

Maryland Climate Action Plan

Maryland Department of Transportation
Draft 2012 Implementation Plan



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Maryland Department of Transportation

report

Maryland Climate Action Plan - MDOT Draft 2012 Implementation Plan

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Executive Summary

In 2007 Governor Martin O'Malley signed an Executive Order establishing the Maryland Commission on Climate Change (the Commission). Sixteen state agency heads, six General Assembly members, local government officials, and representatives from the private sector and non-governmental organizations comprise the Commission. The Commission released a plan of action for addressing climate change in August 2008, and will report each year in November to the Governor and Legislature on progress in implementing the recommendations found in the Climate Action Plan (CAP) and in meeting the preliminary greenhouse gas (GHG) emission reduction goals.

On May 7, 2009, Governor Martin O'Malley signed into law the Maryland Greenhouse Gas Emissions Reduction Act of 2009 (Act) requiring Maryland to achieve a 25 percent reduction in 2006 GHG emissions by 2020. While the majority of GHG related emissions are created by power generation, the transportation sector produces approximately 32 percent of the state's GHG emissions. Achieving a significant reduction in GHG emissions from the transportation sector will be critical to supporting the requirements articulated in the Act.

The Act requires the Maryland Department of Environment (MDE) to develop a proposed Statewide GHG reduction plan by 2011, to solicit public comment on the proposed plan from interested stakeholders and the public, and to adopt a final plan by 2012. The Act also requires the State to demonstrate that the 25 percent reduction can be achieved in a way that has a positive impact on Maryland's economy, protects existing manufacturing jobs and creates significant new "green" jobs in Maryland.

By 2011 the Act requires MDE to:

- Develop a 2006 Statewide greenhouse gas emissions inventory;
- Develop a projected "business as usual" emissions inventory for 2020; and
- Develop and publish for public comment a proposed plan to achieve a 25 percent GHG emissions reduction by 2020.

The MDOT work program summarized in this document supports the ongoing effort of MDE to develop the proposed statewide GHG reduction plan. As part of the GHG reduction plan process, MDE developed agency-based GHG targets that are designed to support the overall State goal. Using key elements of the 2008 Climate Action Plan and the 2009 MDOT Implementation Status Report, MDE provided MDOT a GHG reduction target for 2020 of 6.2 mmt CO₂e in February, 2011. This document provides a summary of the MDOT work program that addresses the GHG reduction target and goals in the Act.

THE MDOT WORK PROGRAM – PAST & PRESENT

Through the Commission's work, MDOT was designated as the implementing agency for six Transportation and Land Use (TLU) mitigation and policy options, and is a primary supporting

agency on two others. The policy options (and subsequent work accomplished by MDOT) are primarily focused on reducing GHG emissions through a wide array of strategies that address infrastructure investment, travel demand management programs, transit investment, clean fuel programs, and new vehicle technology standards.

MDOT was also charged to work with the Maryland Department of Planning (MDP) on land use and location efficiency policies and programs, the Maryland Insurance Administration (MIA) to support the analysis of the Pay-as-You-Drive (PAYD) insurance in Maryland, and the Maryland Department of the Environment (MDE) to implement transportation technologies to reduce GHG emissions per mile. As part of the Phase III work program, MDP took over the responsibility for the TLU mitigation and policy option that addressed land use, and MIA took over the policy option addressing PAYD. The results of both the land use and PAYD initiatives will be presented by MIA and MDP in separate documents (they are referenced in this document in Section 3.5). Both of these policy options affect GHG emissions in the transportation sector, and as such, will be included in subsequent updates of this document.

Phase I

In January 2009, MDOT engaged in a multi-phase work plan to define specific programs, actions, and strategies to address the eight TLU mitigation and policy options. The goal of the Phase I work program focused on defining, evaluating, ranking and determining the feasibility of a series of transportation strategies and actions – consistent with the Commission’s Climate Action Plan – that will assist Maryland in achieving GHG reduction targets.

MDOT created seven broad Working Groups to address each of the TLU policy options, and a Coordinating Committee to oversee the process of identifying GHG reduction strategies. The Coordinating Committee membership was designed to ensure full representation of all MDOT modal agencies and other relevant State agencies. The Working Groups provided technical guidance and included local representation through the participation of the Baltimore Metropolitan Council (BMC), the Metropolitan Washington Council of Governments (MWCOCG), Montgomery County and the City of Baltimore.

In Phase I, 72 strategies were defined by the working groups and 57 were considered critical or important to reducing GHG emissions. Of the 57 strategies, 44 were capable of being implemented by 2020. A macro-level assessment of the strategies was completed as part of Phase II.

Phase II

Phase II began in July 2009 with the objective of quantifying the contribution the strategies defined during Phase I. Under the Phase II work program MDOT organized the strategies into six specific areas to account for potential GHG emission reductions. They included:

- **The proposed national vehicle standards program** to improve fuel economy and reduce greenhouse gases, which were formally proposed by USEPA and USDOT on September 15, 2009.

- **The Maryland Clean Car Program** signed into law by Governor Martin O'Malley in April 2007, which adopts California's more stringent vehicle emissions standards for cars sold in the state.
- **USEPA's proposed National Renewable Fuels Standards** program for 2010 and beyond, which requires new volume standards to be used for renewable transportation fuels.
- **Currently funded and planned transportation system investments 2006-2020**, which are defined in the Maryland 2009 - 2014 Consolidated Transportation Program (CTP), and in the Metropolitan Planning Organizations (MPOs) Transportation Improvement Programs (TIPs) and Long-Range Plans (LRPs) through 2020.
- **Currently funded and planned Transportation Emissions Reduction Measures (TERMs)**, which are defined in the 2009-2014 CTP and in the MPO TIPs and LRPs, including off-highway projects as defined by MAA and MPA.
- **Unfunded TLU strategies** defined by the Phase I Working Groups and Coordinating Committee.

Phase III

Phase III began in December 2010. Phase III provides an update of work completed in previous phases and provides MDE with data and information to support the development of the proposed Statewide GHG reduction plan. The purpose of the Phase III work program is to update the contribution of the transportation sector related strategies that support the Act and to provide the data and information to MDE for incorporation into the proposed 2011 plan submittal.

The major work elements of the Phase III process include:

- Revise the on-road mobile 2006 inventory and 2020 business-as-usual (BAU) forecast of statewide GHG emissions based on EPA's MOVES model.
- Update the GHG emission reduction benefits and costs of Maryland funded transportation plans and programs through 2020, existing and proposed TERMS, and new State and Federal fuel and vehicle technology programs and standards.
- Review and refine the definition, description, costs and GHG emissions benefits of the unfunded transportation GHG reduction strategies through 2020.
- Consult with policy option partner agencies (including MDP for TLU-2, MIA for TLU-6, and MDE for TLU-10) throughout development of the *2011 Implementation Status Report*.
- Address the 2009 GHG Reduction Act legislative requirements in preparation of the *2011 Implementation Status Report*.

RESULTS OF THE MDOT WORK PROGRAM

Phase III of the MDOT work program confirmed the status of the transportation sector related strategies along with updating the GHG emissions estimates associated with the strategies. Several key findings have been identified as part of the Phase III work program.

- MDOT has adopted programs and strategies that achieve **85 percent** or **5.30 mmt CO₂e** of the MDE assigned 2020 GHG emission reduction target.
- GHG beneficial projects adopted in the 2011-2016 CTP and MPO plans and programs total a **\$13.2 billion** capital investment through 2020 that represents **50 percent** of the current capital programs.
- Other transportation sector related GHG reduction strategies focusing on clean fuels and improved state and federal fuel economy standards will result in **6.42 mmt CO₂e** reductions in on-road mobile source emissions by 2020.
- In total, transportation sector GHG related emissions could be reduced by a total of **11.72 mmt CO₂e** in 2020, with a total transportation infrastructure capital investment \$13.2 billion through 2020.
- Using the 25 percent reduction from 2006 emissions as a benchmark to measure progress of the transportation sector, the **11.72 mmt CO₂e** reduction by 2020 achieves **68 percent** of the Act goal.
- If additional transportation funding becomes available, MDOT identified a set of strategies that could reduce GHG up to **3.14 mmt CO₂e** at a cost ranging from **\$2.9 - \$7.1 billion** (cost range is based on the potential level of implementation).
- Based on the 25 percent reduction from 2006 emissions, at the highest level of strategy implementation, including unfunded transportation sector strategies, the transportation sector could achieve a **14.86 mmt CO₂e** reduction by 2020, or **87 percent** of the Act goal.

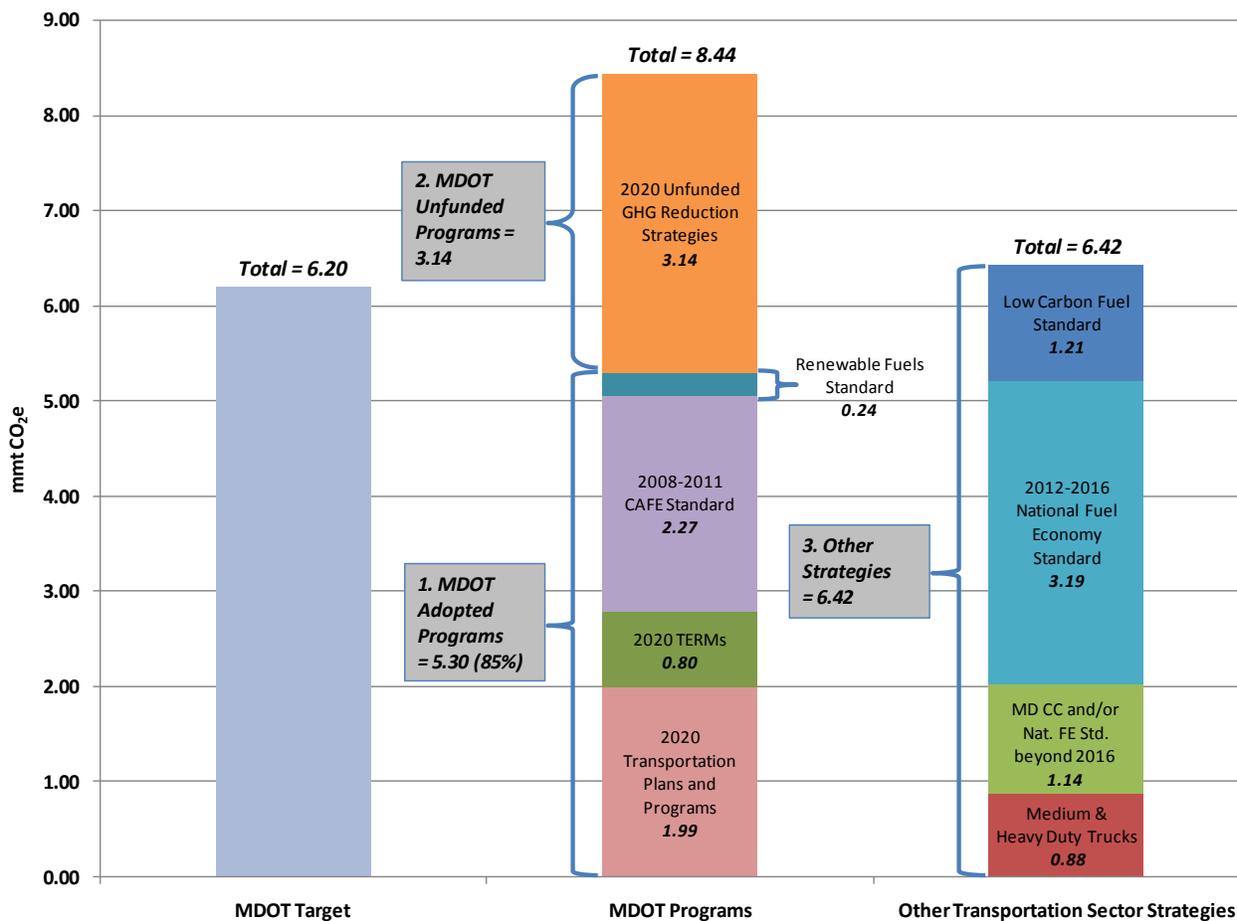
Figure ES.1 provides a summary of the GHG emissions for all programs analyzed as part of this effort. MDOT has identified and adopted programs and strategies that achieve 85 percent or 5.30 mmt CO₂e of the 6.2 mmt CO₂e 2020 target emission reduction target established by MDE. This includes all transportation infrastructure plans and programs currently defined in the adopted *MDOT 2011 - 2016 Consolidated Transportation Program (CTP)*, and all adopted metropolitan planning organization long range plans and programs. In total, this represents a \$13.2 billion capital investment in the transportation system statewide. Major projects include the MARC growth and investment plan, the MTA light rail "Red Line" in Baltimore, and the light rail "Purple Line" in the Washington D.C. suburbs.

Figure ES.1 also includes a summary of "unfunded" strategies that could reduce transportation related GHG emissions by another 3.14 mmt CO₂e by 2020. These strategies were identified during Phase I of this work program and could be implemented by 2020 if funding was available. Based on the final design of these strategies, the capital cost could range from \$2.9 billion to \$7.1 billion. Major projects types in the unfunded program include an expansion of public transit statewide, expanded statewide travel demand management programs, and a targeted congestion pricing program.

Taken together, MDOT has identified plans, programs and strategies that could reduce transportation related emissions by 8.44 mmt CO₂e by 2020. The capital cost to implement this package could range from \$16.1 billion to \$20.3 billion, with \$13.2 billion already fully committed.

MDOT has also accounted for other transportation sector related GHG reduction strategies (Figure ES.1) that focus on cleaner fuels and improved fuel economy standards. Implementing these state and federal programs will result in another 6.42 mmt CO₂e reduction by 2020 with little or no direct cost to Maryland.

Figure ES.1 MDOT Greenhouse Gas Emissions Summary

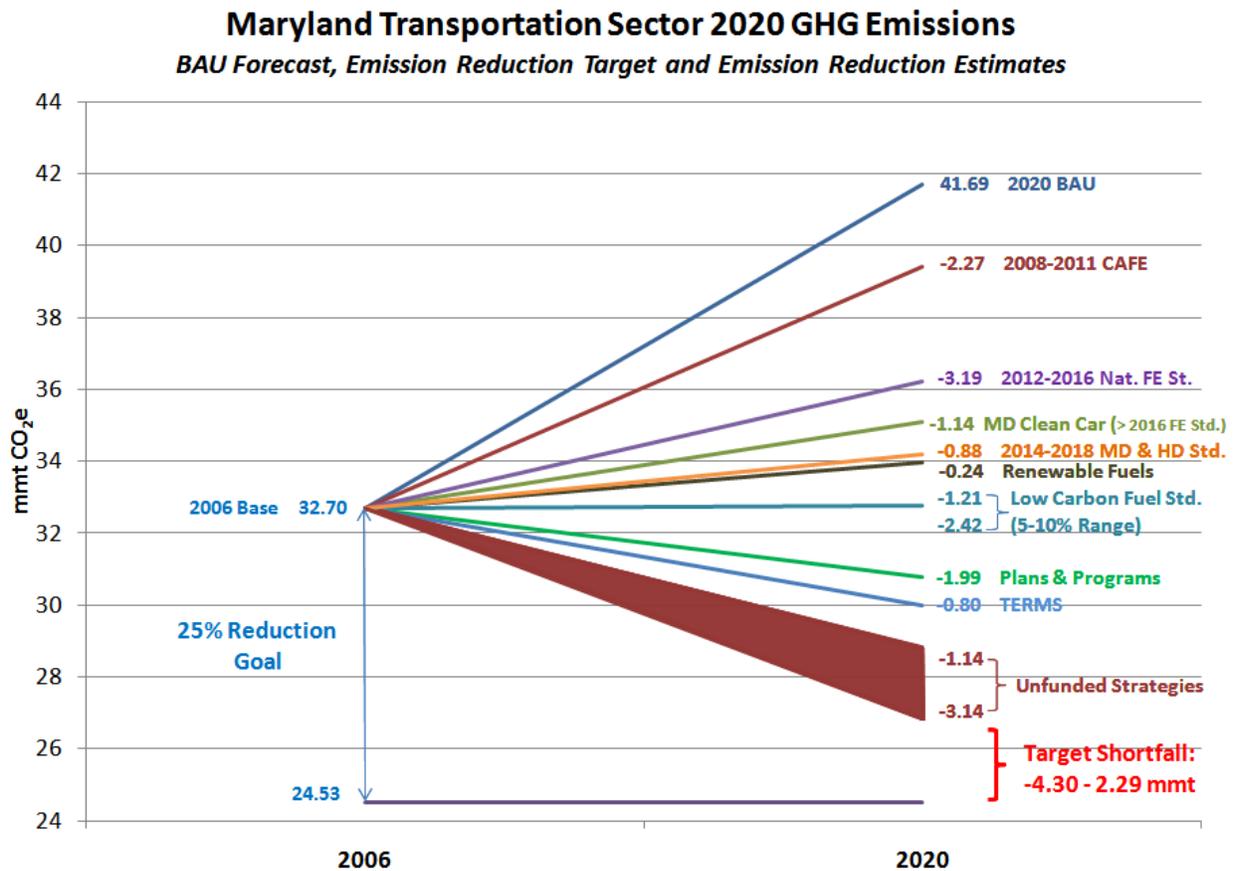


Based on the Phase III work program results, transportation sector GHG related emissions could be reduced by a total of 14.86 mmt CO₂e by 2020. This represents a significant reduction in GHG emissions statewide with an equally significant overall investment ranging from \$16.1 billion to \$20.3 billion.

Prior to receiving the MDE GHG target of 6.2 mmt CO₂e, MDOT used a benchmark for achieving a 25 percent reduction in 2006 emissions as a way to evaluate progress toward achieving the goal of the Act. Figure ES.2 illustrates the anticipated 2020 transportation sector

reductions within the framework of a statewide reduction goal of 25 percent below 2006 levels by 2020. To achieve a 25 percent GHG emissions reduction in 2006 by 2020 from the transportation sector, a 17.16 mmt CO₂e reduction in emissions is required. By implementing all strategies and programs included in Figure ES.2, 2020 transportation sector emission reductions could reach as much as 87 percent (14.86 mmt) of the 25 percent GHG reduction goal for 2020. The figure further illustrates a 2.29 to 4.30 mmt CO₂e target shortfall for the transportation sector.

Figure ES.2 Maryland 2020 Transportation GHG Emissions Forecast and Reductions



While these programs provide the State significant reductions in transportation related GHG emissions, MDOT and the modal administrations continue to actively pursue and implement energy conservation strategies into the daily operating activities of each agency. Included in this report are several samples of energy conservation strategies that have been implemented by MDOT and the modal administrations to gain greater energy independence, efficiency, and focus on the application of cutting edge “green” technology.

MDOT is committed to supporting and consulting with MDE throughout the process in developing the Statewide GHG Reduction Plan. MDOT has been mindful to focus on strategies that will achieve GHG reductions and will positively impact Maryland’s economy, and protect existing manufacturing jobs while creating new “green” job opportunities in Maryland. MDOT also affirms that the strategies included in this plan document will not negatively impact rural

communities and will continue to support Maryland's ability to attract, expand and retain aviation services.

1.0 The MDOT Climate Action Plan Implementation Process

1.1 BACKGROUND

In response to the threat and growing concern with climate change, the Maryland Commission on Climate Change (the Commission) was established in April 2007. The Commission includes 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. Each year in November, the Commission will report to the Governor and Legislature on progress in implementing the Climate Action Plan (CAP) and in meeting the preliminary GHG reduction goals set in it.

In May 2009, Governor Martin O'Malley signed The Maryland Greenhouse Gas Emissions Reduction Act of 2009. The Act establishes a requirement that Maryland achieve a 25 percent reduction of 2006 emissions by 2020. Since the transportation sector contributes 32 percent of the state's GHG emissions, achieving a significant reduction in transportation GHG emissions will be critical to supporting the requirements articulated in the Greenhouse Gas Emissions Reduction Act.

Through the Commission's work, MDOT has been designated as the implementing agency for six Transportation and Land Use (TLU) mitigation and policy options, and is a primary supporting agency on two others. MDOT's policy options are primarily focused on reducing GHGs through vehicle miles of travel (VMT) reductions. MDOT is also charged to work with the Maryland Department of Planning (MDP) on statewide land use and location efficiency strategies, Maryland Insurance Administration (MIA) on expanding deployment of Pay-As-You-Drive insurance, and Maryland Department of the Environment (MDE) to implement transportation technologies to reduce GHG emissions per mile.

1.2 PROCESS

To develop an implementation plan for the policy options developed by the Commission, MDOT established a fully collaborative process comprised of seven Working Groups focused on each TLU policy option, and a Coordinating Committee to provide guidance and oversight for the entire process. Working Group meetings held between February and May 2009 defined a total of 72 strategies (Phase I). The Coordinating Committee reviewed and adjusted the strategy definitions, leading to a list of 44 strategies prioritized for analysis in Phase II.

The Phase II work program conducted a detailed GHG emissions analysis and supported MDOT in the continued refinement of the MDOT Climate Action Plan Implementation activity. The objective of the Phase II work program was to understand the contribution that the transportation sector can make to meeting the 2020 target included in The Maryland

Greenhouse Gas Emissions Reduction Act of 2009 while supporting long term (beyond 2020) GHG reduction goals.

The final Phase II MDOT Draft Implementation Status Report and Appendices were submitted to MDE in November 2009 and are currently posted as part of the November 2009 Report to the Maryland Commission on Climate Change on MDEs website (www.mde.state.md.us).

This document summarizes the Phase III process which updates the *Maryland Climate Action Plan - MDOT 2009 Implementation Status Report* and provides the materials supporting MDE's completion of the *2012 Draft Implementation Plan* as required by the Maryland Greenhouse Gas Emissions Reduction Act of 2009 (Act).

1.3 REPORT

The remainder of the report is organized into the following major sections.

Section 2 - 2006 Baseline and 2020 Business-as-Usual (BAU) Forecast Greenhouse Gas Emissions Inventory Update

- Establishes an updated transportation sector 2006 baseline GHG emissions inventory and a 2020 BAU forecast of GHG emissions based on EPA's MOVES model.

Section 3 - 2020 Transportation Sector Detailed Assessment

- Quantifies GHG reduction strategies associated with existing and proposed vehicle technology and fuel standards.
- Quantifies by transportation GHG reduction policy option the GHG reductions and costs from the MDOT Consolidated Transportation Program (CTP), Metropolitan Planning Organizations (MPOs) Transportation Improvement Programs (TIPs) and Long-Range Plans (LRPs), and Transportation Emission Reduction Measures (TERMs) through 2020.
- Refines the unfunded transportation GHG reduction strategy definitions and provides forecasts of GHG emissions reductions and capital costs through 2020.

Section 4 - 2020 Transportation Sector Summary Results

- Summarizes MDOT's progress in meeting the GHG reduction target through MDOT adopted programs and other transportation sector programs.
- Summarizes overall progress in the transportation sector in reducing GHG emissions through 2020.

Appendices

- A. 2006 Baseline and 2020 BAU Emissions Inventory Documentation
- B. CTP, MPO TIP/LRP Project Listings by Policy Option
- C. TERM Analysis Assumptions, Costs, and Results
- D. Unfunded GHG Reduction Strategy Emission Reductions and Cost Assumptions
- E. MDOT Summary Forms

2.0 2006 Baseline and 2020 BAU Forecast Greenhouse Gas Emissions Inventory Update

The greenhouse gas (GHG) inventory for Maryland's transportation sector includes the 2006 baseline and the 2020 business-as-usual (BAU) forecast year. The inventory was calculated by estimating emissions of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) then converting those emissions to carbon dioxide equivalents that are measured in the units of million metric tons (mmt CO₂e). Carbon dioxide represents about 97 percent of the transportation sector's GHG emissions. The inventory includes both on-road and off-road sources as defined by the Energy Information Administration (EIA).

The on-road portion of the inventory was developed using EPA's new emissions model MOVES (Motor Vehicle Emissions Simulator). The inventory results represent an update of previous analyses conducted by the Center for Climate Strategies (CCS) for the Climate Action Plan (CAP) in 2008 and MDOT's Implementation Status Report, dated November 2009. Those inventory efforts were performed with EPA's MOBILE6.2 emission factor model. The MOVES model provides a more robust estimate of greenhouse gas emissions as compared to the simplified approaches used in MOBILE6.2. In MOVES, greenhouse gases are calculated from vehicle energy consumption rates and vary by vehicle operating characteristics including speed. In addition, the MOVES model includes the affects of current legislation on future vehicle fuel economy standards. The off-road portion of the inventory uses emission rates and data from EPA's State Greenhouse Gas Inventory Tool (SIT) and remains unchanged from the November 2009 MDOT Implementation Status Report.

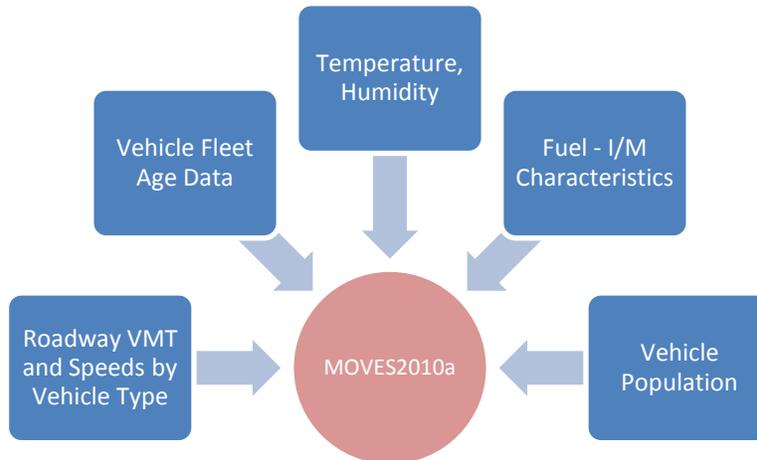
The inventory includes the revised 2006 base year and 2020 BAU forecast based on traffic count data (VMT-based) from the Maryland State Highway Administration (SHA). A more detailed description of the 2006 baseline and 2020 BAU forecast GHG emissions inventory update process can be found in Appendix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

2.1 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 *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity, EPA-420-B-10-023, April 2010*. EPA's MOVES model was officially released on March 2, 2010 and was followed with a revised version (MOVES2010a) in August 2010. The MOVES2010a version incorporates new car and light truck greenhouse gas emissions standards for model years 2012-2016 and updates effects of corporate average fuel economy (CAFE) standards for model years 2008-2011. The MOVES2010a model estimates the reductions in greenhouse gases associated with those standards in future calendar years.

As illustrated in Figure 2.1, the MOVES2010a model has been integrated with local traffic, vehicle fleet, environmental, fuel, and control strategy data to estimate statewide emissions.

Figure 2.1 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 12 monthly MOVES runs. Each monthly run used traffic volumes, speeds, temperatures, and fuel values specific to an average day in each month.

For the 2006 and 2020 BAU emissions inventory, 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 vehicle hours traveled (VHT), and prepare MOVES traffic-related input files. The PPSUITE software and process

methodologies are consistent with that used for regional 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.

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 scenario, the forecasts were determined using assumptions from the original Maryland CAP, which was based on historic trends of 1990-2006 highway performance monitoring system (HPMS) VMT growth. Table 2.1 summarizes the growth rates by county. The average statewide annualized growth rate was assumed to be 1.8 percent.

Table 2.1 Maryland VMT Annual Growth Rates for 2020 BAU

County	Annualized 2006-2020 Growth
Allegany	1.3%
Anne Arundel	2.0%
Baltimore	1.3%
Calvert	2.5%
Caroline	1.3%
Carroll	1.9%
Cecil	2.4%
Charles	2.2%
Dorchester	0.9%
Frederick	2.5%
Garrett	1.4%
Harford	1.8%
Howard	3.2%
Kent	0.5%
Montgomery	1.5%
Prince George's	1.7%
Queen Anne's	2.2%
Saint Mary's	2.0%
Somerset	0.9%
Talbot	1.8%
Washington	2.1%
Wicomico	1.5%
Worcester	1.3%
Baltimore City	0.8%
Statewide	1.8%

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. The VMT summary is provided in Table 2.2.

Table 2.2 Maryland 2006 and 2020 BAU VMT Forecast

Annual VMT (millions)	2006 Baseline	2020 BAU Forecast
Light Duty	51,212	63,878
Medium/Heavy Duty Truck & Bus	5,406	6,775
TOTAL VMT (in Millions)	56,618	70,653

2.2 OFF-ROAD ANALYSIS PROCESS

Off-road GHG emission analyses rely on the emission factors and methodologies provided in EPA’s State Inventory Tool (SIT). The tool estimates off-road CO₂, CH₄ and N₂O emissions. The SIT methodologies for estimating CO₂ follow a simple, top-down approach using state fuel consumption data. Emission factors based on fuel type are applied directly to the fuel consumption data to produce CO₂ estimates. This includes fuel consumption data for transportation fuel types including aviation gasoline, distillate fuel, jet fuel, motor gasoline, residual fuel and natural gas. Off-road CH₄ and N₂O emissions were estimated by the SIT tool based on fuel consumption data, emission factors, energy contents for aircraft and density factors for rail and marine vehicles. Inputs to the SIT tool for the 2006 baseline inventory are based on the United States Department of Energy (US DOE) Energy Information Administration (EIA) State Energy Data (SED).

Forecasting Assumptions

Historical information from EIA’s SED was used to project off-road source emissions to future years. Consistent with the Maryland CAP off-road methodology, the SIT model was used to estimate the GHG emissions. Historical fuel consumption was updated to include 2007 data that was not available when the CAP was developed. Based on the transportation emissions source, fuel consumption projections used the historical fuel consumption data to forecast the growth. For aviation, specific forecasts were obtained from the Federal Aviation Administration’s (FAA) APO terminal area forecasts. The growth rates selected for each off-road component were conservative, reasonable and consistent with historic trends. Table 2.3 summarizes the off-road inventory growth rate data sources.

Table 2.3 Off-Road Transportation Source Growth Rate Assumptions

Fuel Type	Category	Data Used for Forecasting
Motor Gasoline	Marine	1990-2007 Data
Distillate Fuel	Vessel Bunkering	Same as 2007 Data
	Military	Same as 2007 Data
	Railroad	Half the growth as 2000-2007
Natural Gas	Other (Total Minus Vehicle Fuel Consumption)	1990-2007 Data
Residual Fuel	Vessel Bunkering	2000-2007 Data
	Military	Same as 2007 Data
	Other (Total Minus Military & Other)	2000-2007 Data
Aviation Fuel	Aviation	FAA APO Terminal Forecasts

2.3 TRANSPORTATION SECTOR INVENTORY RESULTS

The 2006 baseline and 2020 BAU transportation sector GHG emissions forecast are summarized in Table 2.4. The on-road analyses include data, methods, and procedures approved by MDE during the consultation process of developing the inventory methodology. Off-road analyses utilized the SIT tool and updated information obtained from EIA.

Table 2.4 Maryland 2006 and 2020 Transportation Sector GHG Emissions

GHG Emissions (mmt CO ₂ e)	2006 Baseline	2020 BAU Forecast
<i>Light Duty Vehicles</i>	24.22	31.48
<i>Medium/Heavy Duty Trucks & Buses</i>	5.45	7.11
Total On-Road	29.67	38.59
Off-Road	3.03	3.10
TOTAL GHG Emissions	32.70	41.69

3.0 2020 Transportation Sector Detailed Assessment

The 2020 transportation sector assessment identifies the GHG emissions reduction impact of anticipated vehicle technology improvements in fuel economy or GHG emissions per mile, renewable fuel standards and low carbon fuels, and implemented and adopted transportation plans, programs and TERMS in Maryland through 2020. It also provides an assessment of the overall GHG emissions reduction benefit resulting from unfunded transportation GHG reduction strategies defined by the Working Groups and Coordinating Committee in Phase I. Both funded and unfunded transportation GHG reduction strategies focus on transportation investments, technology and other related programs that lead to a reduction in VMT, a reduction in fuel consumption, and improved travel efficiency.

The goals and objectives in MDOT's Maryland Transportation Plan (MTP) and the associated projects, programs, and TERMS identified in the CTP, MPO TIPs and LRPs lead to significant GHG reductions from the transportation sector by 2020. The MTP and its goals of quality of service, safety and security, system preservation and performance, environmental stewardship, and connectivity for daily life, help guide MDOT in a direction that is consistent with the objectives of the Climate Action Plan and the Maryland Greenhouse Gas Reduction Act of 2009.

Section 3 describes the estimated GHG emission reductions and associated costs of the following subsections.

- 3.1 Vehicle Technology Improvements
- 3.2 Transportation Fuels
- 3.3 Implemented and Adopted Transportation Plans and Programs
- 3.4 Unfunded Transportation GHG Reduction Strategies
- 3.5 Other Transportation GHG Reduction Initiatives

These subsections each provide an overview, strategy definitions, GHG reduction approach, and a summary of results that include GHG emission reductions and estimated capital costs. All related information for projects included in the MDOT 2011 - 2016 CTP, adopted MPO plans, and TERMS is presented in Appendix B and C. The detailed GHG emission reductions, cost assumptions, implementation tracking process, and co-benefits for the unfunded transportation sector strategies are presented in Appendix D.

3.1 VEHICLE TECHNOLOGY IMPROVEMENTS

Overview

Vehicle fuel economy standards are a key consideration in estimating future GHG emissions. By 2020, a number of state and federal initiatives that affect fuel economy standards will be in place and significantly contribute to the 2020 transportation sector GHG reductions. The MOVES2010a emissions model was used to estimate the GHG emissions impact for each of the programs. The technology advances are designed to improve vehicle fuel economy and reduce average GHG emissions per mile. The standards are phased-in for each vehicle model year starting with model year 2008. The technology improvements include:

- The existing CAFE standards for vehicle model years 2008 to 2011,
- The Obama administration's National Program for model years 2012 to 2016 as finalized in the May 7, 2010 joint rulemaking by US DOT and EPA, and
- The Maryland Clean Car Program that incorporates the California emission standards beginning with model year 2011.

Assuming federal approval, there are two federal proposals for additional vehicle standards that would affect fuel economy and potential greenhouse gas emissions prior to 2020. These include:

- The national program covering 2017-2025 model year cars and light-duty trucks, and
- Fuel efficiency and greenhouse gas standards for 2014-2018 model year medium and heavy-duty vehicles.

The effects of the above proposed programs are included as potential greenhouse gas emissions reduction strategies for the Maryland transportation sector by 2020. The programs were analyzed in the MOVES2010a model by adjusting vehicle energy consumption rates by the proportional change in fuel economy or engine standards. Assumptions have been made on each vehicle program based on the best available information at the time of the analysis. The assumptions and modeling methodology were reviewed and approved by MDE. Legislative action or further program refinement could change or modify assumptions used to complete the GHG emission estimates.

National Fuel Economy Standards

There are two promulgated national programs in place that strengthen the fuel economy standards for light duty cars and trucks. They include:

- *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;<http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0472-11424>). Fuel economy improvements begin in 2012 until an average 250

gram/mile CO₂ standard is met in the year 2016. This equates to an average fuel economy near 35 mpg.

The above programs are included in the MOVES vehicle energy consumption rates. To analyze the GHG emissions impacts of the programs, the MOVES2010a vehicle energy consumption rates default database was adjusted by holding constant the emission rates for post-2007 model years. The difference between the 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 MOVES2010a vehicle energy consumption rates table are provided in Appendix A.

Maryland Clean Car Program

The Maryland Clean Car Program implements California's low emissions vehicle standards to vehicles purchased in Maryland starting with model year 2011. By creating a consistent national fuel economy standard, the 2012-2016 National Program, which closely resembles 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 and post-2016 model year vehicles.

The Maryland Clean Car Program is not a direct input to the MOVES2010a model. Therefore, adjustments to the default vehicle energy consumption rates were needed to estimate the GHG reduction. These adjustments were based on the percentage change in fuel economy values between the programs. The fuel economy performance estimates required for model years 2011 and post-2016 were obtained by the California Air Resources Board (CARB) report, *Comparison of Greenhouse Gas Reductions for the United States and Canada Under U.S. CAFE Standards and California Air Resources Board Greenhouse Gas Regulations*, dated February 25, 2008.

Proposed National 2017-2025 Light-Duty Vehicle Standards

The US DOT, EPA and the state of California are currently working towards additional fuel economy standards for light-duty vehicles beyond the 2016 model year. It is expected that a single set of national standards will be proposed by September 2011 covering model year 2017-2025 cars and light-duty trucks. If adopted, the national standards will replace the Maryland Clean Car Program for post-2016 model year vehicles.

The energy rates for the proposed standards were developed based on EPA and DOT's National Highway Traffic Safety Administration (NHTSA) establishment of 2017 and later model year light-duty vehicle greenhouse gas emissions and CAFE standards, *Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards* (published May 7, 2010). A range of options are being considered for new standards ranging from a 3 - 6 percent annual improvement in fuel economy from 2017 to 2025. The adjustments to the MOVES2010a vehicle energy rates were based on these percentage changes in fuel economy.

Proposed National 2014-2018 Medium and Heavy Vehicle Standards

EPA and NHTSA are proposing new standards for three categories of medium and heavy-duty vehicles: combination tractors, heavy-duty pickups and vans, and vocational vehicles. The

proposed rulemaking for these standards is *Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles* (published November 30, 2010). The categories were established to address specific challenges for manufacturers in each area. For combination tractors, the agencies are proposing engine and vehicle standards that begin in the 2014 model year and achieve up to a 20 percent reduction in carbon dioxide (CO₂) emissions and fuel consumption by the 2018 model year.

For heavy-duty pickup trucks and vans, the agencies are proposing separate gasoline and diesel truck standards, which phase in starting in the 2014 model year and 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 agencies are proposing engine and vehicle standards starting in the 2014 model year that would achieve up to a 10 percent reduction in fuel consumption and CO₂ emissions by the 2018 model year.

Specific standards have not yet been proposed for this program. Based on the percent ranges provided above, analyses have been conducted by adjusting existing MOVES fuel economy assumptions to estimate the GHG reduction estimates.

Results

The GHG reductions from National Fuel Economy Standards, the Maryland Clean Car Program, the proposed National Fuel Economy Standards beyond 2016, and the proposed Medium and Heavy Duty Vehicle standards reduce projected 2020 GHG emissions by 7.47 mmt CO₂e as shown in Table 3.1.

Table 3.1 Maryland 2020 Vehicle Technology GHG Emissions Reductions

GHG Emissions Reduction by Program	Annual GHG Emission Reduction (mmt CO ₂ e)
CAFE Standards (2008 – 2011 MY)	2.27
National Program (2012 – 2016 MY)	3.19
Maryland Clean Car Program (2011 MY) & National Fuel Economy Standards (2017 – 2025 MY)	1.14
Proposed National 2014-2018 Medium and HDV Standards	0.88
2020 GHG Emission Total	7.48

While this analysis focuses on 2020, it is important to highlight that preliminary 2030 GHG emissions forecasts provide insight into the relationship between the currently proposed vehicle technology programs, continued vehicle turnover, and VMT growth. It is probable that continued growth in VMT, if additional standards are not implemented, will eventually offset the benefit of the proposed improvements to vehicle technology and fleet turnover. The goal of transportation and land use strategies is to reduce the rate of growth in VMT so that the combined benefits of VMT related strategies and vehicle and fuels technology will be more significant. Understanding these relationships will be essential in attempting to achieve potential post-2020 targets, such as those outlined in the Maryland Greenhouse Gas Emission

Reduction Act of 2009 (90 percent below 2006 by 2050). Additional improvements to fuel economy standards and continued fleet turnover will be critical to meeting post-2020 GHG reduction targets.

3.2 TRANSPORTATION FUELS

Overview

Accounting for increases in the availability of renewable and low carbon fuels in 2020 is an important component of estimating potential GHG emission reductions from the Maryland transportation sector. The 2020 GHG inventory projection considers the final National Renewable Fuel Standard Program (RFS2) as well as a range of potential benefits associated with the 11-state Northeast and Mid-Atlantic Low Carbon Fuel Standard (LCFS) Memorandum of Understanding.

The potential effects of these fuel programs are included as GHG emissions reduction strategies for the Maryland transportation sector by 2020 and will augment the GHG emission reduction benefits achieved through vehicle technology improvements.

Renewable Fuels and Fuel Assumptions

The MOVES2010a greenhouse gas analysis uses fuel assumptions through 2012 as developed and reviewed by MDE. Assumptions for years beyond 2012 continue to use the same fuel standards and characteristics within the MOVES model.

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 CO₂ 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 proposed renewable fuel standard.

Low Carbon Fuel Standard

On December 30, 2009, eleven Northeast and Mid-Atlantic states signed a Low Carbon Fuel Standard (LCFS) Memorandum of Understanding. The Signatory States committed to evaluating a regional low carbon fuel program that will reduce the average carbon intensity of transportation and potentially heating fuels in the Northeast and Mid-Atlantic Region. The states are working to evaluate and develop an agreed upon framework for the program, which would be followed by a model rule based on that framework. The framework and model rule are to include key program elements that could be adopted through state-specific administrative rulemaking or state legislative authority, if individual states choose to adopt and implement a LCFS.

The Signatory States committed to finalizing a proposed program framework in early 2011 that addresses the following elements: 1) compliance goals expressed as a percent reduction in average carbon intensity from an agreed upon baseline, to be achieved over a specific timetable; 2) parties to be regulated under the program; 3) whether heating fuels are to be included in the

program and, if so, options for including such fuels; 4) appropriate mechanisms for creating and trading credits for the sale of low carbon fuels; and 5) appropriate monitoring, compliance and enforcement mechanisms, and approaches to program review.

The LCFS framework, including compliance goals, has not yet been established. As a result, a conservative dissemination approach representing a range of impacts was utilized. The use of low carbon fuels was assumed to represent a 5-10 percent reduction in total mobile CO₂ emissions in 2020.

Results

The GHG reductions in Maryland from the National Renewable Fuel Standard Program and the 11-state Low Carbon Fuel Standard reduce projected 2020 GHG emissions by 1.45-2.66 mmt CO₂e as shown in Table 3.2.

Table 3.2 Maryland 2020 Transportation Fuels GHG Emissions Reductions

GHG Emissions Reduction by Program	Annual GHG Emission Reduction (mmt CO ₂ e)
Renewable Fuel Standard Program (RFS2)	0.24
Low Carbon Fuel Standard (5% - 10%) (1)	1.21 – 2.42
2020 GHG Emission Total	1.45 – 2.66

Note: (1) Figure ES.1, Figure 4.2 and Table 4.1 present only the result of the 5 percent reduction assumption, 1.21 mmt.

3.3 IMPLEMENTED AND ADOPTED TRANSPORTATION PLANS & PROGRAMS

Overview

Transportation projects, TERMS, land use, and travel forecast data from the following list of approved transportation programs were used to assess and quantify the GHG emissions of the State's proposed transportation investments through 2020.

- Maryland 2011-2016 CTP
- MWCOG 2011-16 TIP and 2010 CLRP adopted 11/17/10
- BRTB 2011-14 TIP adopted 7/27/10 and Transportation Outlook 2035 (adopted 11/07, amended 2/24/09)
- Hagerstown/Eastern Panhandle MPO 2010-2013 TIP adopted 6/16/10 and 2035 LRMTIP adopted 4/28/10
- Salisbury-Wicomico MPO 2010-2013 TIP adopted 9/28/09 and Draft 2010 LRTP scheduled for adoption in October 2010

- Cumberland Area MPO 2010-2013 TIP adopted 10/15/09 and Draft 2010 LRTP schedule for adoption in October 2010
- WILMAPCO DRAFT 2012-2015 TIP and 2040 RTP (adopted 10/10)
- Modal Plans including - Maryland Area Regional Commuter (MARC) Growth and Investment Plan, Port of Baltimore Regional Landside Access Study, Maryland Statewide Freight Plan, Washington Metropolitan Area Transit Authority (WMATA) Capital Plan, Maryland Aviation Administration (MAA) Capital Plan

Based on the macro-level analysis of the State's fiscally constrained transportation infrastructure and program investment through 2020, and the associated local land use policies, statewide growth in VMT is forecast to be 1.4 percent annually. This represents a slower rate of growth than was included in the Maryland Climate Action Plan developed in 2007.

TERMs identified in the 2011-2016 CTP and MPO TIPs and LRPs to meet criteria pollutant targets, as well as continuation of current programs such as Commuter Connections, CHART, and Metropolitan Area Transportation Operations Coordination (MATOC) are assessed individually to determine estimates of GHG emission reductions and costs through 2020.

Funded Maryland Plans and Programs

Greenhouse Gas Emission Reductions

The 2020 BAU GHG emission forecast utilizes a methodology consistent with the Climate Action Plan (CAP). The HPMS historical growth rate was based on county reported HPMS VMT totals for the 1990-2006 timeframe. Using HPMS data and the associated timeframe, the average statewide annualized growth rate would be 1.8 percent, which is consistent with the assumptions used for past GHG analysis efforts under the Maryland CAP. Through consultation with MDE, it was determined in Phase II that the updated forecast should consider the MPO transportation and land use forecasts used in the development of TIPs, LRPs and the Maryland CTP. These plans and programs identify the committed and funded projects in Maryland. The modeling conducted by each regional MPO includes the impact of the planned projects and the adopted regional demographic forecasts.

To account for the impact of planned transportation plans and programs in 2020, MPO forecast travel and land use data were employed where available. For rural counties not included in a MPO or travel demand model domain, HPMS historical growth rates were used. The growth rates under this scenario incorporate the impacts of future regional demographic projections from each county, cooperatively developed by the MPO for modeling purposes, and the impacts of planned transportation projects (highway and transit) in the regional TIPs and LRPs. Under this scenario, the average statewide annualized growth rate is 1.4 percent (see Table 3.3). Project level analyses were not performed.

Table 3.3 Maryland VMT Forecasts and Annual Growth Rate

County	Annualized 2006-2020 Growth	
	HPMS Historical (CAP)	MPO Modeling (Plans/Programs/Adopted Land Use)
Allegany	1.3%	-0.6%
Anne Arundel	2.0%	1.6%
Baltimore	1.3%	1.3%
Calvert	2.5%	1.9%
Caroline	1.3%	1.3%
Carroll	1.9%	2.1%
Cecil	2.4%	1.7%
Charles	2.2%	1.8%
Dorchester	0.9%	0.9%
Frederick	2.5%	2.0%
Garrett	1.4%	1.4%
Harford	1.8%	2.6%
Howard	3.2%	3.3%
Kent	0.5%	1.3%
Montgomery	1.5%	0.6%
Prince George's	1.7%	0.9%
Queen Anne's	2.2%	0.7%
Saint Mary's	2.0%	2.0%
Somerset	0.9%	0.9%
Talbot	1.8%	1.8%
Washington	2.1%	1.5%
Wicomico	1.5%	0.8%
Worcester	1.3%	1.3%
Baltimore City	0.8%	0.8%
Statewide	1.8%	1.4%

The statewide GHG reductions in 2020 are equivalent to the VMT difference between the BAU VMT growth rate (1.8 percent) and the 1.4 percent VMT growth rate. As presented in Table 3.4, this difference results in a VMT reduction in 2020 of 3.578 billion vehicle miles. The reduction in VMT is translated to a GHG emission reduction based on an emissions factor (grams CO_{2e} / mile) as calculated through the MOVES model based on Maryland's on-road vehicle fleet in 2020 (see section 2 and Appendix A).

Table 3.4 Maryland 2020 BAU VMT Compared to 2020 Plans and Programs VMT

Scenario	2020 BAU	2020 Plans & Programs Forecast
Annual VMT (millions)		
Light Duty	63,878	60,643
Medium/Heavy Duty Truck & Bus	6,755	6,432
TOTAL VMT (millions)	70,653	67,075

*Project Implementation Costs***Maryland 2011-2016 Consolidated Transportation Program**

Projects that contribute to a change in VMT growth and/or improve system efficiency are a subset of the complete state capital program. These are roadway and transit infrastructure projects, Transportation Emission Reduction Measures (TERMs), and other state and regional programs that act to reduce VMT and/or delay by adding capacity, improving flow, reducing bottlenecks, managing travel demand, or improving overall system efficiency through enhanced system management and operations. These projects are multimodal in nature and span multiple agencies, including MdTA, MAA, MPA, MTA, SHA, and WMATA, as well as local governments. The total costs of these projects are \$4.832 billion (approximately 40 percent of the capital program in the 2011-2016 CTP). Table 3.5 illustrates the groupings of applicable 2011-2016 CTP projects by transportation GHG reduction policy option.

Table 3.5 2011-2016 CTP Projects by Transportation GHG Reduction Policy Option

GHG Reduction Policy Options	Projects	Total Cost (2011-2016) (billions \$) (1)
Public Transportation (2)	38	\$2.431
Intercity Passenger and Freight Transportation (3)	18	\$0.348
Bike and Pedestrian (4)	19	\$0.321
Transportation Pricing and Demand Management	2	\$1.375
Transportation Technology	10	\$0.358
2011 - 2016 CTP Total	87	\$4.832

Note: (1) The total cost includes TERMS listed in the 2011 - 2016 CTP. These are documented in more detail in the TERM section on pg. 3-13 and Appendix C.

- (2) The total cost includes 4 development and evaluation projects in the CTP (Red Line, Purple Line, Corridor Cities Transitway, Bethesda Metro South Entrance). Implementation costs for these projects not included in the CTP are included in the MPO plans and programs in Table 3.6.
- (3) CTP projects include all capacity expansion and interchange improvements on interstate highways and intermodal connectors.
- (4) CTP projects include all capacity expansion projects with accommodations for bike or pedestrian elements in the project description. The costs listed represent total project cost identified in the CTP.

Examples of CTP projects within each policy option are listed below:

- **Public Transportation:** Includes all MTA and WMATA capital projects dedicated to the expansion and increased level of service of public transportation services in Maryland. Projects include infrastructure expansion, vehicle purchase and replacement, transit operations and transit support facilities in the 2011-2016 CTP. Example projects include:
 - MARC Growth and Investment Plan implementation,
 - Completion of the Silver Spring transit center,
 - LOTS capital procurement projects,
 - WMATA Capital Improvement Program, and
 - Matching funds to WMATA for the Passenger Rail Investment and Improvement Act.
- **Intercity Passenger and Freight Transportation:** Includes all highway capacity projects on interstate highway system routes and intermodal connectors in Maryland. Also includes funding for the Baltimore intercity bus terminal, MARC infrastructure and operations improvements, American Recovery and Investment Act funding for planning and engineering for BWI MARC/Amtrak Station improvements and the Baltimore and Potomac tunnel, and rail freight capacity improvements on railroads owned by Maryland.
- **Bike and Pedestrian:** Combination of bicycle and pedestrian infrastructure inclusion in roadway projects (complete streets implementation), SHA's Sidewalk Program and Community Safety and Enhancement Program, projects and programs supporting completion of the statewide transportation trails network, and improved bicycle and pedestrian access to transit facilities. The total cost reported for roadway capacity projects with bicycle and pedestrian accommodations represents the total project cost.
- **Transportation Pricing and Demand Management:** Includes MDTA projects, primarily the Intercounty Connector and I-95 Express Toll Lanes. Also includes state funded commute alternative incentive programs in the Baltimore and Washington regions.
- **Transportation Technology:** Includes CHART program implementation, state and local programs for signal synchronization, MTA diesel-hybrid electric bus purchases, transit CAD/AVL system upgrades and high speed tolling at I-95 Fort McHenry toll plaza.

Maryland MPO TIPs and Long Range Plans

The total cost of the subset of projects and TERMS contributing to changes in VMT growth and/or system efficiency in the MPO TIPs and LRPs through 2020 is **\$8.863 billion**. Table 3.6 illustrates groupings of applicable MPO TIP and LRP projects by transportation GHG reduction policy option.

Table 3.6 MPO TIP and LRP Projects by Transportation GHG Reduction Policy Option

GHG Reduction Policy Options	Projects	Total Cost (2011–2020) (billions \$) (1)
Public Transportation (2)	31	\$4.532
Intercity Passenger and Freight Transportation	33	\$2.736
Bike and Pedestrian	32	\$1.064
Transportation Pricing and Demand Management	4	\$0.022
Transportation Technology	7	\$0.032
MPO TIPs and LRP Total	107	\$8.387

Note: (1) Total cost includes TERMS listed in the MPO TIPs and LRPs as documented in more detail in the TERM section on pg. 3-13 and Appendix C.

(2) Total cost excludes the cost of planning, preliminary engineering and ROW acquisition for four development and evaluation projects as identified in the CTP (Red Line, Purple Line, Corridor Cities Transitway, Bethesda Metro South Entrance).

Projects in MPO TIPs and LRPs funded and committed for completion by 2020 include:

- **Public Transportation:** Major projects planned for opening by 2020 include the Purple Line (Bethesda to New Carrollton), Corridor Cities Transitway (Shady Grove to COMSAT), Red Line (Social Security Administration to Bayview Medical Center), and the MARC Penn Line extension from Perryville to Elkton.
- **Intercity Passenger and Freight Transportation:** Major roadway capacity projects impacting truck freight movement in Maryland planned for opening by 2020 include: I-695 from I-95 South to MD 122, I-695 from I-83 to I-95 North, MD 32 grade separation and interchange at I-795, MD 4 upgrade in Prince Georges County, and US 50 access control improvements in Wicomico County. In addition, there are funded long range projects associated with the MARC Growth and Investment Plan and Maryland Statewide Freight Plan included under this strategy. The GHG reduction benefit from full implementation of the National Gateway and Northeast Corridor Infrastructure Master Plan are included in the unfunded GHG reduction strategy assessment.
- **Bike and Pedestrian:** Combination of bicycle and pedestrian infrastructure inclusion in roadway projects (complete streets implementation), projects supporting completion of the statewide transportation trails network, as well as improved bicycle and pedestrian access to transit facilities. This policy option also includes implementation of a number of local and regional sidewalk, trail, recreation and enhancement programs.
- **Transportation Pricing and Demand Management:** Includes implementation of Baltimore regional ride share and guaranteed ride home programs and MWCOGs Commuter Connections program.
- **Transportation Technology:** Includes installation, repair and replacement of variable message signs; congestion management programs including the employment of variable message signs, CCTV, signal coordination, the deployment of local Intelligent Transportation Systems (ITS) projects (transit signal priority systems, automatic passenger

counters, traffic signal control software, etc.), and the development of park and ride facilities; Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects; Clean Air Partners; and advanced transportation management systems utilizing fiber optics.

Transportation Emission Reduction Measures (TERMs)

Greenhouse Gas Emission Reductions

The Clean Air Act Amendments of 1990 (CAAA) and the Safe, Accountable, Efficient, Flexible, Transportation Efficiency Act (SAFETEA-LU) requires MPOs and state departments of transportation to perform air quality analyses, to ensure that the transportation plan and program conform to the mobile emission budget established for the criteria pollutants such as NO_x, VOCs, CO and particulates in the State Implementation Plans (SIP). As a result, MPO's and DOT's are required to identify transportation emissions reduction measures (TERMs) that provide criteria pollutant emission-reduction benefits. These measures are assessed in conformity documentation and include specific information on the costs and expected air-quality benefits.

The criteria pollutant reductions of a large share 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).

Project Implementation Costs

The range of TERMS considered is diverse in strategy, scope and implementation requirements. The total cost of TERMS listed within the CTP and MPO TIPs and LRPs is estimated at \$483 million.¹ The total cost of additional TERMS sponsored by Maryland Aviation Administration (MAA) and Maryland Ports Administration (MPA) is not included in this report.

The TERMS were organized into the transportation GHG reduction policy options as follows (this list is representative and not inclusive of all the TERMS included in the analysis, refer to Appendix C for descriptions of all the TERMS):

- **Public Transportation:** Projects that enhance public transportation amenities and improve level-of-service through station access improvements, bus stop programs, traveler information, activity center shuttle services, park-and-ride lot expansion, free bus transfers, enhanced commuter and reverse commute service, MTA college pass and commuter choice Maryland pass.

¹ TERMS listed within the CTP and MPO TIPs and LRPs are also included in the total cost estimates presented in Tables 3.5 and 3.6. The summary of total TERM project costs by GHG reduction policy option are listed in Appendix C, Table C.1.

- **Intercity Passenger and Freight Transportation:** No TERM projects.
- **Bike and Pedestrian:** Projects include sidewalk and street rehabilitation, bicycle and pedestrian facilities, acquisition of scenic easements, streetscapes, and functional/safety improvements.
- **Transportation Pricing and Demand Management:** Projects are tied to commute alternative and incentive programs including specific projects such ridesharing (Commuter Connections), guaranteed ride home, TDM program management and marketing, outreach and education programs (Clean Air Partners), parking cash-out subsidies, transportation information kiosks, local carsharing programs, telework partnerships, parking impact fees, and vanpool programs.
- **Transportation Technology:** Projects fall across two primary categories: clean vehicle technology and intelligent transportation systems. Clean vehicle technology includes truck idling (truck stop electrification or auxiliary power units), transit bus purchases, state fleet purchases. Intelligent transportation systems includes CHART, MATOC, and signal coordination/management/upgrade programs. Also includes projects at BWI Marshall such as aircraft taxi/idling/delay reduction strategies, vehicle fleet purchases, dedicated lanes, smart park facilities, APUs for ground service equipment, and facility electricity usage. Maryland Port Administration (MPA) projects include cargo handling equipment replacements and engine repowers, and truck replacements and engine repowers.

Implementation of many of the TERMS requires capital investments along with annual administrative and operations costs. The costs included in Table 3.5 are predominantly capital costs, reflecting expenditures for new technologies, equipment and vehicles as well as transit support infrastructure (bus shelters, park-and-ride lots). For commuter programs and most ITS related programs, there are significant annual administrative and operations costs included.

Results

Greenhouse Gas Emission Reductions

The reduced forecasted rate of VMT growth resulting from implementation of the CTP and MPO TIPs and LRPs through 2020 contributes to a 1.99 mmt CO₂e reduction by 2020 compared to the 2020 BAU forecast.

VMT reduction or fuel consumption savings resulting from the implementation of TERMS through 2020 results in a 0.795 mmt CO₂e reduction in 2020. The TERM strategies are all exclusive of the VMT impacts and resulting GHG emissions from existing plans and programs analysis, ensuring that no double counting of benefits occurs. The contribution of TERMS by each GHG emission reduction strategy policy option is presented in Table 3.7.

Table 3.7 GHG Reduction Summary by Transportation GHG Reduction Policy Option

GHG Reduction Policy Options	Annual 2020 GHG Reduction (mmt CO ₂ e)
Maryland Funded Plans and Programs (excluding TERMS)	1.99
Transportation Emission Reduction Measures (TERMs)	0.795
Public Transportation	0.277
Intercity Passenger and Freight Transportation	--
Bike and Pedestrian	0.001
Transportation Pricing and Demand Management	0.199
Transportation Technology	0.319
Total – Implemented and Adopted Transportation Plans and Programs	2.785

Project Implementation Costs

The total cost of the subset of projects, programs, and TERMS within the 2011-2016 CTP and MPO long-range plans through 2020 that contribute to the reduction in GHG emissions is \$13.219 billion (approximately 50 percent of the complete State capital program 2011 – 2020).

Table 3.8 presents the total capital cost summary of Maryland plans, programs and TERMS 2011 – 2020 by transportation GHG reduction strategy policy option. Refer to Appendix B for the complete project listing.

Table 3.8 Draft Cost Summary by Transportation GHG Reduction Policy Option

GHG Reduction Policy Options	Total Cost (2011–2020) (billions \$) (2)
Public Transportation	\$6.963
Intercity Passenger and Freight Transportation (1)	\$3.085
Bike and Pedestrian (1)	\$1.385
Transportation Pricing and Demand Management	\$1.397
Transportation Technology	\$0.390
Total – Implemented and Adopted Transportation Plans and Programs	\$13.219

Note: (1) The total cost reported represents the complete project cost. The specific cost of the bike or pedestrian element is not reported. There are no overlaps with any roadway capacity projects identified in the intercity passenger and freight transportation policy option.

(2) Total cost includes \$483 million for TERMS documented in more detail in Appendix C.

3.4 UNFUNDED TRANSPORTATION GHG REDUCTION STRATEGIES

Overview

The 2008 Maryland Climate Action Plan (CAP) established GHG emission reduction targets from 2006 levels including targets of 25 percent by 2020 and 90 percent by 2050. In order to assist Maryland in meeting these targets, the Commission also identified 42 GHG “mitigation” policy options designed to reduce GHG emissions. A total of eight transportation and land use policy options were outlined in the CAP. While many State agencies are involved, MDOT was designated as the implementing agency for six policy options, and is a supporting agency on the two others. MDOT’s policy options are primarily focused on reducing GHG emissions through vehicle miles of travel (VMT) reductions and vehicle and transportation system technology improvements.

MDOT developed a multi-phase approach in order to address the responsibility of acting as the implementing agency for the six policy options. That process included the development of a coordinating committee as well as working groups for each policy option.

In Phase I, a total of 44 strategies were determined to have an implementation timeframe of 2020 or before. These were evaluated in Phase II, with the understanding that these strategies could only be realized should funding become available.

Phase III takes the findings of the working groups and coordinating committee in Phase I and Phase II and reassesses the GHG emission reduction benefits through:

1. A more careful consideration of the barriers to implementation by 2020;
2. A review of the GHG reduction and cost methodologies, and;
3. Inclusion of updated emission factors based on vehicle technology and transportation fuel forecasts for Maryland in 2020 from EPAs MOVES model.

The incremental benefit of the unfunded transportation GHG reduction strategies evaluated in Phase III is a 1.14 mmt to 3.14 mmt CO₂e reduction in 2020. The implementation cost estimate (capital costs only) of the Phase III unfunded transportation sector GHG reduction strategies from 2011 to 2020 is \$2.911 to \$7.011 billion in addition to the funded transportation plans, programs and TERMS through 2020.

Unfunded Transportation GHG Reduction Strategy Policy Options

The strategies described in this section were determined by the working groups and coordinating committee in Phase I to be priorities for GHG emission reduction in Maryland and are considered feasible for implementation by 2020. These strategies could only be realized should additional funding become available.

More detailed information, regarding the strategy analysis approach and assumptions can be found in Appendix D.

Public Transportation

This policy option identifies public transportation strategies to reduce on-road mobile source transportation GHG emissions. The strategies are designed to help Maryland meet a goal of doubling transit ridership by 2020, and continuing that same growth rate beyond 2020. In order to achieve this growth, actions to increase the attractiveness and convenience of public transportation, improve the operational efficiency of the system, and increase system capacity are required. Policies also involve supportive actions with regard to land use planning and policy, pricing (disincentives to auto use), and bike and pedestrian access improvements. Policies to reduce GHG produced by public transportation services are also included.

The following strategies defined by the public transportation working group were identified to address the expected gap in meeting the transit ridership goal defined in the Climate Action Plan (e.g. a doubling of 2000 transit ridership by 2020). The intent is for these strategies to complement and support funded MTA and WMATA plans and programs identified for implementation by 2020 in the 2011-2016 CTP and MPO TIPs and long-range plans.

- Additional Capacity on Existing Transit Routes
- Increase Frequencies of Transit Services Statewide
- Expanded Park and Ride Capacity
- Increase Coverage of Transit Services – New Commuter / Intercity Bus Routes
- Increase Coverage of Transit Services – New Local Bus Routes
- Implement Bicycle and Pedestrian Improvements to Support Transit
- Reduce GHG Emissions from Transit Vehicles
- Bus Priority Improvements
- Plan Transit in Conjunction with Land Use

Intercity Passenger and Freight Transportation

This policy option enhances connectivity and reliability of non-automobile intercity passenger modes and multimodal freight through infrastructure and technology investments. For intercity passenger modes, this includes expansion of intercity passenger rail and bus services as well as improved connections between air, rail, intercity bus and regional or local transit systems. For freight movement, this includes expansion and bottleneck relief on priority truck and rail corridors and enhanced intermodal freight connections at Maryland's intermodal terminals and ports.

The intercity transportation working group identified improving passenger convenience for intermodal connections at airports, rail stations, and major bus terminals as the primary pre-2020 unfunded intercity transportation strategies. Two primary strategies are assessed for intercity passenger transportation in Maryland by 2020: (1) improve passenger access, convenience, and information across all modes at BWI Airport, and (2) improve travel times, reliability and overall level of service on the MARC Penn Line and Amtrak NE Corridor

consistent with the MARC Growth and Investment Plan, and Northeast Corridor Infrastructure Master Plan.

The intercity transportation working group did not recommend specific freight strategies in addition to projects identified in implemented and adopted transportation plans and programs for consideration before 2020. Recent developments and Maryland strategic involvement in the CSX Transportation National Gateway initiative will result in implementation of freight rail projects in Maryland and the mid-Atlantic region that will help reduce truck VMT in Maryland by 2020. Funding for the National Gateway is a public-private partnership between the federal government, six states and the District of Columbia, and CSX. The benefit of the National Gateway is assessed in this report.

The benefits of Norfolk Southern's Crescent Corridor initiative is not assessed in this report as direct GHG emission reduction benefits to Maryland are unknown, and a level of support and funding commitment from Maryland has not been recommended to date (see Section 3.5 for more details).

Bike and Pedestrian

This policy option includes infrastructure design and construction policies; funding, regulatory, and land use strategies; and education and marketing measures. These strategies result in improved bike and pedestrian amenities, resulting in an increase in the number of trips made on foot or bicycle, particularly in urban areas and adjacent to Maryland's trail networks. This policy recognizes that local governments are responsible for the design and maintenance of approximately 80 percent of roads in Maryland. Land use and location efficiency strategies addressing density, mix of uses, and urban design represents a very strong predictor of bike and pedestrian travel.

The following strategies were recommended for possible implementation prior to 2020 by the bike and pedestrian working group:

- Promote use and regular review/updates to existing manuals and design standards
- Complete Streets - improve bike/pedestrian access through corridor retrofits and new roadway construction projects
- Update existing land use policy guidance and zoning/development standards to include provisions for bike and pedestrian supportive infrastructure
- Bike facility and supportive infrastructure placement at strategic locations, including transit stations and government facilities
- Provide funds for low-cost safety solutions
- Education, safety programs, and marketing programs to encourage bicycle travel

Transportation Pricing and Demand Management

This policy option addresses transportation pricing and travel demand management incentive programs. It also tests the associated potential GHG reduction benefits of alternate funding sources for GHG beneficial programs. These strategies amplify GHG emission reductions from

other strategies by supporting Smart Growth, transit, and bike and pedestrian investments. The draft MDOT policy design, developed by the pricing working group in Phase I, considers four strategy areas combined with an education component for state and local officials.

The detailed definitions of the four strategy areas are listed below:

- **Maryland motor fuel taxes or VMT fees** – There are two primary options for consideration: (1) an increase in the per gallon motor fuel tax consistent with alternatives under consideration by the Blue Ribbon Commission on Maryland Transportation Funding, and (2) establish a GHG emission-based road user fee (or VMT fee) statewide by 2020 in addition to existing motor fuel taxes. Both options would create additional revenue that could be used to fund transportation improvements and systems operations to help meet Maryland GHG reduction goals.
- **Congestion Pricing and Managed Lanes** – Establish as a local pricing option in urban areas that charges motorists more to use a roadway, bridge or tunnel during peak periods, with revenues used to fund transportation improvements and systems operations to help meet Maryland GHG reduction goals.
- **Parking Impact Fees and Parking Management** – Establish parking pricing policies that ensure effective use of urban street space. Provision of off-street parking should be regulated and managed with appropriate impact fees, taxes, incentives, and regulations.
- **Employer Commute Incentives** – Strengthen employer commute incentive programs by increasing marketing and financial and/or tax based incentives for employers, schools, and universities to encourage walking, biking, public transportation usage, carpooling, and teleworking.

Transportation Technology

This policy option aims to reduce GHG emissions from on and off-road vehicles/engines through the deployment of technologies designed to cut GHG emission rates per unit of activity through such measures as idling reduction, engine/vehicle replacements, and the promotion of fuel efficient technologies. This policy option also encompasses improvements to transportation system efficiencies through measure such as traffic signal synchronization/optimization and active traffic management.

The following strategies were identified for further analysis and possible implementation under this policy option:

- **Active Traffic Management (ATM) / Traffic Management Centers** – Provide real-time, variable-control of speed, lane movement, and traveler information (for drivers and transit users) within a corridor and conduct centralized data collection and analysis of the transportation system. System management decisions are based on inroad detectors, video monitoring, trend analysis, and incident detection (currently performed by CHART).
- **Traffic Signal Synchronization / Optimization** – Traffic signal operations are synchronized to provide an efficient flow or prioritization of traffic, increasing the efficient operations of the corridor and reducing unwarranted idling at intersections. The system can also provide

priority for transit and emergency vehicles. Specific performance measure is “reliability.” Traffic Signal Synchronization is currently performed by SHA and local jurisdictions.

- **Marketing and Education Campaigns** - Initiate marketing and education campaigns to operators of on-and off-road vehicles.
- **Timing of Highway Construction Schedules** - Consider requiring non-emergency, highway and airport construction be scheduled for off-peak hours that minimize the delay in traffic flow. Include incentives for completing projects ahead of schedule.
- **Green Port Strategy** - Develop and implement a “Green Port Strategy” consistent with industry trends and initiatives including EPA’s Strategy for Sustainable seaports.
- **Reduce Idling Times** - Reduce idling time in light duty vehicles, commercial vehicles (including the use of truck stop electrification), buses, locomotive, and construction equipment.
- **Technology Improvements for On-highway Vehicles** - Promote and incentivize fuel efficiency technologies for medium and heavy-duty trucks (on-highway vehicles).
- **Incentives for Low-GHG Vehicles** - Provide incentives to increase purchases of fuel-efficient or low-GHG vehicles / fleets.
- **Technology Advances for Non-highway Vehicles** - Encourage or incentivize retrofits and/or replacement of old, diesel-powered non-highway engines, such as switchyard locomotives, with new hybrid locomotives.
- **Incentives for Low-Carbon Fuels and Infrastructure** - Incentivize the demand for clean low-carbon fuels and the development of infrastructure to provide for increased availability/accessibility of alternative fuels and plug-in locations for electric vehicles.

Evaluate the Greenhouse Gas Emission Impacts of Major Projects and Plans

This policy option focuses on the process of evaluating GHG emissions of all state and local major projects. The goals of this policy option are to understand the impacts of new, major projects on the Governor’s GHG reduction commitment; and to develop guidance for the state and other major project sponsors to use. In Phase I, the working group identified three potential implementation strategies for this policy option:

- Participate in Framing National Policy
- Evaluation of GHG Emissions through the NEPA Process
- Evaluation of GHG Emissions through Statewide/Regional Planning

Results

Table 3.9 presents the results of the Phase III unfunded transportation GHG reduction strategy analysis. The GHG reduction estimates summarized here represent GHG reductions beyond the benefits of implemented and adopted transportation plans, programs, and TERMS. The preliminary cost estimates of the unfunded strategies represent additional capital costs that are not included in the CTP or MPO plans. Ranges of GHG reductions and costs are illustrated in

order to reflect the relationship between achieving more significant GHG reductions and the costs associated with achieving those reductions.

The GHG emission reductions from all projects, programs and TERMS included in funded plans and programs are accounted for within the bundled assessment of the emission reduction benefits in 2020 of implementing the State's implemented and adopted transportation plans, programs, and TERMS (see Section 3.3).

A more detailed summation of the analysis conducted for each policy option, including an overview and definition, approach to the analysis, assumptions and results, is provided in Appendix D.

Table 3.9 Unfunded GHG Reduction Strategy Policy Options – 2020 Emission Reduction and Cost Summary

GHG Reduction Policy Options	GHG Reduction (mmt CO ₂ e)	Total Additional Cost 2010 - 2020 (million \$)
Public Transportation	0.39 - 0.62	\$1,214 - \$1,765
Intercity Passenger and Freight Transportation	0.11	\$0.748
Bike and Pedestrian	0.16	\$0.598 - \$0.817
Transportation Pricing and Demand Management	0.24 – 2.01	\$0.300 - \$3,690
Transportation Technology	0.24	\$0.051
Evaluate GHG Impacts of Major Projects & Plans	N/A	N/A
Total 2020 GHG Reduction and Costs	1.14 – 3.14	\$2.911 – \$7,071

3.5 ADDITIONAL TRANSPORTATION SECTOR GHG EMISSION REDUCTION INITIATIVES (NOT QUANTIFIED)

Overview

MDOT and other Maryland agencies are collaborating on regional and state initiatives and programs that will result in GHG emission reductions from the transportation sector in 2020. These initiatives are documented in this section without quantified GHG emission reductions or costs because they are early in the planning and implementation process, and are not yet associated with specific projects and or identified funding.

In addition there are a number of management, maintenance, and operational activities ongoing or soon to be underway throughout MDOT that will result in GHG emissions from the transportation sector. These items are documented in this section in order to present the additional activities MDOT is undertaking to reduce or offset GHG emissions from the transportation sector. The magnitude of GHG emission reductions of these strategies are

unknown at this time, and in many cases the strategies affect stationary or point source transportation sector GHG emissions which are not modeled in this report.

State and Regional Initiatives

Blue Ribbon Commission

The Blue Ribbon Commission (BRC) on Maryland Transportation Funding is currently evaluating transportation funding shortfalls, identifying potential new revenue sources and any legislation required to initiate them, and the potential uses for additional transportation funds. The overall purpose of BRC is to review, evaluate and make recommendations concerning Maryland transportation funding, particularly related to:

- The current State funding sources and structure of the Maryland Transportation Trust Fund,
- Additional financial support to address MDOTs increasing need for air quality and climate change beneficial projects, and water resource management,
- Short and long-term transit, highway, and pedestrian/bicycle construction and maintenance funding needs,
- Options for public-private partnerships, including partnerships with local governments,
- The structure of regional transportation authorities and the ability of those authorities to meet transportation needs,
- The impact of economic development and smart growth on transportation funding, and
- Options for sustainable, long-term revenue sources for transportation.

A final report on findings and recommendations of the BRC is due to the Governor and General Assembly on or before November 1, 2011. To date, the BRC has investigated existing state revenue sources and yields, historic transportation expenditures in Maryland, alternative revenue and transportation funding programs in neighboring states, and potential new revenue sources in Maryland. The potential new primary revenue sources in Maryland investigated by BRC thus far includes increases in the vehicle titling, sales and use taxes, motor fuel taxes, vehicle registration fees, driver's license fees, and corporate income taxes. Also investigated are changes to MTA transit fare policy and toll rates on MDTA facilities.

Potential uses of alternative revenue sources into Maryland's Transportation Trust Fund include GHG beneficial strategies such as MTA capital expansion needs to address the doubling transit ridership goal, unspecified climate change/air quality related projects, and facilitation of future TOD projects.

The ultimate findings and recommendations of the BRC and the next steps taken by the General Assembly in 2011 and 2012 should help to address the significant estimated cost of the unfunded transportation GHG reduction strategies identified in this plan.

Electric Vehicles

MDOT has been working closely with MDE, MEA, Baltimore City and the Baltimore Electric Vehicle Initiative (BEVI) to select appropriate locations for 65 electric vehicle re-charging

stations around the state. Several of the re-charging stations will be located at MDOT and modal facilities such as MDOT Headquarters in Hanover, the BWI MARC / AMTRAK station, the BWI parking garage and park-and-ride lots maintained by SHA. MDOT's continued involvement in expanding the availability of electric vehicle recharging stations throughout the state will contribute to statewide GHG emission reductions and complement the efforts of the Maryland General Assembly, which has passed legislation approving electric vehicle tax credits and electric vehicle use of HOV lanes, and Governor O'Malley who has proposed legislation to create an Electric Vehicle Infrastructure Council, and establish a state income tax credit of 20 percent of the cost of electric vehicle charging equipment for individuals and businesses.

Transportation and Climate Initiative / NASTO Coordination

In June of 2010, the Secretary of the Maryland Department of Transportation, along with other transportation, environment and energy agency heads of eleven Northeast and Mid-Atlantic states and the District of Columbia, signed a declaration of intent to collaborate to:

- Improve the efficiency of the transportation system,
- Reduce roadway congestion,
- Upgrade public transport,
- Address the challenges of vehicle miles traveled,
- Reduce air pollution and energy use, and
- Ensure that long-term development is sustainable and enhances quality of life in communities within their jurisdictions

As an active member of the Transportation and Climate Initiative (TCI), MDOT will work with other state agency heads over the next three years to develop the most effective and efficient ways for states to meet their own energy, transportation and climate goals through state-based and regional strategies. As part of its three-year work plan, the TCI will focus development of state-level strategies and policies in four areas: alternative fuel and advanced technology vehicles, sustainable communities, freight movement, and information and communications technologies. While the framework is still under development, the TCI has the potential to generate a significant reduction in Maryland's transportation sector GHG emissions.

Transit Oriented Development (TOD) Designation

TOD is an important tool to help leverage future growth, public investments, and achieve Smart Growth and sustainable communities. Maryland has great TOD potential, with more than 75 existing rail, light rail, and subway stations, and dozens more proposed in the next 20 years. People living within a half mile of a transit station drive 47 percent less than those living elsewhere and are up to five times more likely to use transit.²

² http://www.mdot.maryland.gov/Planning/TOD/TOD_Basics.html

Legislation signed by Governor O'Malley in 2008 facilitates the development of TOD in Maryland by authorizing MDOT to use its resources to support "designated" TOD projects. Designated TOD projects are those that are good models of TOD, have strong local support, represent a good return on public investment, demonstrate strong partnerships, and can succeed with a reasonable amount of State assistance but not without state support.

Due to limited State and local resources, not all TOD projects that represent good sustainable development can be "designated" under this program. Instead, projects are prioritized that meet the criteria above and cannot succeed without public sector support. Designated projects could benefit from several potential tools, depending on the needs of the particular project at the particular stage of development. Among the benefits are prioritization for transportation funds and resources, financing assistance, tax credits, prioritization for the location of State offices and support from the State Highway Administration on access needs. As of June 2010, Maryland has designated the following 14 TODs for priority State support:

1. Aberdeen
2. Branch Avenue
3. Laurel
4. Naylor Road
5. New Carrollton
6. Odenton
7. Owings Mills
8. Reisterstown Plaza
9. Savage
10. Shady Grove
11. State Center
12. Twinbrook
13. Westport
14. Wheaton

TOD is consistent with Governor O'Malley's Smart, Green and Growing initiative that brings together state agencies, local governments, businesses and citizens to: create more livable communities, improve transportation options, reduce the state's carbon footprint, support resource based industry, invest in green technologies, preserve valuable resource lands, and restore the health of the Chesapeake Bay.

Carbon Neutral Corridor

Based on several ongoing initiatives within Maryland, MDOT in partnership with other state agencies has engaged in a unique project that takes a multidisciplinary approach to plan and evaluate policies, programs and actions to address energy efficiency and reduce GHG emissions.

The project titled the "Carbon Neutral Corridor" identifies strategies that focus on sustainable transportation, smart growth, land conservation and restoration, and energy efficiency practices that support a long-term goal of achieving significant reductions in carbon emissions. The project objective is the development of an implementation plan that will address specific actions and funding needs that would lead to eventual implementation of corridor strategies to reduce carbon emissions.

The selection in 2010 of the first project corridor, US 40 from the Baltimore City line to the Susquehanna River, was a critical first step in initiating the planning effort. Ongoing work in

2011 includes defining and testing multiple transportation, land use, conservation, and energy consumption scenarios, working with corridor stakeholders to build understanding of the Carbon Neutral Corridor concept and a coalition of support for corridor recommendations, and informing the public and seeking comment on corridor strategies for reducing GHG emissions from all economic sectors. The US 40 corridor's diverse transportation system, economy, and environment permits the recommendations of the US 40 corridor plan to be transferable to other areas in Maryland.

Crescent Corridor

Norfolk Southern's Crescent Corridor is expected to bring safety, environmental, and economic benefits to Maryland, including the creation of 1,800 green jobs in the next decade. Each year, the Crescent Corridor should divert more than 858,000 long-haul trucks from Maryland highways to the rails, especially along I-95. At the same time, it should conserve up to 2.8 million gallons of fuel and eliminate 31,000 tons of CO₂ emissions annually in Maryland by 2020.

The Crescent Corridor will provide Maryland shippers with a new high-speed intermodal freight option between the Northeast and Southeast that could reduce their annual logistics costs by nearly \$35 million. The development of a new intermodal facility in Greencastle, Pa., located in Franklin County near the border of western Maryland, is expected to open in early 2012.

The Crescent Corridor program of projects is estimated to cost \$2.5 billion for full development by 2020. There is no current plan for funding support from Maryland to NS, however MDOT, along with the National Capital Region Transportation Planning Board (TPB) have expressed support for the Crescent Corridor project. A critical concern of the TPB and MDOT (including the Hagerstown-Eastern Panhandle MPO) is that NS ensure that local impacts, including increased local truck traffic in the vicinity of intermodal facilities, noise, safety, grade crossing (conversion to separated grade crossings on major transportation routes), and hazardous materials considerations, are adequately addressed to the satisfaction of these entities as these projects are developed.

CSX Transportation's National Gateway initiative is described and quantified in Section 3.4 as an unfunded intercity freight transportation GHG reduction strategy.

PlanMaryland – Maryland Department of Planning

PlanMaryland, the State's first comprehensive plan for sustainable growth and development, presents an opportunity to address climate change mitigation and adaptation issues in Maryland, in the context of many related quality-of-life, economic, social and environmental goals. The strategies identified in TLU-2, Land Use and Location Efficiency, in the 2008 Climate Action Plan, are directly tied to the objectives of PlanMaryland and are overall consistent with Maryland's Smart, Green and Growing policies. MDP is working with MDOT and MDE with a focus on policies and programs implemented by 2020 to reduce dependence on motor vehicle travel (especially single-occupant vehicles). These policies and programs may include incentives and requirements for projects and regional land use patterns that shorten trip length and greatly facilitate the use of alternative transportation mode choices to reach employment,

shopping, recreation, education, religious and other destinations. The benefits of PlanMaryland are documented separately from this document through MDPs role in developing the Draft 2012 Implementation Plan. There are VMT related benefits associated with PlanMaryland that will accrue to the transportation sector.

Pay-as-you Drive (PAYD) Insurance – Maryland Insurance Administration

For Pay-as-you Drive Insurance, the Climate Action Plan identified a policy goal to make PAYD coverage available to all Maryland drivers as early as possible and to push for adoption of incentives or pilot programs for Maryland drivers. The Maryland Insurance Administration (MIA) led a workgroup in 2009 with MDOT, MDE, representatives from the insurance industry, representatives from consumer advocacy groups, and other stakeholders to explore options for implementing and marketing insurance policies that tie the cost of premiums to miles or hours driven. The workgroup agreed that while the extent to which PAYD insurance will reduce GHG emissions is unclear, it is beneficial to encourage the expansion of these programs in the state as they do offer more options to consumers. Based on a survey with insurance carriers, most indicated they will not offer PAYD due to the cost of developing the product and the regulatory environment MIA will continue to monitor the carriers and work with them to the extent that they would like to offer this product in the state; however, based on the carriers' timeframe, PAYD will not have an immediate impact on the reduction of GHG.

MDOT Modal Administration Activities

A sample of ongoing or planned administrative, management, maintenance, and operations strategies that will result in reductions in energy consumption from the transportation sector are listed below by agency. These strategies reduce GHG emissions through helping to decrease rates of energy consumption from transportation infrastructure and support facilities. Potential greenhouse gas reductions from these strategies are not calculated, as emissions from non-mobile sources are not estimated by MDOT. Partnerships with other agencies are noted.

Maryland Aviation Administration (MAA)

1. Purchased CNG buses for use as shuttles for the Consolidated Rental Car Facility.
2. Implemented Smart Park way-finding system in parking garages that results in reduced vehicle roaming for parking spaces.
3. Designated a "cell phone" lot to reduce vehicle circulation in the terminal area when awaiting pickup of an arriving passenger.

Maryland Port Administration (MPA)

1. Applied for and received EPA grants for demonstration emission reduction projects on MPA fleet vehicles, cargo handling equipment at MPA terminals, and on construction equipment at Hart Miller Island and Poplar Island.
2. Applied for and received EPA grant for a Port-wide assessment of technologies that can effectively reduce emissions related to cargo movement.
3. Retrofit and repowered tugs with anti-idling technology and new engines.

4. Flex-fuel vehicles, alternative fuel vehicle, and hybrid vehicles have been introduced into the MPA fleet.
5. Plans to install a fuel tank capable of storing E85 will be included in the new fuel island configuration at Dundalk Marine Terminal.

Maryland Transit Administration (MTA)

1. In addition to its ongoing replacement of the bus fleet in the Baltimore region with diesel electric hybrid buses (assessed as a TERM in section 3.3), MTA is installing new electric cooling systems on older buses that provide an additional 9 percent fuel savings. In total 259 older diesel buses in the MTA fleet have had this technology installed. All current and future hybrid buses already have this system built in.
2. Installed front-mounted bike racks on all local MTA buses in 2009 and 2010.
3. All 219 MTA "New Flyer" buses, as well as all new hybrids, are equipped with an idle shut down feature that turns the bus off after idling more than 10 minutes.

State Highway Administration (SHA)

1. SHA in partnership with DNR, and Department of Corrections has a target of planting one million trees by 2011.
2. Pilot Study ongoing to convert sign lighting to LED is 90 percent complete
3. Conversion of traffic signals to LED is 25 percent complete
4. Conversion of roadway lighting to LED is ongoing
5. MEA Partnership to support pilot wind energy project at Westminster Maintenance Shop.
6. Transition to bio-diesel is 100 percent complete at all facilities
7. E85 tank was installed at the Hanover Complex through MEA grant and E85 is being dispensed to SHA and MAA vehicles.
8. SHA is working with contractors to locate truck staging areas and to avoid unnecessary idling of construction equipment. Delivery truck idling at sites limited to 5 minutes.

Maryland Transportation Authority (MDTA)

1. E85 dispensers are being installed at the Baltimore Harbor tunnel, ICC Eastern Operations Facility and other locations.
2. The ICC Eastern Operations Facility will use geothermal heating and cooling
3. Message signs and lane signal indications are being replaced with LED lighting
4. For the Travel Plaza Reconstruction Projects, MDTA is specifying that the site/building design and construction seek to obtain Silver LEED Certification.
5. All new roofs are being done to LEED standards as cool roofs.

MDOT Headquarters

1. 75 percent of Headquarters fleet are hybrids

2. Pilot program for hydrogen fuel cell vehicles
3. Electric vehicle recharging system

4.0 2020 Transportation Sector Results

This section presents an overview of the total emission reductions anticipated from the Maryland transportation sector in 2020 and compares those results against two distinct metrics:

1. The MDOT, agency-specific reduction target of 6.2 mmt CO₂e given to MDOT by MDE in February 2011; and
2. The 25 percent statewide GHG emissions reduction goal established in the Maryland Greenhouse Gas Emissions Reduction Act of 2009.

4.1 2020 EMISSIONS REDUCTION OVERVIEW

Table 4.1 presents a summary of the total 2020 transportation sector emission reductions and costs broken down into the following categories: vehicle technologies; transportation fuels; funded and adopted Maryland Plans, Programs, and TERMS; and unfunded GHG reduction strategies that are all included in Section 3.0 of this document.

Table 4.1 Transportation Sector 2020 GHG Emission Reductions and Costs

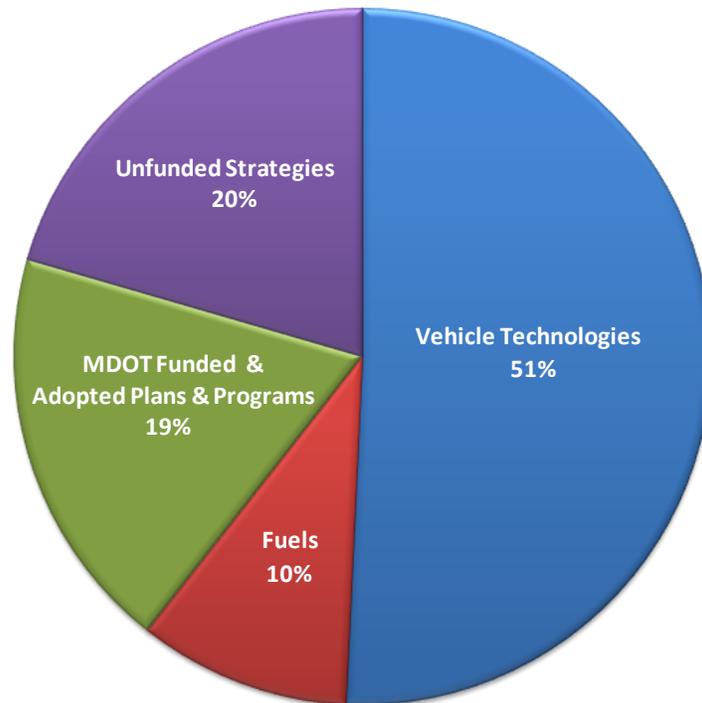
Transportation Sector GHG Reduction Strategy	2020 GHG Reduction (mmt CO ₂ e)	Total Cost (2010-2020) (billions \$)
Vehicle Technologies		
CAFE Standards (2008 – 2011 MY)	2.27	-
National Fuel Economy Standards (Federal) (2012 – 2016 MY)	3.19	-
Maryland Clean Car Program (2011 MY) & Maryland Clean Car or National Fuel Economy Standards (2017 – 2025 MY)	1.14	-
Proposed National 2014-2018 Medium and HDV Standards	0.88	-
Vehicle Technologies Total	7.48	-
Transportation Fuels		
Renewable Fuel Standard Program (RFS2)	0.24	-
Low Carbon Fuel Standard (5%)	1.21	-
Transportation Fuels Total	1.45	-

Transportation Sector GHG Reduction Strategy	2020 GHG Reduction (mmt CO ₂ e)	Total Cost (2010-2020) (billions \$)
Funded and Adopted Maryland Plans, Programs and TERMS		
Maryland Plans, Programs, and TERMS Total	2.79	\$13.219
GRAND TOTAL FOR ADOPTED PROGRAMS		
GRAND TOTAL for Vehicle Technology, Transportation Fuels, and Funded Programs	11.72	\$13.219
Unfunded GHG Reduction Strategies		
Land Use and Location Efficiency	--	<i>MDP Responsibility</i>
Public Transportation	0.39 – 0.62	\$1,214 - \$1,765
Intercity Passenger and Freight Transportation	0.11	\$0.748
Pay-as-you-Drive Insurance	--	<i>MIA Responsibility</i>
Bike and Pedestrian	0.16	\$0.598 - \$0.817
Transportation Pricing and Demand Management	0.24 – 2.01	\$0.300 - \$3,690
Transportation Technology	0.24	\$0.051
Unfunded Strategies Total	1.14 – 3.14	\$2.911 - \$7.071
GRAND TOTAL OF MDOT PROGRESS (ADOPTED AND UNFUNDED)		
GRAND TOTAL GHG Reductions and Costs	12.86 – 14.86	\$16.130 - \$20.290

The total emission reductions attributable to the transportation sector in 2020 are anticipated to range from 12.86 – 14.86 mmt CO₂e, with an estimated cost spanning \$16.130 - \$20.290 billion.

Figure 4.1 provides a breakdown of the transportation sector emission reductions by category. Notably, vehicle technologies and fuels, measures that result in little to no direct costs to the state, contribute 61 percent of the transportation sector’s 14.86 mmt CO₂e reductions in 2020. MDOT strongly supports these programs and is also committed to the funded and adopted plans and programs that contribute 19 percent of the GHG reductions. Based on future funding availability, the unfunded measures and strategies have the potential to contribute as much as 20 percent of the total 2020 transportation sector emissions reductions.

Figure 4.1 2020 Transportation Sector Emission Reductions by Sector Category



4.2 PROGRESS TOWARD THE MDOT AGENCY-SPECIFIC TARGET

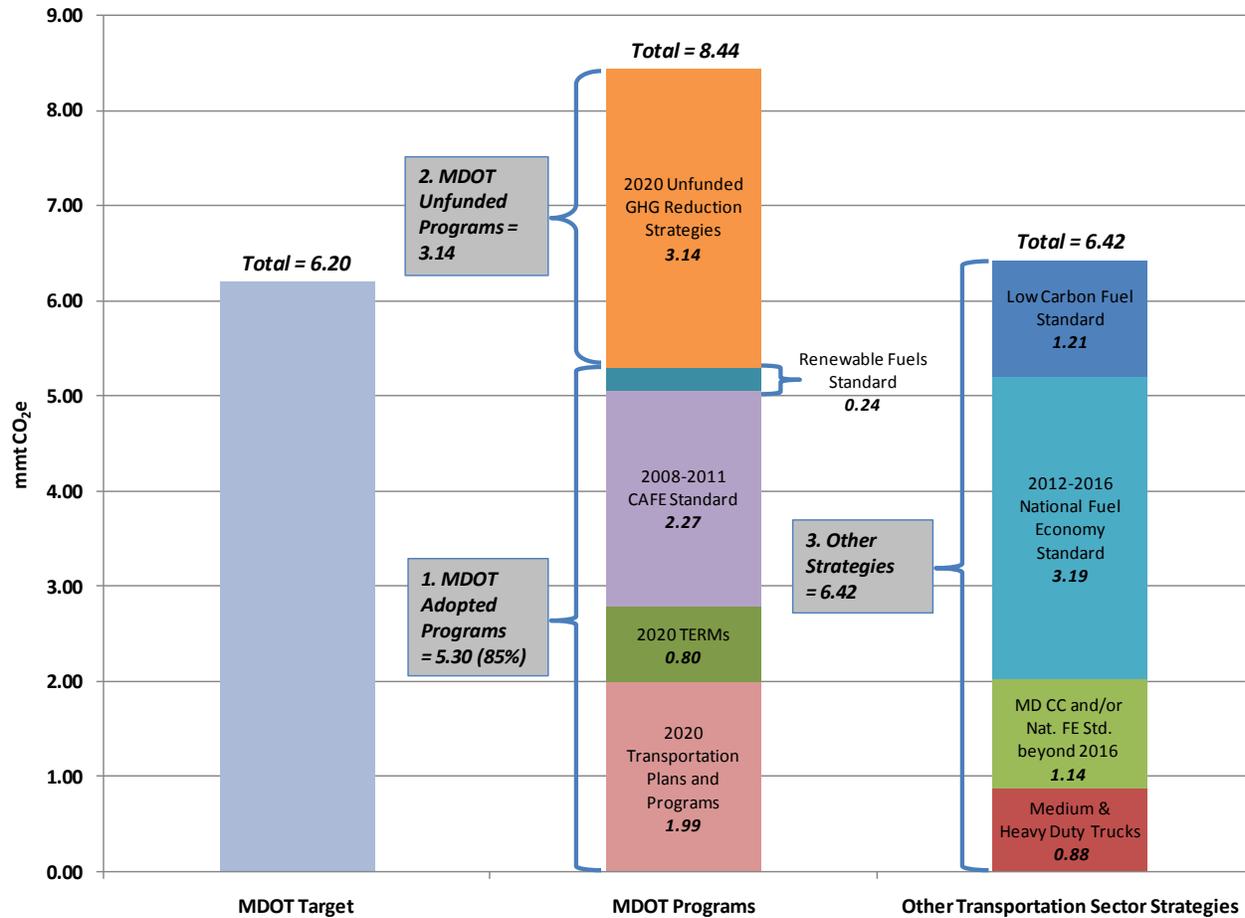
Figure 4.2 provides a summary of the 2020 transportation sector GHG emissions reductions within the context of the MDE-assigned 2020 GHG reduction target of 6.2 mmt CO₂e. The transportation sector reductions have been arranged into three categories for comparison purposes: (1) all MDOT adopted transportation programs, (2) MDOT unfunded transportation programs, and (3) other transportation sector strategies.

1. To date, MDOT has adopted programs that achieve approximately 5.30 mmt CO₂e reductions or 85 percent of the total 2020 target.
2. The unfunded GHG reduction strategies could yield an additional 1.14 - 3.14 mmt CO₂e reduction by 2020.

Should additional funding become available, in total the adopted programs and unfunded strategies would total 8.44 mmt CO₂e in 2020, or 136 percent of the 6.2 mmt reduction target.

3. By 2020, an additional transportation sector emissions reduction of 6.42 mmt CO₂e can be expected from the implementation of state and federal programs addressing cleaner fuels and improved fuel economy standards.

Figure 4.2 Maryland Transportation Sector GHG Emissions – Summary of 2020 GHG Reductions



4.3 TRANSPORTATION SECTOR PROGRESS TOWARD A STATEWIDE 25 PERCENT REDUCTION GOAL

As part of the Phase I and Phase II work program, MDOT used a 25 percent reduction in 2006 emissions as a benchmark to evaluate progress toward GHG reductions by 2020. Figure 4.3 illustrates the anticipated 2020 transportation sector reductions within the framework of a statewide reduction goal of 25 percent below 2006 levels by 2020. In order to achieve a 25 percent GHG emissions reduction from the transportation sector, a 17.16 mmt CO₂e reduction in emissions from the 2020 BAU forecast would be required. At the highest level of strategy implementation, 2020 transportation sector emission reductions could reach as much as 87 percent (14.86 mmt CO₂e) of the 25 percent GHG reduction goal for 2020. The figure further illustrates a 2.29 to 4.30 mmt CO₂e target shortfall for the transportation sector.

Figure 4.3 Maryland 2020 Transportation GHG Emissions Forecast and Reductions

