	$2,939
TOTAL		**$4,236,912**	**68%**	**$2,010,408**

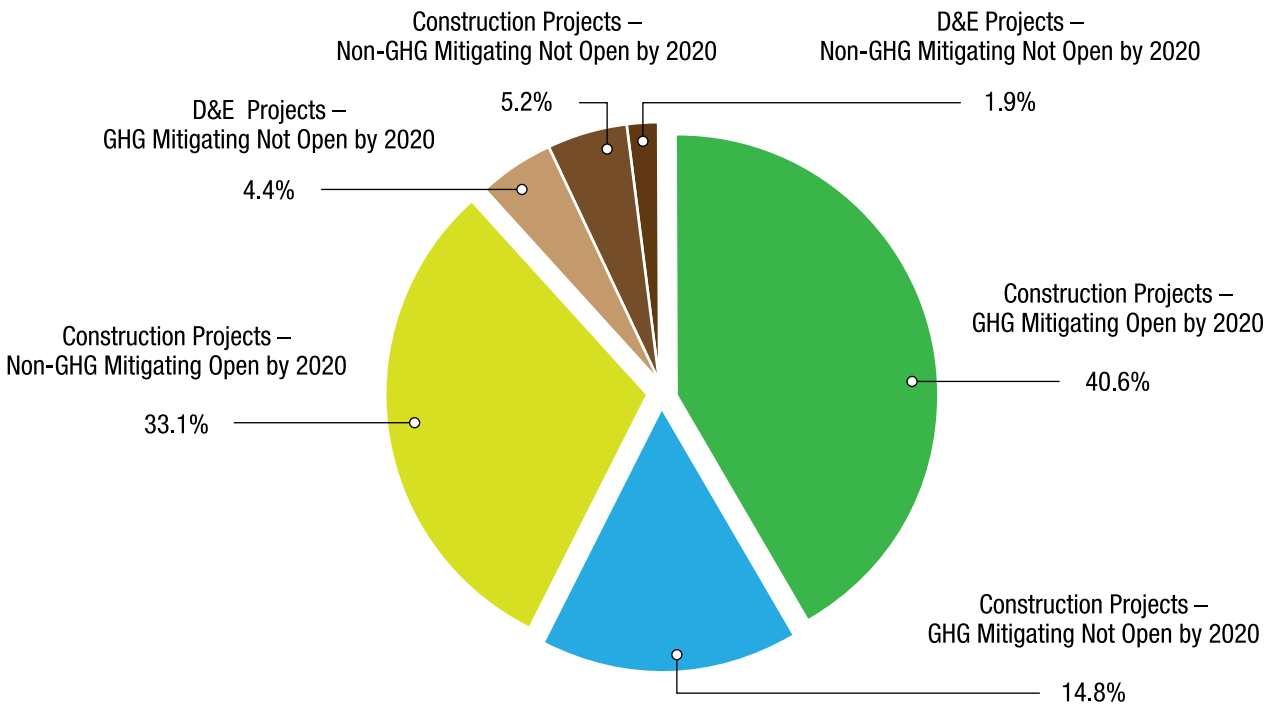
Source: Maryland Department of Transportation, FY 2015 – FY 2020 Consolidated Transportation Program.

**Note: Excludes all previously spent and planned spending on the Red Line. Maintains Purple Line cost documented in the CTP.*

Figure 5.2 presents the share of CTP funding by GHG and non-GHG projects, and the project planned opening (pre or post-2020) in the construction and development and evaluation (D&E) programs. The total 6-year CTP funding associated with the projects and programs within Figure ES-2 total $10.447 billion. The Draft FY 2015 – FY 2020 CTP totals $14.434 billion. The difference ($3.987 billion) is associated with system preservation and minor project programs within the CTP (not reviewed as part of this report). Some facts on projects costs in the CTP relevant to this report include:

- All GHG mitigating projects (independent of opening year) represent **60 percent** of the total CTP funding in the construction and D&E program.
- GHG mitigating projects open by 2020 represent **41 percent** of the total CTP funding in the construction and D&E program.
- There were **266 line items** reviewed in the construction and D&E program, with **159 line items** deemed to support GHG mitigation. The **$6.247 billion** in the CTP for these projects and programs represent **43 percent** of the total cost of the CTP.

Figure 5.2 – CTP Program Summary - GHG Beneficial Project Cost Share
(Construction + Development and Evaluation Program Only)



Appendix B provides detailed documentation of each CTP line item included in this analysis. The analysis excludes all previously spent and planned spending on the Red Line and maintains the Purple Line cost as documented in the FY 2015 – FY 2020 CTP.

5.3 DRAFT FY 2016 – FY 2020 CTP

The CTP is Maryland's six-year capital budget for transportation projects. MDOT continuously works with residents, businesses, local jurisdictions and local and state elected officials to include projects in the CTP that preserve investments, enhance transportation services, and improve accessibility throughout the state. To ensure that every dollar available for transportation in Maryland is efficiently spent, MDOT employs a strategic decision making process, using established priorities and criteria to prioritize programs and projects under consideration for inclusion in the CTP.

In June 2015, Governor Hogan announced $1.97 billion to fund highway and bridge improvements across the State. The $1.97 billion preserves $625 million for planned projects and adds $1.35 billion for new projects to be underway by 2018. The $1.35 billion in new projects includes $845 million for new major construction projects and $500 million for new minor projects to fix bridges and improve roads. The new major construction projects are presented in more detail in the Draft FY 2016 – FY 2021 CTP and address the top project priorities identified by local and state elected officials in their county priority letters presented annually to MDOT.

Included in Governor Hogan's June 2015 announcement and the Draft FY 2016 – FY 2021 CTP is a $100 million pilot implementation of active traffic management (ATM) and innovative congestion mitigation (ICM) tools to reduce congestion on I-270 between the I-270 Spur and I-370/Sam Eig Highway (6.6 miles). Potential tools may include peak dynamic shoulder use, ramp metering, variable speed limits, and other technology-based congestion reduction measures – all which aim to make travel more efficient and thereby reduce GHG emissions.

Most of the major construction projects in Governor Hogan's announcement advance projects identified only for planning and engineering in the FY 2015 – FY 2020 CTP into actual construction by 2018. For the purposes of this plan, this results in a significant increase in the total funding committed toward GHG mitigating projects open by 2020. These projects collectively help reduce congestion at roadway bottlenecks across Maryland through capacity, operational, and safety enhancements.

5.4 NEXT STEPS

A primary objective of the 2015 GGRP is to provide information to the General Assembly regarding the current status of GHG reduction strategies and progress towards meeting the 25 percent below 2006 target in 2020. The General Assembly may decide to retain the current target or adjust it based on information in the GGRP. Regardless of action taken by the General Assembly in 2016 regarding the 2015 GGRP, MDOT will continue climate change mitigation planning consistent with the goals of the Maryland Transportation Plan and to support actions of the Maryland Commission on Climate Change.

Maryland Transportation Plan

As part of the annual development of the Consolidated Transportation Program, MDOT will continue to work with MPOs and local jurisdictions to make strategic investment decisions to support the goals of the Maryland Transportation Plan. As part of the Annual Attainment Report on Transportation System Performance, MDOT will continue to report annual estimates of on-road mobile GHG emissions and details progress on strategies and future strategies to reduce GHG emissions. MDOT will also continue to contribute to the national discussion regarding best practices in performance based planning and programming, including continuous improvement of internal practices for tracking the performance of the transportation system and transportation investments.

Transportation Funding

Enacted in July 2012, the Moving Ahead for Progress in the 21st Century Act (MAP-21) authorized federal funding for highway, transit and other multimodal surface transportation projects through September 30, 2014. MAP-21 included policy changes, consolidated program funding categories, and provided funding certainty through September 2014 (with an extension through October 29, 2015 at existing funding levels).

MAP-21 does not address the long-term solvency of the Federal Highway Trust Fund (FHTF), which continues to constrain MDOT's ability to plan for future State investment. In FFY 2015, MDOT is expected to receive approximately $580 million in highway formula funding and $160 million in transit formula funding. According to the Congressional Budget Office, if Congress does not provide a long term solution to the current gap between FHTF revenues and planned outlays, the threat of reductions in the amount of federal aid provided to states will continue.

Federal aid, representing 19 percent of the total funding in Maryland's TTF, supports the multimodal investments in the Consolidated Transportation Program (CTP). Given the fiscal concerns regarding the soundness of the FHTF, MDOT will continue to assess this risk and work with the Maryland Congressional Delegation to address the potential impact on Maryland transportation projects. The continued support of the federal highway trust fund is critical to planning and implementing many of the programs and projects presented in this plan.

MDOT continues to explore opportunities to leverage state funding with private investment, building from recent successes at the Port of Baltimore and I-95 Travel Plazas. In order to create an enhanced framework for future public-private partnerships (P3) that will attract private investment to help build new infrastructure, Maryland passed House Bill 560, which was signed into law on April 9, 2013. The new legislation provides the private sector with a stronger, more predictable and streamlined process, protects public assets, ensures a strong workforce, requires competitive bidding for all projects and allows the private sector to submit new unsolicited concepts to address Maryland's infrastructure needs. More details are available here: http://www.mdta.maryland.gov/partnerships/tp3overview.html.

Transportation and Climate Initiative

The Transportation and Climate Initiative (TCI) is a collaboration among the agency heads of the transportation, energy, and environmental agencies of 11 states, and the District of Columbia, who in 2010 committed to work together to improve efficiency and reduce greenhouse gas emissions from the transportation sector throughout the northeast and mid-Atlantic region.

In recent years, TCI has developed into a robust partnership with a record of accomplishment through the formation of the Northeast Electric Vehicle Network, shared research on policies to promote sustainable communities, analysis of regional freight movement, and work to remove barriers to use of innovative transportation information technologies.

As part of their work, state leaders indicated that there was a need to better understand transportation-sector greenhouse gas (GHG) emissions trends and opportunities in the region. TCI has recently completed analysis detailing regional emission trends and the opportunities, costs, and benefits associated with GHG emission reduction strategies in the region.

Maryland Commission on Climate Change

MCCC is charged with advising the Governor and General Assembly on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change and maintaining and strengthening the State's existing Greenhouse Gas Reduction Plan.

The MCCC was originally created by a 2007 Executive Order. The MCCC role was expanded and better defined through Executive Order 01.01.2014.14 (in effect as of November 19, 2014) and the Maryland Climate Commission Act (MCCA) of 2015 (signed into law by the Governor and to take effect as of June 1, 2016).

The 2014 Executive Order (EO) and 2015 MCCA requires the MCCC to develop an annual report addressing a number of topics, including:

- Establishing comprehensive and accountable, annual working group work plans that set annual goals and performance benchmarks, and prioritize new and existing climate change mitigation and adaptation actions and initiatives,

- Recommending short and longer-term strategies and initiatives to better mitigate the causes and address the consequences of climate change,

- Maintaining a comprehensive action plan, with five year benchmarks, to achieve science-based reductions in Maryland's GHG emissions of 80% of 2006 levels by 2050, and

- Strengthen and maintain existing State action plans to further mitigate the causes and drivers of climate change, and address (prepare for and adapt to) the consequences of climate change.

Goal Setting

One early goal of the MCCC is to establish a process to develop and ultimately make recommendations on longer-term GHG emission reduction goals in Maryland. This includes looking at both mid-term (2030) and long-term (2050) multisector goals. To inform this process, MDOT plans to conduct a post-2020 analysis that assesses GHG emission trends and forecasts for the transportation sector (on-road and off-road) in Maryland and documents the primary factors impacting these emission trends. The Baltimore Metropolitan Council (BMC) "How Far Can We Get?" analyses, recent and ongoing Metropolitan Washington Council of Governments (MWCOG) scenario planning work, and ongoing mid-Atlantic and northeast regional strategic planning and policy analysis as part of the Transportation and Climate Initiative (TCI) all provide information to assist MDOTs statewide analysis.

The outcomes of the work will collectively help inform long-range transportation planning decisions at the MPO and statewide level, serve as a companion piece to the 2035 Maryland Transportation Plan, and position MDOT as a leader among its partner State agencies to help guide the discussion of potential long-range goals under consideration by the MWG and MCCC.

APPENDIX A:

BASELINE, BUSINESS AS USUAL, AND PLANS AND PROGRAMS METHODOLOGY

A. 2006 BASELINE AND 2020 BAU EMISSIONS INVENTORY DOCUMENTATION

This technical analysis report documents the methodology and assumptions used to produce the greenhouse gas (GHG) inventory for Maryland's on-road portion of the transportation sector. Statewide emissions have been estimated for a 2006 baseline, a 2020 forecast business-as-usual (BAU) scenario and an adjusted 2020 BAU based on traffic trends through 2014. The inventory was calculated by estimating emissions for carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N2O). Those emissions were then converted to carbon dioxide equivalents that are measured in the units of million metric tons (mmt CO_2e). Carbon dioxide represents about 97 percent of the transportation sector's GHG emissions.

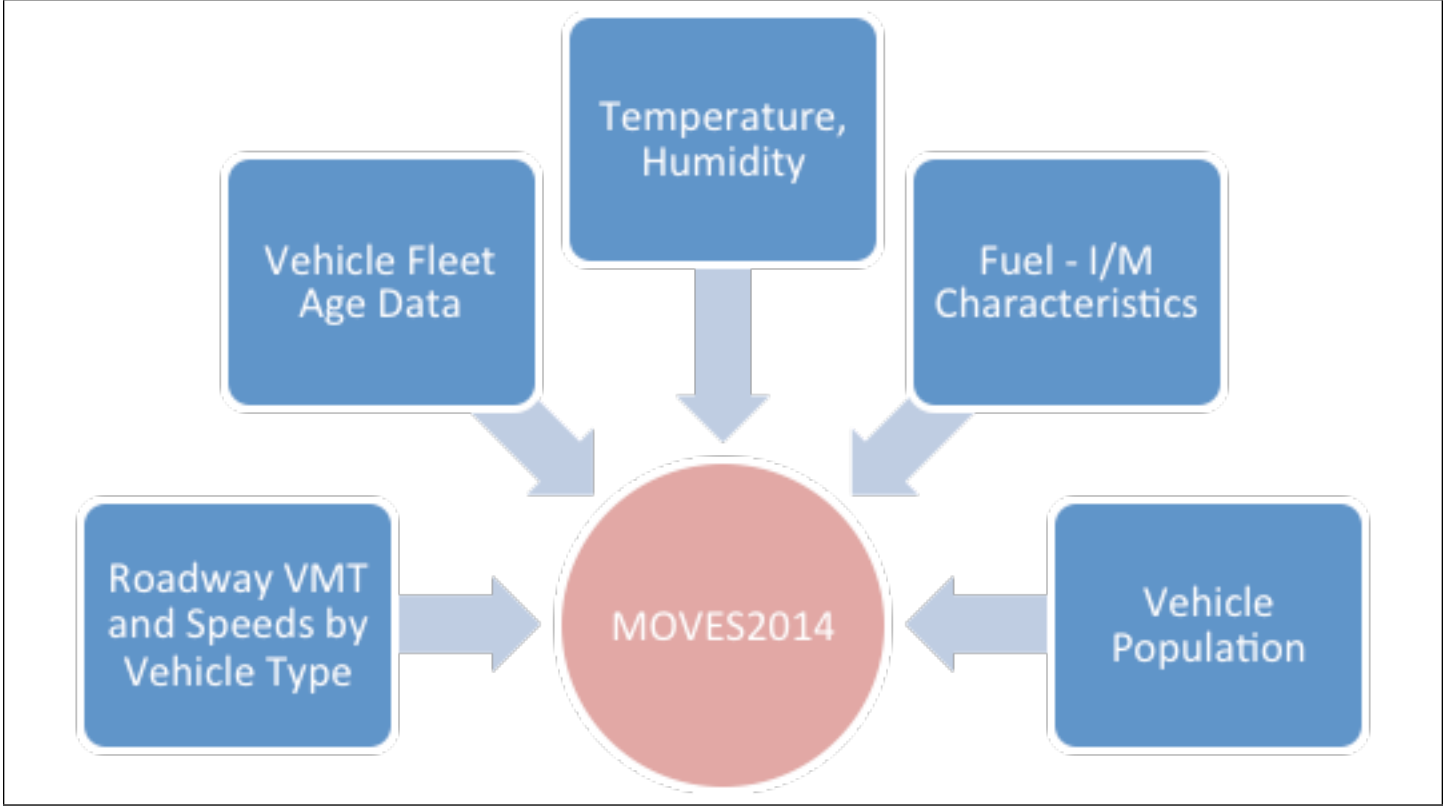
The on-road portion of the inventory was developed using EPA's latest emissions model MOVES2014 (Motor Vehicle Emissions Simulator) released in October 2014. The inventory results represent an update an update to 2013 Greenhouse Gas Reduction Act Plan dated October 2013. The previous inventory efforts were performed with EPA's earlier version of the emission factor model MOVES2010a. The MOVES2014 model includes new data, new emissions standards, and new functional improvements and features over the earlier version. With MOVES, greenhouse gases are calculated from vehicle energy consumption rates and vary by vehicle operating characteristics including speed, engine size, and vehicle age. The off-road portion of the inventory was updated using emission rates and data from EPA's latest State Greenhouse Gas Inventory Tool (SIT).

On-Road Analysis Process

The data, tools and methodologies employed to conduct the on-road vehicle GHG emissions inventory were developed in close consultation with MDE and are consistent with the *MOVES2014 Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity, EPA-420-B-15-007, January 2015*. EPA's MOVES2010 series incorporated new car and light truck greenhouse gas emissions standards for model years 2012-2016 and update effects of corporate average fuel economy standards for model years 2008-2011. MOVES2014 incorporates three new federal emissions standard rules: a) heavy duty greenhouse gas standards for model years 2014-2018, b) light duty greenhouse gas standards for model years 2017-2025, , and c) Tier 3 fuel and vehicle standards for model years 2017-2025.

As illustrated in Figure A.1, the MOVES2014 model has been integrated with local traffic, vehicle fleet, environmental, fuel, and control strategy data to estimate statewide emissions.

Figure A.1 – Emission Calculation Data Process



The modeling assumptions and data sources were developed in coordination with MDE and are consistent with other SIP-related inventory efforts. The process represents a "bottom-up" approach to estimating statewide GHG emissions based on available roadway and traffic data. A "bottom-up" approach provides several advantages over simplified "top-down" calculations using statewide fuel consumption. These include:

- Addresses potential issues related to the location of purchased fuel. Vehicle trips with trip ends outside of the state (e.g. including "thru" traffic) create complications in estimating GHG emissions. For example, commuters living in Maryland may purchase fuel there but may spend much of their traveling in Washington D.C. The opposite case may include commuters from Pennsylvania working in Maryland. With a "bottom-up" approach emissions are calculated for all vehicles using the transportation system.

- Allows for a more robust forecasting process based on historic trends of VMT or regional population and employment forecasts and their relationship to future travel. For example, traffic data can be forecasted using growth assumptions determined by the MPO through their analytic (travel model) and interagency consultation processes.

GHG emission values are reported as annual numbers for the 2006 baseline and 2020 BAU scenarios. The annual values were calculated based on annual MOVES runs as summarized in Figure A.2. Each annual run used traffic volumes, and speeds that represent an annual average daily traffic (AADT) condition, and temperatures and fuel input parameters representing an average day in each month.

Figure A.2 – Calculation of Annual Emissions

For the 2006 and 2020 BAU emissions inventories, the traffic data was based on roadway segment data obtained from the Maryland State Highway Administration (SHA). This data does not contain information on congested speeds and the hourly detail needed by MOVES. As a result, post processing software (PPSUITE) was used to calculate hourly congested speeds for each roadway link, apply vehicle type fractions, aggregate VMT and VHT, and prepare MOVES traffic-related input files. The PPSUITE software and process methodologies are consistent with that used for state inventories and transportation conformity analyses throughout Maryland.

Other key inputs including vehicle population, temperatures, fuel characteristics and vehicle age were obtained from and/or prepared in close coordination with MDE staff. The following sections summarize the key input data assumptions used for the inventory runs.

SUMMARY OF DATA SOURCES

A summary of key input data sources and assumptions were developed in consultation with MDE and are consistent with the *MOVES2014 Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity, EPA-420-B-15-007, January 2015* and are provided in Table A.1. Many of these data inputs are consistent to those used for SIP inventories and conformity analyses. There are several data items that require additional notes.

- Traffic volumes and VMT are forecasted for the 2020 BAU analysis. A discussion of forecasted traffic volumes and vehicle miles of travel (VMT) is discussed in more detail in the following section.

- Vehicle population is a key input that has an important impact on start and evaporative emissions. The MOVES Model requires the population of vehicles by the thirteen source type categories. For light duty vehicles, vehicle population inputs were prepared and provided by MDE for base years (2007, 2008 and 2011). The 2007 and 2008 vehicle population was used to estimate 2006 vehicle population. For the analysis year 2020, the vehicle population was forecasted based on projected household and population growth obtained from state and MPO sources. For heavy duty trucks, vehicle population was calculated from VMT using MOVES default estimates for the typical miles per vehicle by source type (e.g. vehicle type). The PPSUITE post processor automatically prepares the vehicle population file under this method.

- The vehicle mixes is another important file that is used to disaggregate total vehicle volumes and VMT to the 13 MOVES source types. The vehicle mix was calculated based on 2011 SHA vehicle type pattern percentages by functional class, which disaggregates volumes to four vehicle types: light-duty vehicles, heavy-duty vehicles, buses, and motorcycles. As illustrated in Figure A.3, from these four vehicle groups, MOVES default Maryland county VMT distributions by source type was used to divide the four groups into each of the MOVES 13 source types.

Figure A.3 – Defining Vehicle Types

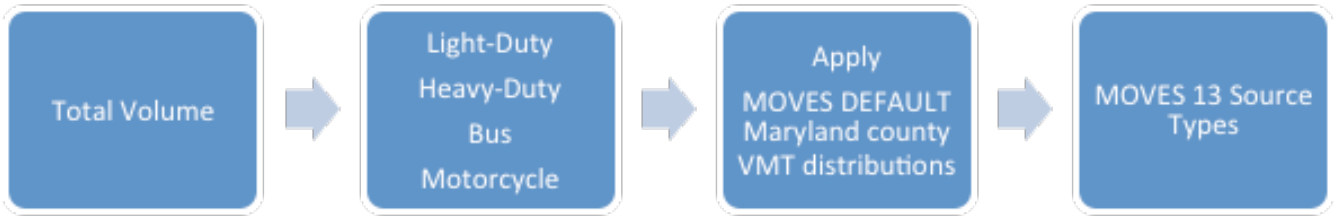


Table A.1 – Summary of Key Data Sources			
Data Item	**Source**	**Description**	**Difference between 2006 and 2020BAU**
Roadway Characteristics	2011 Maryland SHA Universal Database	Lanes, segment distance, facility type, speed limit	*Same Data Source*
Traffic Volumes	2011 Maryland SHA Universal Database	Average Annual Daily Traffic Volumes (AADT)	Volumes forecasted for 2020 BAU
Seasonal Adjustments	SHA 2011 *ATR Station Reports in the Traffic Trends System Report Module* from the SHA website	Used to develop day and month VMT fractions as inputs to MOVES to disaggregate annual VMT to daily and monthly VMT	*Same Data Source*
VMT	Highway Performance Monitoring System 2006	Used to adjust VMT to the reported 2006 HPMS totals by county and functional Class	VMT forecasted for 2020 BAU
Hourly Patterns	SHA 2011 *Traffic Trends System Report Module* from the SHA website	Used to disaggregated volumes and VMT to each hour of the day	*Same Data Source*
Vehicle Type Mix	2011 SHA vehicle pattern data; MOVES default Maryland county VMT distributions	Used to split traffic volumes to the 13 MOVES vehicle source types	*Same Data Source*
Ramp Fractions	MOVES Defaults	MOVES Defaults	*Same Data Source*
Vehicle Ages	2008 and 2011 Maryland Registration data	Provides the percentage of vehicles by each model year	*Used 2008 registration data for 2006 baseline, and 2011 registration data for BAU.*
Hourly Speeds	Calculated by PPSUITE Post Processor	Hourly speed distribution file used by MOVES to estimate emission factors	Higher volumes produce lower speeds in 2020 BAU
I/M Data	Provided by MDE	Based on 2006 and current I/M program	Different I/M Program Characteristics
Fuel Characteristics	Provided by MDE	Fuel characteristics vary by year	Different Fuel Characteristics
Temperatures	Provided by MDE	Average Monthly Temperature sets	*Same Data Source*
Vehicle Population	Light duty vehicles: used vehicle population data provided by MDE and applied growth rates to forecast population to 2020 BAU Heavy duty trucks: Calculated by PPSUITE Post Processor; MOVES Default Miles/ Vehicle Data	Number of vehicles by MOVES source type which impact forecasted start and evaporative emissions	2020 BAU based on projected demographic and VMT growth

TRAFFIC VOLUME AND VMT FORECASTS

The traffic volumes and VMT within the SHA traffic database were forecast to estimate future year emissions. Several alternatives are available to determine forecast growth rates, ranging from historical VMT trends to the use of MPO-based travel models that include forecast demographics for distinct areas in each county. For the 2020 BAU scenarios, two forecasts were developed using assumptions from the original Maryland CAP, and the second based on extending the historic trends beyond 2006 to 2013. Table A.2 summarizes the growth rates by county.

- **2020 BAU** – For the 2020 BAU scenario, the forecasts were determined using assumptions from prior analysis, which was based on historic trends of 1990-2006 highway performance monitoring system (HPMS) VMT growth. The average statewide annualized growth rate through 2020 for this scenario is 1.8 percent.

- **2020 Adjusted-BAU** – To evaluate the greenhouse gas emissions impacts purely from the vehicle fuel economy improvements, the 2020 traffic volumes and VMT forecasts were adjusted based on historic trends of 1990-2013 HPMS VMT growth. Extending the historical data set from 2006 to 2013 resulted in an average statewide annualized growth rate for this scenario of 1.1 percent.

Table A.3 summarizes total 2006 baseline and 2020 forecast VMT by vehicle type.

Table A.2 – VMT Annual Growth Rates (Per Maryland CAP) for 2020 BAU

County	HPMS Historical (CAP)	2020 Adjusted-BAU (Based on 1990-2013 HPMS)
Allegany	1.3%	0.7%
Anne Arundel	2.0%	1.2%
Baltimore	1.3%	0.9%
Calvert	2.5%	1.6%
Caroline	1.3%	0.7%
Carroll	1.9%	1.1%
Cecil	2.4%	1.9%
Charles	2.2%	1.3%
Dorchester	0.9%	0.2%
Frederick	2.5%	1.6%
Garrett	1.4%	0.6%
Harford	1. 9%	1.5%
Howard	3.2%	2.3%
Kent	0.5%	-0.6%
Montgomery	1. 6%	0.9%
Prince George's	1.7%	1.1%
Queen Anne's	2.2%	1.1%
Saint Mary's	2.1 %	1.4%
Somerset	0.9%	0.0%
Talbot	1.8%	1.0%
Washington	2.1%	1.1%
Wicomico	1. 6%	1.0%
Worcester	1. 4%	1.1%
Baltimore City	0.8%	0.2%
Statewide	***1.8%***	***1.1%***

Table A.3 – 2006 Baseline and 2020 BAU VMT by Vehicle Type

Annual VMT (millions)	2006 Baseline	2020 BAU Forecast	2020 Adjusted-BAU
Light Duty	51,823	64,826	59,888
Medium/Heavy Duty Truck & Bus	4,795	6,018	5,554
TOTAL VMT (in millions)	**56,618**	**70,844**	**65,442**

The analysis process (e.g. using PPSUITE post processor) re-calculates roadway speeds based on the forecast volumes. As a result, future year emissions are sensitive to the impact of increasing traffic growth on regional congestion.

VEHICLE TECHNOLOGY ADJUSTMENTS

The MOVES2014 emission model includes the effects of the following post-2006 vehicle programs on future vehicle emission factors:

- *CAFE Standards (Model Years 2008-2011)* – Vehicle model years through 2011 are covered under existing CAFE standards that will remain intact under the Obama Administration's national program.

- *National Program (Model Years 2012-2016)* – The light-duty vehicle fuel economy for model years between 2012 and 2016 are based on the May 7, 2010 Rule *"Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule" (EPA-HQ-OAR-2009-0472-11424:*http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0472-11424). Fuel economy improvements begin in 2012 until an average 250 gram/mile CO_2 standard is met in year 2016. This equates to an average fuel economy near 35 mpg.

- *National Program Phase 2 (Model Years 2017-2025)* – The light-duty vehicle fuel economy for model years between 2017 and 2025 are based on the October 15, 2012 Rule *"2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards"* (EPA-HQ-OAR-2010-0799 and No. NHTSA-2010-0131: http://www.gpo.gov/fdsys/pkg/FR-2012-10-15/pdf/2012-21972.pdf). The new fuel economy improvements apply to model years 2017 to 2025. The standards are projected to result in an average 163 gram/mile of CO_2 in model year 2025. This equates to an average fuel economy of 54.5 mpg.

- *Maryland Clean Car Program* – The Maryland Clean Car Program implements California's low emissions vehicle (LEV) standards to vehicles purchased in Maryland starting with model year 2011. By creating a consistent national fuel economy standard, the 2012-2016 National Program and the Phase 2 2017-2025 National Program, which closely resemble the California program, replaces Maryland's Clean Car Program for those model years. As a result, the GHG reduction credits for the Maryland Clean Car Program, apply only to 2011 model year vehicles and post-2011 electric vehicles that meet the California's zero emission program (ZEV) requirement.

- *National 2014-2018 Medium and Heavy Vehicle Standards* – The medium- and heavy- duty vehicle fuel economy for model years between 2014-2018 are based on the September 15, 2011 Rule "*Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles*". The rulemaking have adopted standards for three main regulatory categories: combination tractors, heavy-duty pickups and vans, and vocational vehicles. For combination tractors, the final standard will achieve 9 to 23 percent of reduction in carbon dioxide (CO_2) emissions and fuel consumption by the 2017 model year compared to the 2010 baseline. For heavy-duty pickup trucks and vans, separate standards have been established for gasoline and diesel trucks, which will achieve up to a 10 percent reduction for gasoline vehicles and a 15 percent reduction for diesel vehicles by the 2018 model year (12 and 17 percent respectively if accounting for air conditioning leakage). Lastly, for vocational vehicles, the final standards would achieve CO_2 emission reductions from 6 to 9 percent by the 2018 model year.

The above technology programs were not included in the 2020 BAU, as they are included as credits applied to BAU emissions. To remove the potential emission credits of both of these programs, the MOVES2014a default database was revised. Fuel economy assumptions within MOVES2014 are provided as vehicle energy consumption rates within the "EmissionRates" table as illustrated in Figure A.4.

Figure A.4 – MOVES Default "EmissionRate" Table

sourceBinID	polProcessID	opModeID	meanBaseRate	meanBaseRateCV	meanBaseRateIM	meanBaseRateIMCV	dataSourceId
1010142940000000000	9101	16	2990000	0.5	2990000	0.5	8597
1010142940000000000	9101	15	2093000	0.5	2093000	0.5	8597
1010142940000000000	9101	14	1495000	0.5	1495000	0.5	8597
1010142940000000000	9101	13	897001	0.5	897001	0.5	8597
1010142940000000000	9101	12	309133	0.5	309133	0.5	8597
1010142940000000000	9101	11	130195	0.5	130195	0.5	8597
1010142940000000000	9101	1	96819.4	0.5	96819.4	0.5	8597
1010142940000000000	9101	0	122412	0.5	122412	0.5	8597
1010142930000000000	9101	40	4450150	0.5	4450150	0.5	8597
1010142930000000000	9101	39	3641030	0.5	3641030	0.5	8597
1010142930000000000	9101	38	2831910	0.5	2831910	0.5	8597
1010142930000000000	9101	37	2022800	0.5	2022800	0.5	8597
1010142930000000000	9101	35	1213680	0.5	1213680	0.5	8597
1010142930000000000	9101	33	590005	0.5	590005	0.5	8597
1010142930000000000	9101	30	5004750	0.5	5004750	0.5	8597
1010142930000000000	9101	29	4094790	0.5	4094790	0.5	8597
1010142930000000000	9101	28	3184840	0.5	3184840	0.5	8597
1010142930000000000	9101	27	2274890	0.5	2274890	0.5	8597
1010142930000000000	9101	25	1592420	0.5	1592420	0.5	8597
1010142930000000000	9101	24	1137440	0.5	1137440	0.5	8597
1010142930000000000	9101	23	959934	0.5	959934	0.5	8597
1010142930000000000	9101	22	365300	0.5	365300	0.5	8597
1010142930000000000	9101	21	173057	0.5	173057	0.5	8597
1010142930000000000	9101	16	2990000	0.5	2990000	0.5	8597
1010142930000000000	9101	15	2093000	0.5	2093000	0.5	8597

To remove the benefits of the 2008-2011 CAFE standards, the 2012-2025 National Programs for light duty vehicle, and the 2014-2018 National Program for medium- and heavy- duty vehicle, the database was revised so that all energy rates beyond 2007 were the same for each vehicle type, model year and fuel type. The table was updated per the following steps:

1. Open the "EmissionRate" table in the latest MOVES2014 default database (named: movesdb20141021). The fields to be modified include: *meanBaseRate* & *meanBaseRateIM* (values in both fields are the same)
2. Select records in the table that are related to energy consumption. This includes records with the polProcessID = 9101, 9102, 9190 and 9191.
3. Use the sourceBinID field to determine how each record correlates to vehicle type, model year and fuel type.
4. Modify meanBaseRate & meanBaseRateIM fields to be same for all model years beyond 2007 for the applicable vehicle type, model year and fuel type.

EMISSION RESULTS

The 2006 and 2020 BAU scenarios emission results for the Maryland statewide GHG inventories are provided in Table A.4 for 2006 Baseline, A.5 for the 2020 BAU, and A-6 for the 2020 Adjusted-BAU. Within each table, emissions are also provided by fuel type and vehicle type.

Table A.4 – 2006 Annual On-Road GHG Emissions (mmt)					
	VMT (Millions)	CO_2	CH_4	N_2O	CO_2e
TOTAL	**56,618**	**30.259**	**0.0013**	**0.0014**	**30.72**
By Fuel Type					
Gasoline	51,590	22.986	0.00125	0.00141	23.44
Diesel	4,914	7.217	0.00001	0.00001	7.22
CNG	3.7	0.005	0.00004	0.00000	0.01
E-85	110	0.051	0.00001	0.00000	0.05
By MOVES Vehicle Type					
Motorcycle	291	0.109	0.00001	0.00000	0.11
Passenger Car	27,779	10.474	0.00048	0.00055	10.65
Passenger Truck	17,820	9.238	0.0052	0.00061	9.43
Light Commercial Truck	5,933	3.074	0.00020	0.00022	3.14
Intercity Bus	72	0.125	0.00000	0.00000	0.12
Transit Bus	36	0.047	0.00004	0.00000	0.05
School Bus	86	0.083	0.00000	0.00000	0.08
Refuse Truck	67	0.119	0.00000	0.00000	0.12
Single Unit Short-haul Truck	1,515	1.559	0.00004	0.00004	1.57
Single Unit Long-haul Truck	209	0.201	0.00000	0.00000	0.20
Motor Home	41	0.044	0.00000	0.00000	0.04
Combination Short-haul Truck	1,320	2.383	0.00000	0.00000	2.38
Combination Long-haul Truck	1,449	2.802	0.00001	0.00000	2.80

Table A.5 – 2020 BAU Annual On-Road GHG Emissions (mmt)					
	VMT (Millions)	CO_2	CH_4	N_2O	CO_2e
TOTAL	**70,844**	**39.928**	**0.0013**	**0.0006**	**40.13**
By Fuel Type					
Gasoline	63,742	30.182	0.00056	0.00054	30.36
Diesel	6,536	9.451	0.00068	0.00002	9.47
CNG	9	0.011	0.00003	0.00000	0.01
E-85	557	0.284	0.00001	0.00000	0.29
By MOVES Vehicle Type					
Motorcycle	366	0.139	0.00001	0.00000	0.14
Passenger Car	33,734	13.296	0.00027	0.00025	13.38
Passenger Truck	23,118	12.907	0.00026	0.00020	12.97
Light Commercial Truck	7,609	4.253	0.00011	0.00007	4.28
Intercity Bus	28	0.048	0.00000	0.00000	0.05
Transit Bus	60	0.080	0.00004	0.00000	0.08
School Bus	150	0.147	0.00001	0.00000	0.15
Refuse Truck	22	0.040	0.00000	0.00000	0.04
Single Unit Short-haul Truck	1,989	2.171	0.00012	0.00002	2.18
Single Unit Long-haul Truck	279	0.288	0.00002	0.00000	0.29
Motor Home	12	0.013	0.00000	0.00000	0.01
Combination Short-haul Truck	1,536	2.803	0.00009	0.00000	2.81
Combination Long-haul Truck	1,944	3.743	0.00035	0.00000	3.75

Table A.6 – 2020 Adjusted-BAU Annual On-Road GHG Emissions (mmt)					
	VMT (Millions)	CO_2	CH_4	N_2O	CO_2e
TOTAL	**65,442**	**36.272**	**0.0012**	**0.0005**	**36.46**
By Fuel Type					
Gasoline	58,882	27.418	0.00052	0.00045	27.58
Diesel	6,038	8.586	0.00063	0.00002	8.60
CNG	8	0.010	0.00003	0.00000	0.01
E-85	515	0.258	0.00001	0.00000	0.26
By MOVES Vehicle Type					
Motorcycle	336	0.128	0.0000	0.0000	0.13
Passenger Car	31,177	12.069	0.0003	0.0002	12.15
Passenger Truck	21,349	11.737	0.0003	0.0002	11.80
Light Commercial Truck	7,025	3.865	0.0001	0.0001	3.89
Intercity Bus	26	0.045	0.0000	0.0000	0.04
Transit Bus	56	0.074	0.0000	0.0000	0.07
School Bus	141	0.136	0.0000	0.0000	0.14
Refuse Truck	22	0.039	0.0000	0.0000	0.04
Single Unit Short-haul Truck	1,832	1.952	0.0001	0.0000	1.96
Single Unit Long-haul Truck	257	0.258	0.0000	0.0000	0.26
Motor Home	12	0.013	0.0000	0.0000	0.01
Combination Short-haul Truck	1,417	2.551	0.0001	0.0000	2.55
Combination Long-haul Truck	1,793	3.405	0.0003	0.0000	3.41

APPENDIX B:

2015 – 2020 CTP SUMMARY

B. FINAL 2015 – 2020 MDOT CONSOLIDATED TRANSPORTATION PROGRAM

Greenhouse Gas Reduction Projects and Program Summary

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
On-Road Technology			$1,333,456	$1,000,740		$332,716	E.2.A
SHA	MD 175, Annapolis Road	Constructed intersection capacity improvements from west of MD 713 (Rockenbach Road/Ridge Road) to east of Disney Road/26th Street. (BRAC Related)	$14,617	$1,502	$13,115	$-	E.2.A
SHA	MD 175, Annapolis Road	Construct intersection capacity improvements at Mapes Road/Charter Oaks Boulevard and Reece Road. (BRAC intersection improvement) This project includes construction of a new security fence and tree buffer along Fort Meade's property.	$28,256	$26,278	$1,978	$-	E.2.A
SHA	MD 175, Annapolis Road	Widen MD 175 from Disney Road to Reece Road, from the existing two lane roadway to a six lane roadway. Bicycle and pedestrian facilities will be provided.	$46,667	$46,667	$-	$-	E.2.A & H2
SHA	MD 175/MD 295 Interchange Reconstruction	Reconstructing the existing interchange to replace the loop ramps with signalized left turns at MD 175.	$75,000	$75,000	$-	$-	E.2.A
SHA	MD 295, Baltimore Washington Parkway	Study to widen MD 295 from 4 to 6 lanes from MD 100 to I-195 including an interchange at Hanover Road and improvements to Hanover Road from the CSX railroad tracks in Howard County to MD 170 (3.27 miles).	$2,554	$-	$2,554	$-	E.2.A
SHA	MD 175, Annapolis Road	This study will identify traffic flow improvements on MD 175 from MD 295 to MD 170 including the MD 175/MD 295 interchange (5.2 miles). Bicycles and pedestrian accommodations will be provided where appropriate. (BRAC Related)	$41,735	$35,159	$6,576	$-	E.2.A & H.2
SHA	MD 198, Laurel Fort Meade Road	Study to address capacity needs on MD 198 from MD 295 to MD 32 (2.66 miles). Bicycle and pedestrian access will be provided where appropriate. (BRAC Related)	$2,000	$1,999	$1	$-	E.2.A & H.2
SHA	MD 140, Reisterstown Road	Capacity and safety improvements to MD 140 at Painters Mill Road. Bicycle and pedestrian improvements will be provided where appropriate (0.75 miles).	$13,913	$3,363	$1,750	$8,800	E.2.A & H.2

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	MD 140, Reisterstown Road	Widening northbound MD 140 from Painters Mill Road to Garrison View Road to accommodate an additional third travel lane and a bicycle-compatible shoulder. Additional work includes adding new Americans with Disabilities Act-compliant sidewalks, storm drain system improvements and landscaping.	$5,000	$5,000	$-	$-	E.2.A & H.2
SHA	MD 140, Reisterstown Road	Capacity and safety improvements to MD 140, from Garrison View Road to north of Owings Mills Boulevard. Bicycle and pedestrian improvements will be provided where appropriate (0.75 miles).	$10,800	$6,029	$4,771	$-	E.2.A & H.2
SHA	MD 2/4, Solomons Island Road	Widening MD 2/MD 4 (Solomons Island Road) to provide a third through lane and auxiliary lanes in each direction from north of Stoakley Road to south of MD 765A (Main Street) in Prince Frederick.	$25,000	$25,000	$-	$-	E.2.A & H.2
SHA	MD 2/4, Solomons Island Road	Upgrade MD 2/4, from south of MD 765 to north of Stoakley Road, excluding the MD 231 intersection, to a 6 lane divided highway with auxiliary lanes (3.29 miles). Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$20,437	$15,708	$4,729	$-	E.2.A & H.2
SHA	MD 4, Solomons Island Road	Study to upgrade MD 4 between MD 2 and MD 235, including the Thomas Johnson Bridge and MD 235 intersection (2.91 miles). Sidewalks will be provided where appropriate for pedestrians. Shoulders, wide curb lanes and a parallel trail system will accommodate bicycles.	$20,035	$15,807	$4,228	$-	E.2.A & H.2
SHA	MD 404, Shore Highway	Upgrade existing MD 404 from west of MD 309 to Cemetery Road (Phase 1B) (1.09 miles). Shoulders will accommodate bicycles and pedestrians.	$30,073	$23,016	$7,057	$-	E.2.A & H.2
SHA	MD 404, Shore Highway	Upgrade existing MD 404 to a 4 lane divided highway with access controls from US 50 to MD 404 Business (11.83 miles). Shoulders will accommodate bicycles and pedestrians.	$26,876	$21,422	$5,454	$-	E.2.A & H.2

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	MD 140, Baltimore Boulevard	Study to consider capacity improvements along MD 140 between Market Street and Sullivan Road through Westminster (2.46 miles). The project will add a 16 foot wide outside lane for bicyclist and sidewalks for pedestrians.	$1,431	$-	$1,431	$-	E.2.A & H.2
SHA	MD 26, Liberty Road	Project to provide access, operational, safety and streetscape improvements along the MD 26 corridor between the Liberty Reservoir and MD 32 (2.55 miles). Bicycle and pedestrian facilities will be provided.	$1,651	$-	$1,651	$-	E.2.A & H.2
SHA	MD 272, Mauldin Ave	Replace Bridge 7036 over Amtrak. Shoulders and sidewalks will accommodate bicycles and pedestrians.	$20,940	$18,102	$2,838	$-	E.2.A & H.2
SHA	US 301, South Corridor Transportation Study	Multi-modal corridor study to consider highway/ transit improvements from the Potomac River to the US 301/US 50 interchange in Bowie (45.5 miles). Includes preparing appropriate environmental approvals for recommended alternatives. Bicycle and pedestrian accommodations will be included.	$71,419	$15,661	$55,758	$-	E.2.A & H.2
SHA	US 301, Waldorf Area Project	Examine alternatives to upgrade US 301 through Waldorf including grade separated interchanges at US 301 at MD 5 and US 301 at MD 228.	$14,636	$4,740	$9,896	$-	E.2.A & H.2
SHA	US 15, Catoctin Mountain Highway	Construct a grade-separated interchange at Monocacy Boulevard including a park-and-ride lot. This project will include appropriate bicycle and pedestrian facilities. (BRAC Related)	$70,839	$53,700	$17,139	$-	E.2.A & H.2
SHA	I-270, Eisenhower Highway, and US 15, Frederick Freeway	Multimodal corridor study to consider highway and transit improvements in the I-270/US 15 corridor in Montgomery and Frederick counties from Shady Grove Metro Station to north of Biggs Ford Road (27.90 miles).	$18,536	$-	$18,536	$-	E.2.A
SHA	MD 85, Buckeystown Pike	Upgrade MD 85 to a multi-lane divided highway from south of English Muffin Way to north of Grove Road (2.40 miles). The project will include six-foot bicycle lanes.	$20,911	$15,785	$5,126	$-	E.2.A & H.2

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SHA	MD 180/MD 351, Jefferson Pike/ Ballenger Creek Pike	Study to improve capacity and operations along MD 180 and MD 351 from Greenfield Drive to Corporate Drive while supporting existing and planned development. This project will include appropriate bicycle and pedestrian facilities.	$2,771	$507	$2,264	$-	E.2.A & H.2
SHA	MD 7, Philadelphia Road	Replaced the MD 7 (Philadelphia Road) bridge over James Run. Shoulders will accommodate bicyclists.	$4,079	$2,973	$1,106	$-	E.2.A & H.2
SHA	MD 22, Aberdeen Thruway	Intersection improvements at Old Post Road. (BRAC Intersection Improvements)	$8,875	$7,329	$1,546	$-	E.2.A
SHA	MD 22, Aberdeen Thruway	Intersection improvements at Beards Hill Road. (BRAC Intersection Improvements)	$15,987	$12,116	$3,871	$-	E.2.A
SHA	MD 22, Aberdeen Thruway	Intersection improvements at MD 462 (Paradise Road). (BRAC Intersection Improvements)	$21,196	$14,521	$6,675	$-	E.2.A
SHA	US 40, Pulaski Highway*	Constructed intersection improvements on US 40 at MD 7/MD 159 in Aberdeen (Phase 1). (BRAC Intersection Improvements)	$4,091	$728	$3,363	$-	E.2.A
SHA	US 40. Pulaski Highway	Construct intersection improvements on US 40 at the MD 7/MD 159 (Phase 2) to support the Base Realignment and Closure (BRAC) initiative.	$20,500	$19,554	$946	$-	E.2.A
SHA	US 1, Belair Road	Study to reconstruct US 1 to a multi-lane highway from MD 152 to the Hickory Bypass (5.50 miles). Sidewalks will be included where appropriate and shoulders will accommodate bicycles.	$2,556	$-	$2,556	$-	E.2.A & H.2
SHA	MD 32, Patuxent Freeway	Construct access management improvements by relocating private driveways from MD 32 to the local road system, specifically Wellworth Way.	$3,084	$750	$2,334	$-	E.2.A
SHA	US 29, Columbia Pike	Construct access improvements by relocating direct access at Gales Lane and Old Columbia Road from US 29 to the local road system (Phase 1A).	$8,227	$5,534	$2,693	$-	E.2.A
SHA	US 29, Columbia Pike	Widen the northbound section of US 29 from Seneca Drive to MD 175 (Phase 1B) from 2 to 3 lanes (2.8 miles).	$35,202	$28,057	$7,145	$-	E.2.A

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SHA	MD 32, Patuxent Freeway	Study to upgrade existing MD 32 from MD 108 to I-70 to address safety concerns (9.06 miles). Shoulders will accommodate bicycles.	$23,489	$17,330	$6,159	$-	E.2.A
SHA	US 29, Columbia Pike	Widen the northbound section of US 29 from the Middle Patuxent River to Seneca Drive (Phase 2) from 2 to 3 lanes (1.7 miles).	$3,000	$2,892	$108	$-	E.2.A
SHA	US 1, Washington Boulevard	Study to identify potential improvements along the US 1 corridor from the Prince George's County Line to the Baltimore County Line, including potential interchange improvements at MD 175 (11.0 miles).	$1,022	$-	$1,022	$-	E.2.A
SHA	MD 97, Georgia Avenue	Construct interchange improvements at Randolph Road. Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$73,831	$45,476	$28,355	$-	E.2.A & H.2
SHA	MD 97, Georgia Avenue	Construct a two-lane highway from south of Brookeville, near Gold Mine Road, to north of Brookeville. Shoulders will accommodate bicycles.	$36,825	$34,366	$2,459	$-	E.2.A & H.2
SHA	MD 185, Connecticut Avenue	Constructed intersection improvements on MD 185 at Jones Bridge Road (Phases 1 and 2). Bicycle and pedestrian facilities were provided where appropriate. (BRAC Intersection Improvements)	$5,030	$494	$4,536	$-	E.2.A & H.2
SHA	MD 185, Connecticut Avenue	Construct intersection improvements on MD 185 at Jones Bridge Road (Phase 3). Bicycle and pedestrian facilities will be provided where appropriate. (BRAC Intersection Improvements)	$14,337	$13,717	$620	$-	E.2.A & H.2
SHA	MD 187, Old Georgetown Road	Construct intersection improvements at MD 187 at Oakmont Avenue/West Cedar Lane. (BRAC Intersection Improvements)	$4,420	$4,044	$376	$-	E.2.A & H.2
SHA	MD 355, Rockville Pike	Construct intersection improvements on MD 355 at Cedar Lane (Phase 1 and 2). Bicycle and pedestrian facilities will be provided where appropriate. (BRAC Intersection Improvements)	$15,981	$11,916	$4,065	$-	E.2.A & H.2

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SHA	MD 355, Rockville Pike	Construct intersection improvements including upgrades to pedestrian/ bicyclist facilities, resurfacing, and geometric improvements from Woodmont Avenue to South Wood Road/South Drive. (BRAC Intersection Improvements)	$4,696	$4,696	$-	$-	E.2.A & H.2
SHA	US 29, Columbia Pike	Construct an interchange at Musgrove and Fairland roads.	$9,079	$6,669	$2,410	$-	E.2.A
SHA	US 29, Columbia Pike	Construct interchanges at Stewart Lane, Tech Road, Greencastle Road, and Blackburn Road.	$7,269	$-	$7,269	$-	E.2.A
SHA	MD 28 (Norbeck Road)/MD 198 (Spencerville Road)	Study of safety, capacity, and operational improvements in the MD 28/MD 198 corridor in Montgomery and Prince George's Counties (10.50 miles). Sidewalks will be included where appropriate. Wide curb lanes to accommodate bicycles will be included where a	$7,032	$3,000	$4,032	$-	E.2.A & H.2
SHA	MD 97, Georgia Avenue	Construct interchange improvements at MD 28. Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$2,827	$-	$2,827	$-	E.2.A & H.2
SHA	MD 97, Georgia Avenue	Bus rapid transit (BRT) study from Wheaton Metro Station to Olney. This study will evaluate roadway improvements to implement Montgomery County's BRT system on MD 97 from Wheaton Metro Station to Olney. Sidewalks and curb lanes will accommodate bicycles.	$5,000	$3,992	$1,008	$-	E.2.A & H.2
SHA	MD 117, Clopper Road	Construct intersection capacity improvements from west of Game Preserve Road to I-270 (1.73 miles). Sidewalks will be included where appropriate, including a shared-use path on the south side. Wide curb lanes will accommodate bicycles.	$2,933	$-	$2,933	$-	E.2.A & H.2
SHA	MD 124, Woodfield Road	Reconstruct MD 124 from Midcounty Highway to south of Airpark Road and north of Fieldcrest Road to Warfield Road (2.3 miles). Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$10,821	$7,893	$2,928	$-	E.2.A & H.2

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SHA	MD 355, Rockville Pike	Construct a grade-separated crossing over CSX railroad and interchange improvements at Parklawn Drive. Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$10,860	$6,600	$4,260	$-	E.2.A & H.2
SHA	I-95/Virginia Manor Road (Konterra Drive) Interchange	Constructed a new interchange with collector-distributor roads at I-95 and Virginia Manor Road (Konterra Drive) (2.0 miles). Bicycle and pedestrian access were provided on Virginia Manor Road (Konterra Drive).	$64,427	$4,957	$59,470	$-	E.2.A & H.2
SHA	I-95/I-495, Capital Beltway	Phase 2 Access improvements from MD 5 (Branch Avenue) and I-95/I-495 to the Branch Avenue Metro Station including improvements to the Access Road, pedestrian bridge, and the County Roads. Pedestrian/bicycle facilities are included.	$47,258	$35,948	$11,310	$-	E.2.A & H.2
SHA	MD 4, Pennsylvania Avenue	Construct a new interchange at MD 4 and Suitland Parkway. Bicycles and pedestrians will be accommodated where appropriate. (BRAC Related)	$159,160	$146,488	$12,672	$-	E.2.A & H.2
SHA	MD 5, Branch Avenue	Construct a new interchange at MD 5, MD 373 and Brandywine Road Relocated. This project also includes a park and ride lot. Bicycle and pedestrian access will be included where appropriate.	$81,124	$74,831	$6,293	$-	E.2.A & H.2
SHA	MD 210, Indian Head Highway	Construct a new interchange at MD 210 and Kerby Hill Road/Livingston Road. Bicycles and pedestrians will be accommodated where appropriate.	$109,993	$106,232	$3,761	$-	E.2.A & H.2
SHA	MD 337, Allentown Road	Construct intersection improvements at MD 337 (Allentown Road) at Suitland Road and I-95/I-495 NB off Ramp. Bicycle and pedestrian access will be provided where appropriate.	$7,285	$7,249	$36	$-	E.2.A & H.2

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SHA	I-95/I-495 Greenbelt Metro Interchange	Upgrading the partial interchange to a full interchange on I-95/495 at the Greenbelt Metro Station to support future growth. The new full interchange will provide an off-ramp from northbound I-95/495 to the Greenbelt Metro Station and an on-ramp from the Greenbelt Metro Station to southbound I-95/495. This project also includes reconstructing the I-95/I-495 bridges at MD 193 and Rhode Island Avenue and other safety and operational improvements between US 1 and the Baltimore-Washington Parkway.	$185,000	$185,000	$-	$-	E.2.A
SHA	US 1 College Park Pedestrian, Bicycle, and Safety Improvements	Reconstructing US 1 to a four-lane divided highway with a raised median and enhanced bicycle and pedestrian accommodations from College Avenue to MD 193. This project is the first of three phases of a larger US 1 reconstruction project from College Avenue to I-95/I-495.	$30,000	$30,000	$-	$-	E.2.A & H.2
SHA	I-95/I-495, Capital Beltway	Construct a full interchange along I-95/I-495 at the Greenbelt Metro Station.	$8,775	$6,515	$2,260	$-	E.2.A
SHA	MD 4, Pennsylvania Avenue	Upgrade existing MD 4 to a multi-lane freeway from MD 223 to I-95/I-495 (Capital Beltway) (3.08 miles). Bicycles and pedestrians will be accommodated where appropriate. (BRAC Related)	$1,615	$-	$1,615	$-	E.2.A & H.2
SHA	MD 5, Branch Avenue	Study to upgrade existing MD 5 to a multi-lane freeway from US 301 interchange at T.B. to north of I-95/I-495 Capital Beltway (10.5 miles). Bicycles and pedestrians will be accommodated where appropriate.	$13,984	$362	$13,622	$-	E.2.A & H.2
SHA	MD 210, Indian Head Highway	Multi-modal transportation study to relieve traffic congestion along MD 210 and improve intersections from I-95/I-495 to MD 228 (10.0 miles). Bicycles and pedestrians will be accommodated where appropriate.	$4,041	$-	$4,041	$-	E.2.A & H.2

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	MD 28 (Norbeck Road)/MD 198 (Spencerville Road)	Study of safety, capacity, and operational improvements in the MD 28/MD 198 corridor in Montgomery and Prince George's Counties (10.50 miles). Sidewalks will be included where appropriate. Wide curb lanes to accommodate bicycles will be included.	$7,032	$3,000	$4,032	$-	E.2.A & H.2
SHA	MD 197, Collington Road	Upgrade and widen existing MD 197 to a multi-lane divided highway from Kenhill Drive to MD 450 Relocated (1.4 miles). Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$12,580	$10,828	$1,752	$-	E.2.A & H.2
SHA	MD 201 Extended (Edmonston Road)/US 1 (Baltimore Ave.)	Study of capacity improvements on MD 201 and US 1 from I-95/I-495 (Capital Beltway) to north of Muirkirk Road (7.1 miles). Bicycle and pedestrian access will be considered as part of this project.	$6,839	$-	$6,839	$-	E.2.A & H.2
SHA	MD 202, Largo Road	Improve the MD 202 intersection at Brightseat Road. This improvement will enhance capacity, operations and safety of the intersection. Pedestrian and bicycle facilities will be included where appropriate.	$461	$-	$461	$-	E.2.A & H.2
SHA	MD 223, Piscataway Road	A study to establish a long term vision for the MD 223 Corridor, from Steed Road to MD 4. Bicycle and pedestrian facilities will be included where appropriate.	$1,671	$646	$1,025	$-	E.2.A & H.2
SHA	MD 450, Annapolis Road	Upgrade and widen existing MD 450 to a multi-lane divided highway from Stonybrook Drive to west of MD 3 (1.37 miles). Sidewalks will be included where appropriate. Wide curb lanes will accommodate bicycles.	$2,811	$-	$2,811	$-	E.2.A & H.2
SHA	US 1, Baltimore Avenue	Reconstruct US 1 from College Avenue to I-95 (Capital Beltway) (2.6 miles). Bicycle and pedestrian facilities will be included where appropriate.	$24,057	$20,947	$3,110	$-	E.2.A & H.2
SHA	MD 404, Shore Highway	Upgrade existing MD 404 from west of MD 309 to Cemetery Road (Phase 1B) (1.09 miles). Shoulders will accommodate bicycles and pedestrians.	$30,073	$23,016	$7,057	$-	E.2.A & H.2

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SHA	MD 404, Shore Highway	Upgrade existing MD 404 to a 4 lane divided highway with access controls from US 50 to MD 404 Business (11.83 miles). Shoulders will accommodate bicycles and pedestrians.	$26,876	$21,422	$5,454	$-	E.2.A & H.2
SHA	US 50, Ocean Gateway	Widen existing US 50 from US 301 at Queenstown to MD 404 (13.8 miles) to 6 lanes, acquire access controls and replace at-grade intersections with interchanges. Shoulders and service roads will accommodate bicycles and pedestrians.	$20,282	$2,227	$18,055	$-	E.2.A & H.2
SHA	MD 404, Shore Highway*	Widening MD 404 from a two-lane road to a four-lane divided highway with a median and shoulders to accommodate bicycles and pedestrians. The entire 11.3-mile widening project is from US 50 to the Denton Bypass.	$160,000	$160,000	$-	$-	E.2.A & H.2
SHA	MD 822, University of Maryland Eastern Shore Access Road	Construct a roundabout at the MD 675 intersection and sidewalks along MD 675.	$4,556	$2,846	$1,710	$-	E.2.A & H.2
SHA	MD 5 Intersection Improvements	Constructing northbound and southbound MD 5 left-turn lanes at Abell Street/Moakley Street and associated MD 5 widening. This breakout project was recommended by MDOT's MD 5 Leonardtown Planning Study that examined MD 5 (Point Lookout Road) improvements between MD 243 (Newtowne Neck Road)/Maypole Road and MD 245	$10,100	$10,100	$-	$-	E.2.A
SHA	MD 4, Solomons Island Road	Study to upgrade MD 4 between MD 2 and MD 235, including the Thomas Johnson Bridge and MD 235 intersection (2.91 miles). Sidewalks will be provided where appropriate for pedestrians. Shoulders, wide curb lanes and a parallel trail system will accommodate bicycles.	$20,035	$15,807	$4,228	$-	E.2.A & H.2
SHA	MD 5, Point Lookout Road	Upgrade and widen MD 5 to provide shoulders from south of Camp Brown Road to the Ranger Station (2.0 miles).	$3,229	$2,000	$1,229	$-	E.2.A & H.2

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SHA	MD 5, Point Lookout Road	Study to upgrade MD 5 between MD 243 and MD 245 (1.39 miles). Sidewalks will be included where appropriate for pedestrians. Wide curb lanes will accommodate bicycles. Shoulders will accommodate Amish buggies.	$5,325	$3,205	$2,120	$-	E.2.A & H.2
SHA	Virginia Manor Road (Konterra Drive), Old Gunpowder Road to Ritz Road	A Secretary's grant to Prince George's County for construction/ reconstruction of Relocated Virginia Manor Road between the InterCounty Connector and Old Gunpowder Road (approximately 3.2 miles).	$30,000	$12,980	$17,020	$-	E.2.A & H.2
SHA	BRAC Intersections near Bethesda Naval Center	Design and construct intersection improvements at key locations along access routes to Bethesda Naval Center. Bicycle and pedestrian facilities will be provided where appropriate.	$18,282	$6,592	$11,690	$-	E.2.A & H.2
SHA	BRAC Intersections near Fort Meade	Design and construct intersection improvements at key locations along access routes to Fort Meade. Bicycle and pedestrian facilities will be provided where appropriate.	$7,703	$29	$7,674	$-	E.2.A & H.2
SHA	BRAC Intersections near Aberdeen Proving Grounds	Design and construct intersection improvements at key locations along access routes to Aberdeen Proving Grounds. Bicycle and pedestrian facilities will be provided where appropriate.	$8,608	$410	$8,198	$-	E.2.A & H.2
SHA	BRAC Intersections near Andrews Air Force Base	Design and construct intersection improvements at key locations along access routes to Andrews Air Force Base. Bicycle and pedestrian facilities will be provided where appropriate.	$2,988	$1,000	$1,988	$-	E.2.A & H.2
SHA	MD 404, Shore Highway	Upgrade existing MD 404 to a 4 lane divided highway with access controls from US 50 to MD 404 Business (11.83 miles). Shoulders will accommodate bicycles and pedestrians.	$26,876	$21,422	$5,454	$-	E.2.A & H.2
SHA	US 113, Worcester Highway	Upgrade existing US 113 as a 4 lane divided highway, Massey Branch to Five Mile Branch (Phase 3) (4.6 miles). Shoulders will accommodate bicycles and pedestrians.	$63,068	$59,119	$3,949	$-	E.2.A & H.2

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SHA	US 113, Worcester Highway	Upgrading US 113 from two to four lanes with a median and shoulders wide enough to accommodate bicycles from Five Mile Branch Road to north of Public Landing Road, a distance of 4.6 miles. (Phase IV)	$65,000	$65,000	$-	$-	E.2.A & H.2
SHA	US 50, Ocean Gateway	Study to replace Bridge 23007 over the Sinepuxent Bay. The study will investigate options to eliminate/ upgrade the drawspan structure. Shoulders or wide curb lanes and sidewalks will accommodate bicycles and pedestrians.	$2,906	$-	$2,906	$-	E.2.A & H.2
SHA	US 113, Worcester Highway	Upgrade existing US 113 as a 4 lane divided highway, including access controls from north of MD 365, Public Landing Road, to Five Mile Branch (4.3 miles). Shoulders will accommodate bicycles and pedestrians.	$18,690	$14,203	$4,487	$-	E.2.A & H.2
SHA	MD 589, Racetrack Road	Study for potential improvements to the existing MD 589 corridor from US 50 to US 113 (4.7 miles). Bicycles and pedestrians will be accommodated by a shared-use path and sidewalks.	$1,417	$-	$1,417	$-	E.2.A & H.2
TSO	Virginia Manor Road Relocated, Old Gunpowder Road to the InterCounty Connector	A Secretary's grant to Prince George's County for construction/ reconstruction of Virginia Manor Road Relocated between the InterCounty Connector and Old GunPowder Road (Approximately 2.6 miles). Connections will be made to both the InterCounty Connector	$30,000	$16,851	$13,149	$-	E.2.A
MTA	CAD/AVL Systems	The Computer-Aided Dispatch and Automated Vehicle Location (CAD/AVL) project provides radio data channel expansion to improve the bus fleet's voice and data communication. It includes upgrades to the existing CAD/AVL system hardware and software as well a	$17,702	$1,458	$16,244	$-	E.2.A
SHA	I-695, Baltimore Beltway	Development of traffic management strategies to improve operations on the Baltimore Beltway by implementing interim improvements prior to the implementation of future widening projects.	$10,448	$10,326	$122	$-	E.2.A

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SHA	MD 355, Rockville Pike	Relocated utilities on MD 355 at Cedar Lane and Jones Bridge Road (Phases 1 and 2). Constructed dynamic lane controls on MD 355 at Cedar Lane. (BRAC Intersection Improvements)	$9,967	$3,194	$6,773	$-	E.2.A
SHA	Coordinated Highway Action Response Team (CHART)	Install advanced traffic management system (ATMS) and advanced traffic information system (ATIS) technologies on Interstate highways and arterials statewide. Technologies include cameras, traffic detectors, weather sensors, dynamic message signs, highway	$426,854	$113,800	$313,054	$-	E.2.A
SHA	Operational Improvement Studies	Develop traffic management strategies to improve operations on the Capital Beltway, I-95/495, I-270 and US 301.	$5,000	$4,388	$612	$-	E.2.A
Airport Initiatives			**$12,480**	**$12,480**		**$-**	E.2.B
MAA	Loading Bridge Replacement Program at BWI Marshall Airport	This project consists of the purchase and installation of 13 new passenger loading bridges. All new passenger loading bridges on common use gates are being equipped with PCAir, 400 HZ power units and bag slides.	$12,480	$12,077	$403	$-	E.2.B
Port Initiatives			**$38,857**	**$38,857**		**$-**	E.2.C
MPA	Port of Baltimore Export Expansion Project	MPA's TIGER project has three portions: provide rail access to Fairfield Marine Terminal; widening and straightening the navigation channel to Seagirt Marine Terminal; and filling the Fairfield Basin to develop seven acres of new land for cargo storage.	$38,857	$38,605	$252	$-	E.2.C
Freight and Freight Rail Programs			**$411,261**	**$392,611**		**$18,650**	E.2.D
SHA	MD 3, Robert Crain Highway	Study to upgrade MD 3 from US 50 to MD 32 to address safety and capacity concerns (8.89 miles). Bicycle and pedestrian access will be provided where appropriate.	$8,546	$-	$8,546	$-	E.2.D & H.2
SHA	I-695, Baltimore Beltway*	This project from US 40 to MD 144 will improve the mobility and safety on I-695 by widening the roadway to provide a fourth lane on the outer loop. This project will also accommodate for the ultimate configuration of this section of the beltway.	$117,430	$107,083	$10,347	$-	E.2.D

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SHA	I-695, Baltimore Beltway	This project will provide a continuous auxiliary lane on both the Inner and Outer Loops of I-695 between MD 41 (Perring Parkway) and MD 147 (Harford Road).	$32,376	$27,547	$4,829	$-	E.2.D
SHA	I-695, Baltimore Beltway	Upgrade existing I-695 to an 8 lane freeway from I-95 to MD 122 (Security Blvd.) (5.67 miles).	$8,095	$-	$8,095	$-	E.2.D
SHA	I-695, Baltimore Beltway	Upgrade existing I-695 to an 8 lane freeway from I-83 (JFX) to I-95 (east) including the MD 139 (Charles Street) Interchange (11.38 miles).	$5,641	$-	$5,641	$-	E.2.D
SHA	I-70, Baltimore National Pike	Widened I-70 from east of MD 355 to east of MD 144FA (Phase 2D) (1.57 miles). Replaced I-70 bridge over South Street and replaced the existing ramps to Monocacy Boulevard and South Street.	$46,795	$685	$46,110	$-	E.2.D
SHA	I-70, Baltimore National Pike	Upgrade existing I-70 from Mount Phillip Road to I-270 (Phase 4) (3.02 miles).	$29,468	$-	$29,468	$-	E.2.D
SHA	I-70, Baltimore National Pike	Study to construct interchange improvements at Meadow Road, MD 144FA and Old National Pike.	$252	$-	$252	$-	E.2.D
SHA	US 15, Frederick Freeway, and US 40, Frederick Freeway	Engineering study of US 15 and US 40 improvements between I-70 and MD 26.	$5,000	$5,000	$-	$-	E.2.D
SHA	US 40, Pulaski Highway	Constructed interchange improvements which addressed operational issues at MD 715. (BRAC Related)	$32,727	$861	$31,866	$-	E.2.D
SHA	I-70	Study to address current and future capacity needs on I-70 between MD 32 and US 29 (6.0 miles).	$858	$-	$858	$-	E.2.D
SHA	I-495, Capital Beltway	Upgrade the I-495 interchange at MD 185.	$3,000	$-	$-	$3,000	E.2.D
SHA	I-270/Watkins Mill Road Extended	Construct a new I-270 interchange at Watkins Mill Road. Bicycle and pedestrian improvements will be included as appropriate.	$159,419	$155,524	$3,895	$-	E.2.D & H.2
SHA	I-95/I-495, Capital Beltway	Study to widen I-495 and determine the feasibility of managed lanes from the American Legion Bridge to the Woodrow Wilson Bridge (42.2 miles).	$11,044	$-	$11,044	$-	E.2.D

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	I-270, Eisenhower Highway, and I-495, Capital Beltway	Planning study of I-270 improvements from I-495 to I-370, I-270 Spur improvements from I-495 to I-270, and I-495 improvements from the Potomac River to I-270 Spur.	$6,000	$6,000	$-	$-	E.2.D
SHA	MD 3, Robert Crain Highway	Study to upgrade MD 3 from US 50 to MD 32 to address safety and capacity concerns (8.89 miles). Bicycle and pedestrian access will be provided where appropriate.	$8,546	$-	$8,546	$-	E.2.D & H.2
SHA	US 50, John Hanson Highway	Feasibility study to investigate improving traffic capacity and operations for US 50 from the D.C. Line to I-95/I-495 (Capital Beltway).	$500	$500	$-	$-	E.2.D
SHA	US 301, Crain Highway	Study to upgrade and widen US 301, from north of Mount Oak Road to US 50 (2.0 miles), and MD 197 from US 301 to Mitchellville Road (0.3 miles). Sidewalks will be included where appropriate. Shoulders will accommodate bicycles.	$2,504	$-	$2,504	$-	E.2.D & H.2
SHA	US 301, Waldorf Area Project	Examine alternatives to upgrade US 301 through Waldorf including grade separated interchanges at US 301 at MD 5 and US 301 at MD 228.	$14,636	$4,740	$9,896	$-	E.2.D & H.2
SHA	US 301, Blue Star Memorial Highway	Construct a new interchange at MD 304. Shoulders on MD 304 will accommodate bicycles and pedestrians.	$42,852	$36,760	$6,092	$-	E.2.D & H.2
SHA	I-70, Eisenhower Memorial Highway	Evaluate potential improvements at the I-70/MD65 (Sharpsburg Pike) interchange.	$500	$500	$-	$-	E.2.D
TSO	Baltimore Rail Intermodal Facility	Project funding removed.	$-	$-	$-	$-	E.2.D
MDTA	Upgrade Truck Weigh Facilities at the Kennedy Highway, Bay Bridge and Hatem Bridge Locations	Upgrade the existing truck weigh facilities in accordance with increased truck traffic.	$14,417	$14,142	$275	$-	E.2.D

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	US 50 Severn River Bridge Reconfiguration	Reconfiguring traffic lanes along the US 50 bridge over the Severn River to address recurring congestion. The project includes adding an additional eastbound lane on the bridge by shifting the existing median barrier and restriping to provide seven through travel lanes.	$25,000	$25,000	$-	$-	E.2.D
SHA	US 50, John Hanson Highway	Study to investigate options for alleviating congestion on US 50 from MD 70 to MD 2 (north), including the Severn River/Pearl Harbor Memorial Bridge. (1.7 miles)	$2,563	$2,000	$563	$-	E.2.D
Public Transportation Initiatives			**$3,612,336**	**$2,043,412**		**$1,568,924**	F.1
MTA	Paul S. Sarbanes Transit Center	Construct a transit center at the Silver Spring Metrorail Station. It includes the construction of bus bays for Metrobus and Ride On, an intercity bus facility, a taxi queuing area, kiss and ride parking, and MARC platforms with connecting pedestrian bridges.	$122,211	$11,744	$110,467	$-	F.1
MTA	Bus Procurement	Annual purchase of buses to replace those that have been in service for 12 or more years. The MTA has more than 700 buses in its Active Fleet.	$352,378	$196,178	$156,200	$-	F.1
MTA	Bus Communications Systems Upgrade	Retrofit of MTA buses with a unified, integrated, state-of-the-art suite of on-board bus equipment as well as fixed-end systems at operations and security monitoring centers, allowing MTA to upgrade equipment and systems.	$37,683	$31,783	$5,900	$-	F.1
MTA	Mobility Vehicle Procurement	Procurement of paratransit services vehicles for service expansion and vehicle replacement.	$85,454	$40,020	$45,434	$-	F.1
MTA	Southern Maryland Commuter Bus Initiative	Construction of Southern Maryland Commuter Bus Park and Ride lots at Dunkirk and Waldorf.	$20,341	$10,230	$10,111	$-	F.1
MTA	Locally Operated Transit Systems Capital Procurement Projects (Local Jurisdictions)	Funding to rural and small urban jurisdictions for transit vehicles, equipment, and facilities. In addition, the MTA provides rideshare funds to Baltimore City, Anne Arundel, Baltimore, Calvert, Carroll, Frederick, Harford, Howard, Montgomery and Prince George's.	$274,559	$97,245	$177,314	$-	F.1

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
MTA	Assistance to Private Non-Profit Agencies for the Transportation of the Elderly and Persons with Disabilities	Federal funding is available to assist non-profit agencies with transportation for the elderly and persons with disabilities.	$52,940	$28,804	$24,136	$-	F.1
MTA	Montgomery County Local Bus Program	Funding for annual bus replacements.	$78,255	$28,239	$50,016	$-	F.1
MTA	Prince George's County Local Bus Program	Funding for bus replacements as well as capital improvements to bus facilities.	$10,327	$4,500	$5,827	$-	F.1
MTA	Takoma/Langley Park Transit Center (ARRA)	Construction of an off-street covered transit center at the intersection of MD 193 and MD 650 in the Takoma/ Langley Park community. Associated SHA improvements include roadway and intersection improvements, pedestrian safety measures, and new sidewalks.	$34,770	$15,610	$19,160	$-	F.1
MTA	Purple Line	The Purple Line is a 16-mile double track light rail line that will operate 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.	$1,804,443	$1,295,443	$180,500	$328,500	F.1
MTA	Purple Line: Montgomery County Funded Projects	Montgomery County has elected to fund a program of projects that will be implemented through and associated with the Purple Line. Projects include a new southern entrance to the Bethesda Red Line station, Capital Crescent Trail, and the Silver Spring Greenway.	$160,490	$160,490	$-	$-	F.1
MTA	Corridor Cities Transitway (CCT)	The Corridor Cities Transitway (CCT) is a 16-mile bus rapid transit line between Shady Grove Metrorail Station and the former COMSAT facility in Montgomery County.	$260,811	$92,502	$23,309	$145,000	F.1
MTA	Southern Maryland Mass Transportation Analysis	Planning activities to identify and protect an alignment for future development of high-capacity transit services in the US 301/MD 5 corridor from White Plains in Charles County to the Branch Avenue Metrorail Station in Prince George's County.	$6,236	$4,576	$1,660	$-	F.1

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	US 29, Columbia Pike	Study Bus Rapid Transit (BRT) from Downtown Columbia (Brokenland Parkway) to Burtonsville (Montgomery County Line).	$2,000	$2,000	$-	$-	F.1
SHA	US 29, Colesville Road	Bus rapid transit (BRT) study from Silver Spring Metro Station to Burtonsville. This study will evaluate roadway improvements to implement Montgomery County's BRT system on MD 384 and US 29 from Silver Spring Metro Station to Burtonsville.	$3,000	$3,000	$-	$-	F.1
SHA	MD 355, Frederick Road	Bus rapid transit (BRT) study from Bethesda Metro Station to Clarksburg. This study will evaluate roadway improvements to implement Montgomery County's BRT system on MD 355 from Bethesda Metro Station to Clarksburg.	$6,500	$6,500	$-	$-	F.1
SHA	MD 586, Veirs Mill Road	Bus rapid transit (BRT) study from Rockville Metro Station to Wheaton Metro Station. This study will evaluate roadway improvements to implement Montgomery County's BRT system on MD 586 from Rockville to Wheaton. Wide curb lanes to accommodate bicycles.	$6,000	$4,413	$1,587	$-	F.1
WMATA	Metro Debt Service	Maryland Department of Transportation's share of Metrorail debt service payments, which supplement the 103-mile rail system's construction.	$638,683	$-	$638,683	$-	F.1
WMATA	WMATA Capital Improvement Program	This program provides Maryland's share of the funding for the Washington Metropolitan Area Transit Authority's Capital Improvement Program (CIP).	$2,525,471	$1,206,337	$1,319,134	$-	F.1
WMATA	Project Development Program	The program funds Maryland's allocated share of the Washington Metropolitan Area Transit Authority's Project Development Program.	$19,536	$6,456	$13,080	$-	F.1
WMATA	Matching Funding for "Passenger Rail Investment and Improvement Act of 2008" - P.L. 110-432	The Passenger Rail Investment and Improvement Act of 2008 authorizes new federal funds to be appropriated over a ten year period for capital and preventative maintenance projects.	$500,000	$303,554	$196,446	$-	F.1

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
WMATA	Metro Matters Program	Metro Matters is a regionally funded program of capital improvements for the Washington Metropolitan Area Transit Authority. This program provides Maryland's share of the required contributions under the terms of the Metro Matters Funding Agreement.	$114,971	$62,712	$52,259	$-	F.1
Intercity Transportation Initiatives			**$391,908**	**$305,027**		**$86,881**	F.2
MTA	MARC Improvements on Camden, Brunswick, and Penn Lines	Ongoing improvement program of the MARC Camden, Brunswick, and Penn lines to ensure safety and quality of service. Program is implemented through CSX and Amtrak construction agreements. CSX efforts include projects such as interlocking replacements.	$252,479	$117,720	$134,759	$-	F.2
MTA	MARC Coaches - Overhauls and Replacement	Minor overhaul of 63 MARC III coaches, purchase of 54 MARC IV multi-level coaches, and mid-life overhaul of 26 MARC IIA coaches.	$212,024	$114,133	$97,891	$-	F.2
MTA	MARC Locomotives - Overhauls and Replacements	Procure 8 new diesel MP-36 locomotives and repower 6 GP-39 diesel locomotives.	$67,781	$67,689	$92	$-	F.2
MTA	MARC Halethorpe Station Improvements	Phase I of the project provided an additional 428 surface parking spaces at the Halethorpe MARC Station. Phase II includes installation of high-level platforms, a pedestrian bridge, new shelters, lighting, landscaping, and full ADA access.	$36,620	$430	$36,190	$-	F.2
MTA	MARC West Baltimore Station Parking Expansion	Demolition in Phase I cleared the way for parking expansion. Phase II will more than double MARC commuter parking capacity from 316 to 638 spaces. In addition, project will reconnect divided communities by rebuilding the 400 block of North Payson Street,	$10,531	$2,585	$7,946	$-	F.2
MTA	MARC BWI Rail Station Upgrades and Repairs	Structural improvements to the BWI Rail Station parking garages.	$4,463	$2,470	$1,993	$-	F.2
MTA	MARC Growth and Investment Program	The MARC Growth and Investment program includes design and engineering for facility renovation and improvements at the BWI Rail station. Project also includes the planning and design of new stations at Bayview and West Baltimore.	$9,163	$5,763	$3,400	$-	F.2

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
TSO	Amtrak's Susquehanna River Bridge	The purpose of this project is to complete preliminary engineering and National Environmental Policy Act (NEPA) documentation for the replacement of Amtrak's Susquehanna River Bridge between Harford and Cecil Counties. This project is funded by a FRA High Speed Intercity Rail grant.	$22,000	$19,028	$2,972	$-	F.2
TSO	Amtrak's Baltimore and Potomac (B&P) Tunnel	The purpose of this project is to complete preliminary engineering and National Environmental Policy Act (NEPA) documentation for the replacement of Amtrak's B&P Tunnel in Baltimore City. This project is funded by a FRA High Speed Intercity Passenger Rail grant.	$60,000	$58,409	$1,591	$-	F.2
Pricing Initiatives			**$287,047**	**$286,749**		**$298**	G
MDTA	I-95 John F. Kennedy Memorial Highway - Express Toll Lanes (ETL)	Constructed two Express Toll Lanes in each direction from I-895 North to north of MD 43 (8.0 miles) and improved the interchanges with I-895, I-695 and MD 43. (BRAC related.)	$1,097,719	$138,918	$958,801	$-	G
MDTA	MD 200, InterCounty Connector	Constructed a new east-west, multi-modal highway in Montgomery and Prince George's counties between I-270 and I-95/US 1.	$2,386,588	$64,399	$2,322,189	$-	G
MDTA	Authority-Wide - Replace Electronic Toll Collection and Operating System - 3rd Generation	The project will develop the framework and consequential contracts for the 3rd generation toll system. The project's contracts will replace the Electronic Toll Collection Next Generation (ETCNG) contracts currently deployed.	$82,903	$57,186	$1,847	$23,870	G
MDTA	US 40 Thomas J. Hatem Memorial Bridge - Convert to All Electronic Tolling (AET) and Rehabilitate Approaches	Remove the toll plaza, realign the roadway, rehabilitate pavement, install AET gantry and toll collection equipment, overlay and restripe pavement.	$1,430	$13	$1,417	$-	G
MDTA	MD 695 Francis Scott Key Bridge - Convert to All Electronic Tolling (AET)	Remove the toll plaza and tunnel, realign the roadway, install AET gantry and toll collection equipment, overlay and restripe pavement.	$1,707	$285	$1,422	$-	G

Mode	Project/ Program Name	Description	Project Total Cost (000's $)	6-Year Total Cost (000's $)	Amount Spent Through 2014 (000's $)	Amount Remaining post-2020 (000's $)	GGRP ID
SHA	MD 200, InterCounty Connector	Constructed a new east-west multimodal highway in Montgomery and Prince George's Counties between I-270, I-95, and US 1.	$19,422	$-	$19,422	$-	G
SHA	I-95/I-495, Capital Beltway	Study to widen I-495 and determine the feasibility of managed lanes from the American Legion Bridge to the Woodrow Wilson Bridge (42.2 miles).	$11,044	$-	$11,044	$-	G
TSO	Transportation Emission Reduction Program	The object of the program is the reduction of traffic congestion and/or mobile source emissions. This program will incorporate and expand proven strategies to reduce emissions in Maryland's air quality non-attainment areas.	$71,944	$26,246	$45,698	$-	G
Bike and Pedestrian Initiatives Note: Much of the funding total for this policy option are included as a component of other policy options, particularly roadway widening projects in E.2, and as a small cost component of otherwise non-GHG reduction projects such as bridge replacement/ rehabilitation projects, resurfacing projects, or streetscape projects. The projects and programs listed below are the primary bike and pedestrian components of the CTP.			**$160,131**	**$157,192**		**$2,939**	H.2
SHA	Transportation Enhancement Program	Projects that may be considered include: pedestrian or bicycle facilities and provision of safety and educational activities for pedestrians and bicyclists.	$44,150 (bike/pedestrian cost component of program)				H.2
SHA	Community Safety and Enhancement Program	This is the SHA element of the Statewide Neighborhood Conservation Program. Funds will be made available for highway transportation projects in designated revitalization areas.	$18,525 (bike/pedestrian cost component of program)				H.2
SHA	Sidewalk Program	This program will provide matching funds for the construction of sidewalks adjacent to State highways. Fifty percent of project costs will be required from local and municipal project sponsors, except in urban revitalization areas where projects are eligible for 100 percent funding.	$70,771	$25,600	$45,171	$-	H.2
TSO	Bikeways Network Program	Planning, design and construction of on-road and off-road bicycle facilities that fill priority missing links and create a safe, functional bicycle network.	$16,295	$15,369	$926	$-	H.2
Other programs include the Bicycle Retrofit Program and Recreational Trails Program.			$17,500				H.2

APPENDIX C:

POLICY OPTIONS AND TERMS ANALYSIS METHODOLOGY

C. TERM ANALYSIS ASSUMPTIONS AND RESULTS

The Transportation Emissions Reduction Measures (TERMs) analysis is broken down into Maryland Statewide and Regional TERMs and the mode-specific TERMs that realize benefits at the State's airports (Maryland Aviation Administration) and port facilities (Maryland Port Administration). The MAA and MPA reviewed MDOT's 2012 Implementation Plan and determined that no changes were required at this time. As a result, the assumptions related to the MAA and MPA TERMs analyses were not changed for this report.

MARYLAND STATEWIDE AND REGIONAL TERMS

TERMs identified in the 2015-2020 CTP and MPO TIP and CLRPs as well as continuation of current programs such as Commuter Connections, CHART, and Metropolitan Area Transportation Operations Coordination (MATOC) are assessed to determine estimates of GHG emission reductions through 2020.

The air quality benefits of a large share of these strategies have been analyzed through BMC's and MWCOG's air quality conformity process. For these strategies, reductions in VMT or fuel consumption as estimated by BMC, MWCOG, MDOT and MDE are adjusted to reflect 2020 conditions and converted to GHG emission savings. For the strategies where a prior analysis was not completed, observed data on the benefits of these strategies in other locations or research reports were utilized to determine potential 2020 benefits.

General assumptions for the calculation of Statewide and Regional TERMs are provided in Table C.1. Additional details regarding the calculation of specific TERMs can be obtained upon request. Table C.2 presents the complete 2020 Statewide and Regional TERM listing with source, description, and estimated GHG reductions.

Table C.1 – TERMs Assumptions / Data Sources

Factor	Assumption / Data Source
VMT Growth	Assumed adjusted-BAU growth rate of 1.1% (1990-2013 HPMS).
Emission Factors	Generated, using MOVES2014, by vehicle type and speed and operation phase (running, idle, extended idle).
Trip length, Average Vehicle Occupancy Rates, Average Operating Days per Calendar Year	MPO documentation. Where MPO documentation was not available tools such as MAQONE or the Commuter model were used.

Table C.2 – Transportation Emission Reduction Measures (TERMs) Project Listing					
Project Type	Agency	Source	Project	Description	2020 Reductions
Commute Alternatives Incentive	ARTMA/ Annapolis Transit	BRTB: Outlook 2035 & TIP Conformity Report	Fare-less Cab	When a company participates in Fare-less Cab, an employee who participates in the program can get a free cab ride home in the event of illness (personal or family) or unscheduled overtime.	0.00003
Commute Alternatives Incentive	Baltimore City	BRTB: Outlook 2035 & TIP Conformity Report	Live Near Your Work	Provide matching grant money to employees moving near their work.	0.0021
Commute Alternatives Incentive	Howard County	BRTB: Outlook 2035 & TIP Conformity Report	Park & Ride at MD 32/ MD 108	Funds for land acquisition for Park & Ride MD 32/MD 108 is included in this project. New roadway construction in Howard County	0.0002
Commute Alternatives Incentive	JHU Sustainability Initiative	BRTB: Outlook 2035 & TIP Conformity Report	Car Sharing Program - JHU Sustainability Initiative	Johns Hopkins University Sustainability Initiative has partnered with FlexCar to offer car-sharing service to JHU students and people in the surrounding neighborhoods.	0.0008
Commute Alternatives Incentive	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	I-95 at MD 543 Park-n-ride lot	128 new spaces	0.0001
Commute Alternatives Incentive	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	US 1 at MD 23 Park-n-Ride Lot	60 new spaces	0.00003
Commute Alternatives Incentive	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC BWI Rail Station Parking Garage	1790 Spaces	0.0023
Commute Alternatives Incentive	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC Halethorpe Station Parking Expansion	Expand surface parking and investigate future parking at the Halethorpe MARC Station.	0.0001
Commute Alternatives Incentive	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC Odenton Parking Expansion	A 700-space parking lot, and a facility study for structured parking (garage or parking deck)	0.0002187
Bicycle and Pedestrian	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Various bike / pedestrian projects throughout the region.		0.00019
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Charles Street Improvements	Construct sidewalk	0.0001
Public Transit Amenities Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Public Transit Amenities Improvements	Public Transit Amenities	0.0012
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Local Bus Replacement	Purchase 4 new vehicles	0.0001
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 100 buses in Contract Year - 1	0.0016
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 125 buses in Contract Year - 2	0.0020

Project Type	Agency	Source	Project	Description	2020 Reductions
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 107 buses in Contract Year - 3: 94 -40 ft. Low-floor diesel buses; 3 - 30 ft. Low-floor diesel buses; 10- 40ft. Hybrid Electric Buses (included in a separate entry)	0.0017
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC New Bi-level Coach Purchase	Purchase and use 50 bi-level coaches	0.0144
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Hampden Shuttle	Neighborhood shuttle in Hampden, including connection to Woodberry Light Rail Station (Bus Route #98) and MTA bus routes #22 and #27	0.0001
Public Transit Improvement	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	State Worker Free Transit Program	Provide free service to state employees for MTA bus, light rail, some commuter buses, and Metro subway systems.	0.0053
Traffic Control	Baltimore City	BRTB: Outlook 2035 & TIP Conformity Report	Traffic Signal LED Upgrades	Traditional traffic signal heads are to be replace with LED signal heads.	0.0260
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Employer Outreach for Public Sector Agencies	Marketing and implementing employer based TDM programs	0.0076
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Expanded Employer Outreach for Private Sector Employers	Marketing and implementing employer based TDM programs	0.0009
Commute Alternatives Incentive	WMATA	MWCOG TERMs Analysis, 2014 CLRP	Expansion of Car Sharing Program	Funds incentives for1000 new car sharing customers. Car sharing customers typically increase their transit ridership and decrease driving. Started sponsorship in 2005.	0.0002
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Improve Pedestrian Facilities Near Rail Stations	Assumes improvements to sidewalks curb ramps, crosswalks, and lighting in order to improve pedestrian access to 11 MARC stations and 12 Metrorail stations in Montgomery County.	0.0010
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Construction of 1000 Additional Parking at WMATA Metrorail Stations	A total of 1000 parking spaces will be added at different Metrorail Stations	0.0009
Clean Technology	WMATA	MWCOG TERMs Analysis, 2014 CLRP	Purchase of 185 Buses to Accommodate Ridership Growth	WMATA will purchase 185 new CNG buses in the District of Columbia and deploy them on 36 crowded routes resulting in increased frequency. (assume 1/4 of benefit to Maryland)	0.0132
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Implement Neighborhood Circulator Buses	The circulator bus service would operate over an expanded period from 5:30 am to 10:00 am and from 3:00 pm to 8:00 pm on weekdays. (assume half of benefit in Maryland)	0.0021

Project Type	Agency	Source	Project	Description	2020 Reductions
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Voluntary Employer Parking Cash-Out Subsidy	A program that gives equal compensation "cash-out" to employees who choose not to use free parking provided by employers and use alternative modes of travel instead.	0.0116
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Transit Stores in Maryland	Establish 10 transit stores in MD.	0.0060
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	6 Kiosks in Maryland	Establish 6 Transportation Information Kiosks in Maryland similar to those being placed in Virginia and DC	0.0000
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	Parking Impact Fees	This measure would consist of a parking impact fee administered by local governments throughout the region.	0.0851
Public Transit Improvement	WMATA	MWCOG TERMs Analysis, 2014 CLRP	Bus Information Displays with Maps at Bus Stops	Provide more information at 2,000 Metrobus locations (assume 1/3 of benefit in Maryland).	0.0015
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Real Time Bus Schedule Information	Provide real time bus schedule information to the transit riders through internet and at bus shelter display units.	0.0009
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Free Bus-to-Rail/Rail-to-Bus Transfer (Similar to NYC Pricing Structure)	This program would institute a free bus to rail transfer similar to the reduced fare rail to bus transfer.	0.0036
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Free Bus Service Off-Peak (10:00 AM - 2:00 PM Mid-Day and Weekends)	Free bus service (10:00AM-2:00PM mi-day, weekends): Free service during the mid-day and all day on weekends.	0.0030
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Enhanced Commuter Services on Major Corridors in Maryland (HOV Facilities)	Bus service on corridors with HOV facilities and bus lanes such as US 50, I-270, and US 29.	0.0048
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Enhanced Commuter Services on Major Corridors (Reverse Commute)	Proposes bus service to Potomac Mills and Arundel Mills shopping centers from Metrorail stations. The service would benefit reverse commuters whose work place is in Prince William and Anne Arundel Counties.	0.0013
Public Transit Improvement		MWCOG TERMs Analysis, 2014 CLRP	Metrorail Feeder Bus Service	Improve Metrorail feeder bus service at two underutilized park and ride lots and implement a fare buy down program.	0.0003
Clean Technology		MWCOG TERMs Analysis, 2014 CLRP	Bose Automobile Anti-Air Pollutant and Energy Conservation System	The Bose Automobile Anti- Air Pollutant and Energy Conservation System is a mechanical, gas turbine operated system with no platinum catalysts involved as in catalytic converter systems.	0.0055
Clean Technology		MWCOG TERMs Analysis, 2014 CLRP	Truck Idling (Truck Stops and Auxiliary Power Units)	This is a voluntary program designed to install pollution-reduction technology on existing diesel vehicles and equipment.	0.0109

Project Type	Agency	Source	Project	Description	2020 Reductions
Clean Technology		MWCOG TERMs Analysis, 2014 CLRP	100 CNG Buses in place of Old Diesel Buses	The 100 oldest remaining buses in the fleet will be replaced in 2010 with CNG buses.	0.0006
Clean Technology		MWCOG TERMs Analysis, 2014 CLRP	100 Hybrid Buses in place of Old Diesel Buses	The 100 old diesel buses in the fleet will be replaced in 2010 with Hybrid Buses	0.0010
Commute Alternatives Incentive		MWCOG TERMs Analysis, 2014 CLRP	MD/DC Vanpool Incentive Program	This measure is a package of programs and incentives designed to increase the number of vanpools in the region. Expansion of existing Virginia program.	0.0036
Public Transit Improvement	WMATA		Glenmont Metro Parking Garage Expansion	Provides for the design and construction of 1200 additional garaged parking spaces at the Glenmont Metrorail Station on the west side of Georgia Ave. The project will be designed and constructed by WMAA.	0.0032
Clean Technology	MDOT	MWCOG 2014 CLRP CDR	Fleet Replacement	MDOT auto fleet, gas to hybrid, 250 vehicles	0.0013
Bike and pedestrian	Montgomery County	MWCOG 2014 CLRP CDR	Bicycle Facilities	Ongoing	0.00002
Bike and pedestrian	Region	MWCOG 2014 CLRP CDR	Bicycle Parking	Ongoing	0.00005
Bike and pedestrian	MDOT	MWCOG 2014 CLRP CDR	Bike Facilities at Park and Ride Lots	Ongoing	0.0001
Bike and pedestrian	MDOT	MWCOG 2014 CLRP CDR	Sidewalks at/near rail stations	Ongoing	0.00003
Bike and pedestrian	MDOT	MWCOG 2014 CLRP CDR	Neighborhood Conservation Program	Ongoing	0.0001
Public Transit Improvement	Montgomery County	MWCOG 2014 CLRP CDR	Various park and ride lot improvements	Ongoing	0.0006
Public Transit Improvement	MDOT	MWCOG 2010 CLRP CDR	Grosvenor Metro Station Parking	2004	0.0033
Public Transit Improvement	MDOT	MWCOG 2010 CLRP CDR	Bethesda Shuttle Bus Services	2004	0.00004
Public Transit Improvement	MDOT	MWCOG 2014 CLRP CDR	Bike Racks on Ride-On Buses	Ongoing	0.00004
Outreach/ Education	SHA	BRTB Outlook 2035 CDR, MWCOG 2009 CLRP	Clean Air Partners	A public/private consortium that carries out a public education campaign in the Baltimore and Washington D.C. regions, to encourage individuals to take actions to reduce air emissions and protect their health from air pollution.	0.0063
ITS	SHA	2014 for 2013 CHART Report	CHART	Statewide CHART program	0.1526
ITS	SHA	MDOT 2015 AR	Signal Systemization Total	Statewide signal system optimization	0.0045

Project Type	Agency	Source	Project	Description	2020 Reductions
ITS	SHA	Source from 2009 MDOT CAP Status Report	Metropolitan Area Transportation Operations Coordination (MATOC)*	The MATOC program coordinates and supports regional sharing of transportation systems' conditions and info management during regional incidents.	0.0665
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Guaranteed Ride Home	Statewide (includes all Commuter Connection program benefits)	0.0215
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Employer Outreach (Inc. for bicycles)	Statewide (includes all Commuter Connection program benefits)	0.1339
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Integrated Rideshare	Statewide (includes all Commuter Connection program benefits)	0.0067
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Commuter Operations and Ridesharing Center	Statewide (includes all Commuter Connection program benefits)	0.0493
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Telework Resource Center	Statewide (includes all Commuter Connection program benefits)	0.0207
Commute Alternatives Incentive	MDOT	MDOT 2015 AR	Mass Marketing	Statewide (includes all Commuter Connection program benefits)	0.0175
Public Transit Improvement	MTA	MDOT 2015 AR	MTA College Pass	Discounted monthly transit passes to university / college students.	0.0027
Commute Alternatives Incentive	MTA	MDOT 2015 AR	MTA Commuter Choice Maryland Pass		0.0245
Public Transit Improvement	MTA	MDOT 2015 AR	Transit Store in Baltimore		0.0069

MARYLAND AVIATION ADMINISTRATION

The *BWI, Thurgood Marshall Airport Greenhouse Gas Baseline Emissions Inventory* document, dated March 2008 was utilized in order to identify the key on-going GHG emission reduction activities conducted by MAA. The emission reduction strategies were categorized into four groups: aircraft, surface transportation; ground service equipment (GSE) / auxiliary power units (APUs), and electrical usage.

The 2006 CO_2 baseline contained in the 2008 emissions inventory document was utilized in combination with the FAA's Terminal Area Forecast, issued in December 2008, in order to determine forecast 2020 CO_2 emissions. This 2020 forecast was used as a benchmark from which to measure emissions reductions from the airport strategies. The following assumptions, organized by strategy group, were employed to calculate emissions benefits.

AIRCRAFT EMISSION REDUCTIONS

- Based on the 2020 forecast, annual 2020 CO_2 emissions from aircraft in 2020 are equal to 142,766 metric tons (MT) per year.
- Taxi/idle/delay accounts for 4 percent of total CO_2 emissions from aircraft operations, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- All measures result in 10 percent reduction in air taxi or aircraft turnaround idling/delay

SURFACE TRANSPORTATION

Alternative Fuels - MAA Vehicles

- Based on the 2020 forecast, annual 2020 CO_2 emissions from surface transportation are equal to 84,367 mt/yr.
- 28 percent of MAA vehicles use alternative fuels
- MAA vehicles accounts for 12 percent of total CO_2 emissions from surface transportation, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- 70 percent of MAA vehicles using alternative fuels are gasoline-powered, and 30 percent are diesel-powered.
- 30 CNG shuttle buses in use in place of traditional diesel buses, resulting in 20 percent reduction in emissions.
- Gasoline vehicles will use E85, resulting in a 15 percent CO_2 emissions reduction, based on *Alternative Fuels: E85 and Flex Fuel Vehicles. EPA420-F-06-047* (October, 2006).
- Emission benefits from diesel vehicles utilizing B20, were not quantified in this report. MAA reported experiencing several problems with the implementation of biodiesel due to the fact that much of the fleet utilizing B20 can sit idle for extended periods of time during which the biodiesel became fouled.

Buses & Vans Congestion Reduction

- Buses & vans account for 1 percent of total CO_2 emissions from surface transportation, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- 5 percent of CO_2 emissions reductions are attributable to reduced congestion

Vehicle Idling/Delay/VMT Reduction at Parking

- CO_2 emissions associated with vehicle parking account for 10 percent of total CO_2 emissions from surface transportation.
- A 30 percent reduction in parking time can be attributed to parking management measures, such as use of automated navigational signs or an increase in parking capacity, based on methodology from *Evaluating ITS Parking management Strategies: A Systems Approach* (May, 2000).

GROUND SERVICE EQUIPMENT (GSE) / AUXILIARY POWER UNITS (APUS)

All strategies under this group will result in a 10 percent reduction of GSE/APU usage.

ELECTRICAL USAGE

Total electrical consumption is reduced by 20 percent, including: a state initiative to reduce electrical consumption by 15 percent from 2007, by 2015, and purchasing 5 percent of electricity from renewable energy sources.

MARYLAND PORT ADMINISTRATION

The Port of Baltimore was recently awarded $3.5 million in Recovery Act funding to help clean the air in and around the Port. The funds will be used primarily for clean diesel technologies, but it is anticipated that anti-idling devices, vehicle replacements, and engine repowers will result in GHG emissions reductions.

MPA provided data regarding the current and replacement equipment including type, average age of current engines and replacement engines, average use and remaining life. CO_2 emission factors were calculated for each operating piece of equipment based on EPA's, NONROAD technical guidance document, EPA420-P-04-009, dated April 2004. It was estimated that the replacement equipment (vehicles and engines) would result in a 5percent improvement in fuel efficiency. The following set of equipment assumptions was utilized in order to quantify GHG emission reductions associated with the anticipated use of the Recovery Act funding:

- 15 truck engines (average model year 1990, average HP 150) will be replaced with MY 2004 engines.
- 10 truck engines (average model year 1992, average HP 150) will be replaced with MY 2004 engines.
- 5 truck engines (average model year 1996, average HP 150) will be replaced with MY 2007 engines.
- 65 truck engines (average model year 1996, average HP 150) will be replaced with MY 2007 engines, which will include auto engine start stop (AESS) technology preventing idling for longer than 10 minutes.
- 7 locomotives will be equipped with auto engine start stop (AESS) technology.
- 7 Forklifts, MY 1991-1997 will be repowered / replaced.
- Replace 1 MY 2000 rough terrain forklift
- Replace 1 MY 2000 crawler tractor
- Replace 5 MY 1994 and 3 MY 2001 terminal tractors
- Repower 3 MY 1992 terminal tractors

Maryland Department
of Transportation