

Maryland Climate Action Plan

Draft Maryland Department of Transportation Implementation Status Report



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September 30, 2009



Maryland Department of Transportation

Maryland Climate Action Plan - Draft Implementation Status Report

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September 30, 2009

Table of Contents

Executive Summary	ES-1
Phase I.....	ES-1
Phase II	ES-2
1.0 The MDOT Climate Action Plan Implementation Process	1-1
Background.....	1-1
Process	1-1
Report	1-2
2.0 2006 Baseline and 2020 Base Forecast Greenhouse Gas Emissions	
Inventory Update	2-1
On-road Analysis Process.....	2-1
Forecasting Assumptions	2-2
Off-road Analysis Process	2-3
Forecasting Assumptions	2-4
Transportation Sector Inventory Results.....	2-4
3.0 2020 Transportation Sector Assessment	3-1
3.1 Technology Improvements and Fuels	3-2
Overview.....	3-2
Approach and Assumptions	3-2
Results	3-3
3.2 Existing Funded Plans & Programs	3-5
Overview.....	3-5
Approach and Assumptions	3-5
Results	3-7
3.3 Transportation Emission Reduction Measures (TERMs).....	3-8
Overview.....	3-8
Approach and Assumptions	3-9
Results	3-9
3.4 Transportation and Land Use Policy Options – Implementation	
Strategy Development and Analysis	3-12
Overview.....	3-12
Approach & Assumptions.....	3-12
TLU-2 Land Use and Location Efficiency.....	3-13
TLU-3 Public Transportation.....	3-14

TLU-5 Intercity Transportation.....3-14

TLU-6 PAYD Insurance.....3-14

TLU-8 Bike and Pedestrian.....3-15

TLU-9 Pricing3-15

TLU-10 Transportation Technologies3-16

TLU-11 Evaluate the Greenhouse Gas Emission Impacts of
Major Projects and Plans.....3-16

Strategy Implementation Barriers & Opportunities.....3-17

Results3-17

4.0 Next Steps.....4-1

List of Tables

Table ES.1 Summary of Phase I Strategies	ES-2
Table ES.2 2020 GHG Transportation Sector Emissions Summary	ES-3
Table 2.1 Maryland VMT Forecast and Annual Growth Rates	2-3
Table 2.2 Off-road Transportation Source Growth Rate Assumptions	2-4
Table 2.3 Maryland 2006 and 2020 VMT and GHG Emissions Reduction Goals.....	2-5
Table 3.1 Maryland 2020 Transportation GHG Emissions Forecast and Reductions	3-3
Table 3.2 2009-2014 CTP Projects by TLU Category	3-6
Table 3.3 2020 TERMS GHG Reductions and 2009-2020 Costs	3-11
Table 3.4 TLU Policy Options – 2020 Emission Reduction and Cost Summary	3-18

List of Figures

Figure 2.1 Maryland Transportation Sector GHG Emissions – 2020 GHG Reduction Goal and Target	2-5
Figure 3.1 Maryland Transportation Sector GHG Emissions - Technology Improvements and Fuels	3-4
Figure 3.2 Maryland Transportation Sector GHG Emissions - Existing Funded Plans and Programs	3-8
Figure 3.3 Maryland Transportation Sector GHG Emissions - Transportation Emission Reduction Measures (TERMs)	3-10
Figure 3.4 Maryland Transportation Sector GHG Emissions - Transportation and Land Use Policy Options	3-19

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 and in meeting the preliminary GHG reduction goals.

On May 7, 2009, the Governor signed into law the Maryland Greenhouse Gas Emissions Reduction Act of 2009 (Act) requiring Maryland to achieve a 25 percent reduction in 2006 emissions by 2020. The transportation sector contributes 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.

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 vehicle miles of travel (VMT) reductions. MDOT was also charged with working with the Maryland Insurance Administration (MIA) to expand deployment of 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.

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.

The MDOT work program established seven broad Working Groups for the TLU policy options, and a Coordinating Committee to oversee the process. The Coordinating Committee membership (see Appendix E) was designed to ensure full representation of all MDOT modal agencies, other relevant State agencies, along with providing local representation through the participation of Baltimore Metropolitan Council (BMC), Metropolitan Washington Council of Governments (MWCOG), Montgomery County and the City of Baltimore. Working Group membership (see Appendix E) was designated based on (1) agency relevance to the topic area, (2) to ensure broad cross-sectional representation among State, regional and local agencies, and (3) to maintain a manageable size and focus to each Working Group.

During Phase I, 21 TLU Working Group meetings were held, over 50 individual staff participated from 19 different agencies and 72 strategies were defined and evaluated. Strategies were summarized and ranked within each TLU working group by the following set of criteria:

- *Implementation Timeframe* – Short term (2010-2012), Medium term (2013-2020), and Long term (2020-2050)
- *GHG Reduction Potential* – High > 25 percent total TLU reduction, Medium < 25 percent and > 10 percent total TLU reduction, Low < 10 percent total TLU reduction
- *Implementation Cost* – High > \$100m, Medium > \$20m, Low < \$20m
- *Ease of Implementation* – Based on a combination of implementation timeframe and costs
- *Strategy Prioritization* –
 - Critical - essential to meeting the GHG reduction goal (*carried into Phase II*),
 - Important - supports critical strategies in meeting goal (*carried into Phase II*),
 - Value Added - adds value but is not essential to achieving the goal at this time (*excluded from Phase II at this time*)

Of the 72 strategies considered, 57 were considered critical or important and 44 capable of implementation by 2020. A macro-level assessment of the strategies is being completed as part of Phase II and will be further refined during later phases. Table ES.1 highlights the final prioritization of the Phase I TLU strategies.

Table ES.1 Summary of Phase I Strategies

Implementation Timeline	Strategy Prioritization			
	Critical	Important	Value Added	Total
Short (by 2012)	19	9	7	35
Mid (by 2020)	6	10	7	19
Long (>2020)	10	3	1	17
<i>Total</i>	35	22	15	72

PHASE II

Phase II was begun in July of 2009. This phase quantifies the GHG emissions from transportation infrastructure investments, transportation program investments, technology, and fuel programs and updated the transportation sector GHG emissions inventory. *The purpose of the Phase II work program is to quantify what contribution the transportation sector can make to meet the 2020 target included in The Maryland Greenhouse Gas Emissions Reduction Act of 2009.*

As defined by the Maryland Greenhouse Gas Emissions Reduction Act of 2009, the State is expected to achieve a 25% reduction from 2006 GHG emissions levels by 2020. *If the transportation sector contributes its proportional share to the State's goal, a 12.62 million*

metric ton (mmt) reduction in GHG emissions is required from the transportation sector by 2020 (see Section 2 for further detail).

The Phase II work program focused on six specific areas to account for potential GHG emission reductions. They include:

1. **The proposed national vehicle standards program** to improve fuel economy and reduce greenhouse gases. Defined by the Obama administration in May and formally proposed by USEPA and USDOT on September 15, 2009.
2. **The Maryland Clean Car Program** signed into law by the Governor in April 2007, adopts California’s more stringent vehicle emissions standards for cars sold in the state.
3. **USEPA proposed National Renewable Fuels Standards** program for 2010 and beyond requires renewable fuels program requires new volume standards to be used for transportation fuel.
4. **The funded transportation system investments 2006-2020.** Defined in the Maryland 2009 - 2014 CTP, Metropolitan Planning Organizations (MPOs) Transportation Improvement Programs (TIPs) and Long-Range Plans (LRPs) through 2020.
5. **Currently funded Transportation Emissions Reduction Measures (TERMs)** as defined in the 2009-2014 CTP and MPO TIPs and LRPs. This includes off-highway projects as defined by MAA and MPA.
6. **TLU strategies** defined by the Phase I Working Groups and Coordinating Committee.

A summary of the results of the Phase II analysis are included in the following Table ES.2.

Table ES.2 2020 GHG Transportation Sector Emissions Summary

Program Element	Annual GHG Emission Reduction (mmt)
1. Proposed National Fuel Economy Standard (Federal)	3.76
2. 2020 Maryland Clean Car Program	1.00
3. National Renewable Fuels Program	0.28
4. Maryland Plans and Programs	1.38
5. Maryland TERM Projects	0.73
6. TLU Analysis ⁽¹⁾	1.62 -3.16
2020 Total Potential GHG Emission Reduction	8.77 - 10.31

Note: (1) TLU GHG emission reductions are based on the type and level of deployment of specific of the TLU strategies (see Section 3 for more detail).

The capital investment in transportation infrastructure program and the TERM related projects represents a \$12.6 billion investment over the next 6 years. The initial capital cost estimate of the TLU strategies ranges from \$4.8 to \$6.0 billion. The TLU strategies represent nearly a 50% increase over currently funded transportation system capital investment identified in the CTP through 2014.

The GHG emission reductions accounted for in Table ES.2 account for 70% to 80% of the 2020 GHG emission reduction target goal (12.62 mmt). While this represents a significant reduction in GHG emissions from the transportation sector, the level of reduction comes with marked challenges in developing and implementing plans and programs, obtaining the necessary funding increases and addressing legislative and policy barriers.

The Phase II analysis prepared here does not consider the synergistic benefits from strategically deploying the TLU strategies in concert with one another. There will likely be multiplicative benefits achieved by logically programming these strategies. For example, logical combinations of corridor pricing and enhanced transit services or investment in transit with supportive pedestrian infrastructure and dense, mixed-use development are particularly critical interactions that need further study in Maryland. Subsequent phases of the MDOT work program will be designed to “bundle” or develop logical combinations of strategies to account for the synergistic benefits of these strategies. When implemented together, these “bundles” could obtain more significant long-term GHG reductions.

The Phase II analysis is also uniquely focused only on GHG reductions by 2020. The lengthy start-up time, review process, costs and accrual of benefits from land use and transportation decisions result in the transportation sector strategies taking much longer to realize benefits than in other economic sectors. In light of future targets being identified beyond 2020, continued reevaluation of transportation investment priorities and land use policies and additional improvements to fuel economy standards and continued fleet turnover will be critical for meeting potential post-2020 GHG reduction targets.

1.0 The MDOT Climate Action Plan Implementation Process

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 is composed of 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, and will report each year in November to the Governor and Legislature on progress in implementing the Climate Action Plan and in meeting the preliminary GHG reduction goals set in it.

In May 2009, the Governor 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 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 with working with the Maryland Insurance Administration (MIA) on expanding deployment of Pay-As-You-Drive insurance and the Maryland Department of the Environment (MDE) to implement transportation technologies to reduce GHG emissions per mile.

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 were held between February and May 14, 2009 and defined 72 total strategies. The Coordinating Committee reviewed and adjusted the strategy definitions, leading to a list of 44 strategies prioritized for detailed analysis in Phase II. Draft TLU implementation status reports were forwarded to MDE on May 22, 2009 and were presented to MDE on May 28, 2009.

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 is 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 project team briefed the Coordinating Committee and Working Groups on the Phase II work program on July 9, 2009 and will conduct another briefing outlining the results described in this report, on September 25, 2009.

REPORT

This report and associated appendices are designed to provide information and data to support the required updates to the Maryland Commission on Climate Change. Accordingly, the remainder of the report is organized in the following major sections.

Section 2 – 2020 Baseline Greenhouse Gas Emissions Inventory Update

- Establishes an updated transportation sector 2006 baseline GHG emissions inventory and a 2020 base forecast of GHG emissions.
- Determines the 2020 transportation sector GHG emissions target (25% below 2006 baseline emissions).

Section 3 – 2020 Transportation Sector Assessment

- Quantifies GHG reduction strategies associated with major new vehicle technology and fuel standards.
- Quantifies GHG reductions from the Maryland Consolidated Transportation Plan (CTP), Metropolitan Planning Organizations (MPOs) Transportation Improvement Programs (TIPs) and Comprehensive Long-Range Plans (CLRPs) through 2020
- Quantifies the GHG reductions from all Transportation Emissions Reduction Measures (TERMs) and off-highway projects (MAA & MPA).
- Refines the TLU strategy definitions and provides macro-level forecast of GHG emissions and capital costs requirements through 2020.

Section 4 – Next Steps

- Summarizes the potential next steps in the analysis, refinement of the MDOT climate change initiative.

Appendices

- A. Phase I TLU Implementation Status Reports
- B. TLU Detailed Analyses
- C. List of Maryland Plans and Program Projects
- D. List of TERMS
- E. Coordinating Committee and TLU Working Group Members

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

The updated greenhouse gas (GHG) inventory for Maryland’s transportation sector includes 2006 baseline and 2020 forecast analysis years. 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 assists in identifying the target reduction goals needed from the transportation sector, serves as a basis for TLU strategy analyses, and provides a benchmark from which to measure the potential benefits of vehicle technology programs. The inventory includes both on-road and off-road sources as defined by the Energy Information Administration (EIA).

The results presented here represent an update of previous analyses conducted by the Center for Climate Strategies (CCS) for the CAP. They include the revised 2006 base year (CCS reported 2005) and forecasts based on traffic count data (VMT-based) from the Maryland State Highway Administration (SHA), and forecasted growth rates from MPO travel demand models and planning documents.

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 is consistent with the EPA’s February, 2005 Fact Sheet (EPA420-F-05-004) and previous MDE emission inventories. The MOBILE6.2 model and available post processing software (PPSUITE) were used to facilitate GHG calculations. Revisions to the model default fuel economy assumptions were necessary to establish consistency with current CAFE standards and vehicle technology programs. The DRAFT MOVES 2009 model was used only to develop speed adjustments to the CO₂ emissions factors to support TLU strategy analyses.

EPA’s State Inventory Tool (SIT) was used to calculate estimates for on-road CH₄ and N₂O emissions based on the input of actual vehicle miles of travel (VMT) and SIT defaults for fleet characteristics and vehicle technology. The VMT is based on available 2005-2006 Maryland State Highway traffic data and reported 2006 Highway Performance Monitoring System (HPMS) VMT.

Forecasting Assumptions

The 2020 base forecast utilized the methodologies and tools consistent with the 2006 baseline. Additional considerations were made to address VMT growth and forecast vehicle fuel economy, both of which have a significant impact on projected CO₂ emissions. The original Maryland Climate Action Plan (CAP) forecast was based on HPMS historical growth rates only. Through consultation with MDE, it was determined that the updated forecast should consider the Metropolitan Planning Organization (MPO) transportation and land use forecasts used in the development of Transportation Improvement Programs (TIPs), Long Range Transportation Plans (LRTPs) and the State Consolidated Transportation Program (CTP). These plans and programs identify the committed and funded projects. The modeling conducted by each regional MPO includes the impact of the planned projects and the adopted regional demographic forecasts.

Fuel economy values were adjusted to reflect actual on-road performance based on recent fuel economy trends and projected fuel economy from proposed legislation and programs. This is an update, based on national research that was not included in Maryland's Climate Action Plan (CAP). Fuel economy values were adjusted to reflect actual on-road performance (typically 15% lower) using degradation factors provided in the AEO2009 data source (*EIA, Transportation Sector Model of the National Energy Modeling System, Model Documentation 2007, DOE/EIA-MO70 (2007)*).

Table 2.1 summarizes the growth rates of HPMS and MPO planning. The HPMS historical growth rate was based on county reported HPMS VMT totals for the 1990-2006 timeframe. Using HPMS data and this associated timeframe, the average statewide annualized growth rate was calculated to be 1.8 percent. This rate is consistent with the assumptions used in past GHG analysis efforts under the Maryland CAP.

The second scenario includes county growth rates obtained from MPO travel demand modeling summaries representing the most recent model sets used for conformity determinations. For rural counties not included in a MPO or travel demand model domain, HPMS historical growth rates were used. These growth rates reflect the impacts of expected future regional demographic projections from each MPO region and the impacts of planned transportation projects (highway and transit) in the regional TIPs and LRTPs. Under this scenario, the average statewide annualized growth rate is calculated to be 1.4 percent.

Table 2.1 Maryland VMT Forecast and Annual Growth Rates

County	Annualized 2006-2020 Growth	
	HPMS Historical (CAP)	MPO Modeling (Plans/Programs/Adopted Land Use)
Allegany	1.3%	1.3%
Anne Arundel	2.0%	1.4%
Baltimore	1.3%	1.2%
Calvert	2.5%	1.6%
Caroline	1.3%	1.3%
Carroll	1.9%	1.6%
Cecil	2.4%	1.3%
Charles	2.2%	1.8%
Dorchester	0.9%	0.9%
Frederick	2.5%	2.0%
Garrett	1.4%	1.4%
Harford	1.8%	2.4%
Howard	3.2%	1.9%
Kent	0.5%	1.3%
Montgomery	1.5%	1.0%
Prince George's	1.7%	1.0%
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%	2.4%
Wicomico	1.5%	1.5%
Worcester	1.3%	1.3%
Baltimore City	0.8%	0.6%
Statewide	1.8%	1.4%

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) EIA's 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 data 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 2.2 summarizes the off-road inventory growth rate data sources.

Table 2.2 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

TRANSPORTATION SECTOR INVENTORY RESULTS

The 2006 baseline and 2020 base transportation sector GHG emissions forecast are summarized in Table 2.3. The on-road analyses include data, methods, and procedures approved by MDE during the consultation process of developing the inventory methodology. Recent fuel economy trends not contained within the MOBILE6.2 model were updated to reflect EPA’s reported values in the report, “*Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2008*” (EPA420-S-08-003, September 2008). Off-road analyses utilized the SIT tool and updated information obtained from EIA.

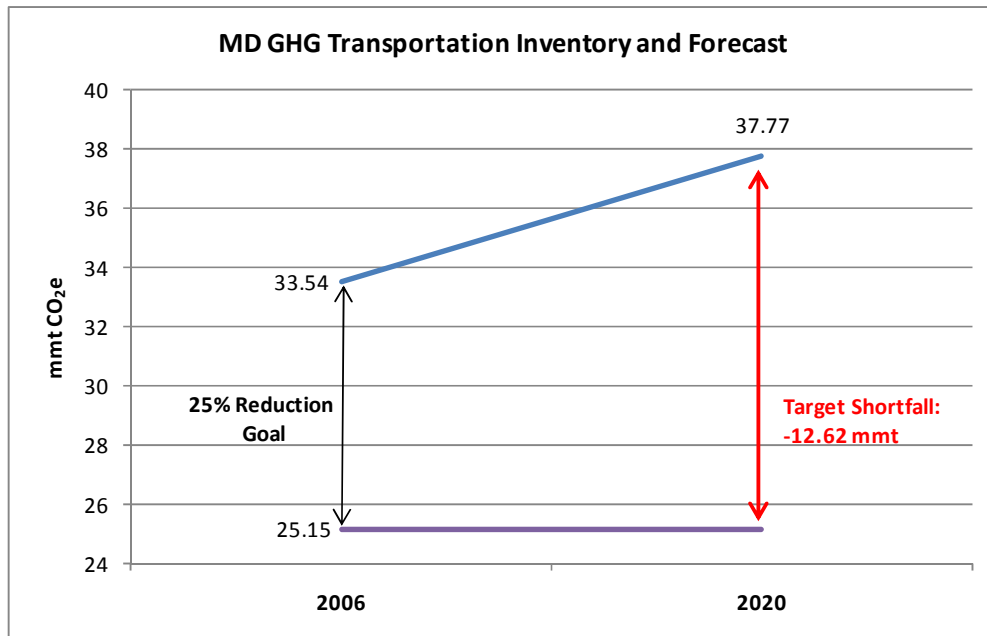
The *Greenhouse Gas Emissions Reduction Act of 2009* requires the State of Maryland to reduce statewide greenhouse gas emissions 25 percent from 2006 levels by 2020. To date, MDE has not assigned GHG emission reduction targets by sector, but as a point of comparison to meet a 25 percent reduction target, the transportation sector would strive to reduce GHG emissions by 12.62 mmt CO₂e (2020 base forecast – 25 percent goal).

Table 2.3 Maryland 2006 and 2020 VMT and GHG Emissions Reduction Goals

Scenario	2006 Baseline	2020 Base Forecast
VMT (in Millions)	56,618	67,357
On-Road	30.51	34.67
Off-Road	3.03	3.10

GHG Emissions	mmt CO ₂ e	mmt CO ₂ e
TOTAL GHG Emissions	33.54	37.77
GHG GOAL (25 percent below 2006)	25.15	
2020 GHG Reduction Target (2020 Base – Goal)		12.62

Figure 2.1 Maryland Transportation Sector GHG Emissions – 2020 GHG Reduction Goal and Target



3.0 2020 Transportation Sector Assessment

The 2020 transportation sector assessment identifies the GHG emissions reduction impact of anticipated vehicle technology improvements in fuel economy, revised renewable fuel standards, and currently funded transportation investment in Maryland through 2020. It also provides an assessment of the overall GHG emissions reduction benefit resulting from TLU strategies defined by the TLU Working Groups and Coordinating Committee. The TLU strategies focus on transportation investments, technology and other related programs that lead to a reduction in VMT, a reduction in fuel consumption and improved vehicle efficiencies.

The result indicates that MDOT and its partner agencies, through the Maryland Transportation Plan (MTP) goals of quality of service, safety and security, system preservation and performance, environmental stewardship and connectivity for daily life, also have developed a transportation plan that leads to significant GHG reductions from the transportation sector by 2020. These goals all help guide MDOT in a direction that is consistent with the objectives 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 - Technology Improvements and Fuels
- 3.2 - Consolidated Transportation Plan (CTP) and MPO TIPs and LRPs
- 3.3 - Transportation Emissions Reduction Measures (TERMs)
- 3.4 - Transportation and Land Use (TLU) Strategies

Each of these subsections provides an overview, a general approach, and a summary of results that include GHG emission reductions and preliminary estimated capital costs. All related information for projects included in the Maryland 2009 -2014 CTP, approved MPO plans and TERMS is presented in Appendix C and D. The detailed GHG emission reduction and cost assumptions for the TLU strategy analysis is presented in Appendix B.

3.1 TECHNOLOGY IMPROVEMENTS AND FUELS

Overview

Vehicle fuel economy standards are a key consideration in estimating future GHG emissions. The 2020 GHG inventory projection considers current CAFE standards as well as potential legislation that will further improve vehicle fuel economy. The technology improvements include:

- The Obama administration’s national policy aimed at increasing fuel economy and reducing GHG emission per mile for all new cars and trucks sold in the US, and
- The Maryland Clean Car Program that incorporates the California emission standards for model years through 2020.

For fuels, EPA has proposed revisions to the National Renewable Fuel Standard program that will require increases to the total amount of renewable fuels that must be used for transportation fuels each year. The revised statutory requirements include allowable GHG performance reduction thresholds for the renewable fuel categories.

Approach and Assumptions

The GHG emissions inventory projections reflect methodologies, data, assumptions, and tools developed in consultation with MDE. The 2020 base GHG emissions forecast for the transportation sources identified a **12.62 mmt GHG reduction target** (see Figure 2.1).

Assumptions have been made on each vehicle program based on the best available information at the time of the analysis. Legislative action or further program refinement could change or modify assumptions used to complete the GHG emission estimates. All fuel economy projections were adjusted to reflect actual on-road performance as discussed previously. Key program assumptions include:

- *Current CAFE Standards (Model Years 2008-2010)* – Vehicle model years through 2011 are covered under existing 2008-2011 CAFÉ standards that will remain intact under the Obama Administration’s national program. Fuel economy values have been projected based on information from the National Highway Traffic Safety Administration (NHTS).
- *National Program (Model Years 2012-2016)* – The light-duty vehicle fuel economy for model years between 2012 and 2016 were estimated based on the National Program proposed by the Obama administration and on September 15, 2009 jointly by USEPA and USDOT as referenced in the federal register, “*Notice of Upcoming Joint Rulemaking to Establish Vehicle GHG Emissions and CAFE standards*” (FR DOC E9-12009). Fuel economy improvements begin in 2012 until an average 250 gram/mile CO₂ standard is met in year 2016. This equates to an average fuel economy near 35 mpg.
- *MD Clean Car Program (Model Years 2011, 2017-2020)* – The MD Clean Car Program assumptions are based on the 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*”, Feb 25, 2008 and May, 2008 Addendum. These standards are

consistent with the National program but include several key differences: an earlier phase-in 2011 and continued reductions beyond 2016 until 2020.

The EPA issued a proposed renewable fuel standard in May 2009, which would mandate 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. The costs associated with implementing the proposed standard were based on the Draft Regulatory Impact Analysis: Changes to Renewable Fuel Standard Program, (EPA-420-D-09-001, May 2009). Estimated additional costs were calculated for Maryland, based on a low and high per barrel crude oil price of \$53 and \$92. The total gasoline consumption replaced with E85 and B20 was assumed to be 80,436,600 gal/yr and 34,472,828 gal/yr, respectively.

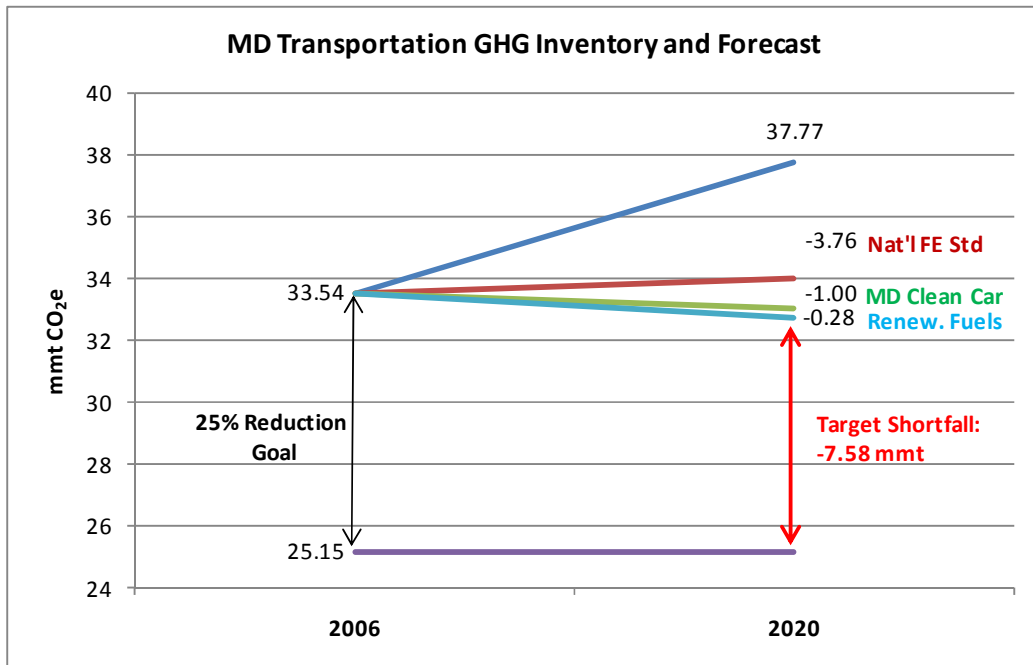
Results

The GHG reductions from the National Vehicle Program, the Maryland Clean Car Program, and renewable fuels reduce projected 2020 GHG emissions by **5.04 mmt** as shown in Table 3.1. These items represent a 13 percent reduction from the 2020 base forecast (37.77 mmt), that leaves a **7.58 mmt** target shortfall as shown in Figure 3.1. To better understand the relationship between VMT and GHG emission reductions; by 2020 a 1 mmt CO₂e reduction in GHG emissions is equivalent to a 2.4 billion or 3.6 percent reduction in VMT statewide.

Table 3.1 Maryland 2020 Transportation GHG Emissions Forecast and Reductions

GHG Emissions Reduction by Program	Annual GHG Emission Reduction (MMT CO ₂ e)
National Fuel Economy Standards (Federal)	3.76
Maryland Clean Car Program	1.00
Renewable Fuels	0.28
2020 GHG Emission Total	5.04

Figure 3.1 Maryland Transportation Sector GHG Emissions - Technology Improvements and Fuels



While this analysis focuses on 2020, it is important to highlight that preliminary 2030 GHG emissions forecasts provide significant 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 will eventually offset the benefit of the proposed improvements to vehicle technology and fleet turnover. 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 (90 percent below 2006 by 2050) and the proposed federal climate change legislation (42 percent below 2005 by 2030). Additional improvements to fuel economy standards and continued fleet turnover will be critical to meeting post-2020 GHG reduction targets.

3.2 EXISTING FUNDED PLANS & PROGRAMS

Overview

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

- 2009-2014 CTP
- BMC 2010-2013 TIP and 2035 LRP
- MWCOG 2010-2015 TIP and 2030 CLRP
- Hagerstown/Eastern Panhandle MPO (HEPMPO), Salisbury/Wicomico MPO, and Wilmington Area Planning Council (WILMAPCO) TIPs and LRPs
- 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 overall transportation infrastructure investment and the associated land use policies, statewide growth in VMT is 1.4 percent annually. This represents a slower rate of growth than was included in the Maryland Climate Action Plan developed in 2007.

The reduced growth in VMT contributes to a 1.38 mmt reduction in GHG emissions by 2020. The infrastructure investment that affects travel and congestion documented in the Maryland 2009-2014 CTP and MPO TIPs and LRPs represent a \$13.3 billion investment through 2020.

Approach and Assumptions

The 2020 base 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 associated timeframe, the average statewide annualized growth rate is 1.8%, which is consistent with the assumptions used for past GHG analysis efforts under the Maryland CAP.

To develop future year travel and GHG emissions estimates, 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 MPO and the impacts of planned transportation projects (highway and transit) in the regional TIPs and LRTPs. Under this scenario, the average statewide annualized growth rate is 1.4%.

The majority of the transportation funding that supports the funded transportation program is summarized in the MDOT's 2009-2014 Consolidated Transportation Plan (CTP). The total state 6-year capital program is **\$12.30 billion** and includes \$3.82 billion for MdTA projects.

Total capital funding for MPO long-range plans beyond the timeframe of the CTP includes \$6.33 billion in the MWCOG 2010-2015 TIP and 2035 CLRP, \$7.59 billion in the BMC 2030 LRP and \$0.46 billion in other Maryland MPO long range plans.

The total Maryland capital investment program, including the CTP and MPO LRPs, 2009 – 2020, is \$26.68 billion.

Projects that contribute to a change in VMT growth are a subset of the complete state capital program. These are roadway and transit infrastructure projects that act to reduce VMT and/or delay by adding capacity, improving flow, reducing bottlenecks 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 and SHA as well as regional and local transit operators. The total costs of these projects are **\$5.46 billion** and are summarized in Table 3.2 (approximately 44 percent of the capital program in the 2009-2014 CTP).

Table 3.2 2009-2014 CTP Projects by TLU Category

TLU	Projects	Total Cost (2009-2014) (billions \$)
TLU-2 – Land Use and Location Efficiency	1	\$0.01
TLU-3 – Transit	32	\$1.76
TLU-5 ⁽¹⁾ – Intercity	15	\$0.31
TLU-8 ⁽²⁾ – Bike & Pedestrian	31	\$0.37
TLU-9 – Pricing	2	\$2.77
TLU-10 – Technology	2	\$0.23

Notes:

- 1) CTP projects in TLU-5 include all capacity expansion and interchange improvements on interstate highways and intermodal connectors.
- 2) CTP projects in TLU-8 include all capacity expansion projects with an identified bike or pedestrian element in the project description. The costs represent total project cost.

Examples of CTP projects within each TLU are listed below:

- TLU-2: Owings Mills joint development project.
- TLU-3: Includes all MTA and WMATA capital projects in CTP (vehicle purchases, facilities and route expansion).

- TLU-5: Includes all highway capacity projects on interstate highway system routes and intermodal connectors. Also includes funding for Baltimore intercity bus terminal and MARC efficiency improvements.
- TLU-8: Combination of bike and pedestrian infrastructure inclusion in roadway projects as well as improved access to transit facilities (funding amount represents total project cost).
- TLU-9: Includes MdTA projects: Intercounty Connector and I-95 Express Toll Lanes.
- TLU-10: Includes transit LED sign replacement, MTA diesel-hybrid bus purchases, transit CAD/AVL system upgrades and high speed tolling at I-95 Fort McHenry toll plaza.

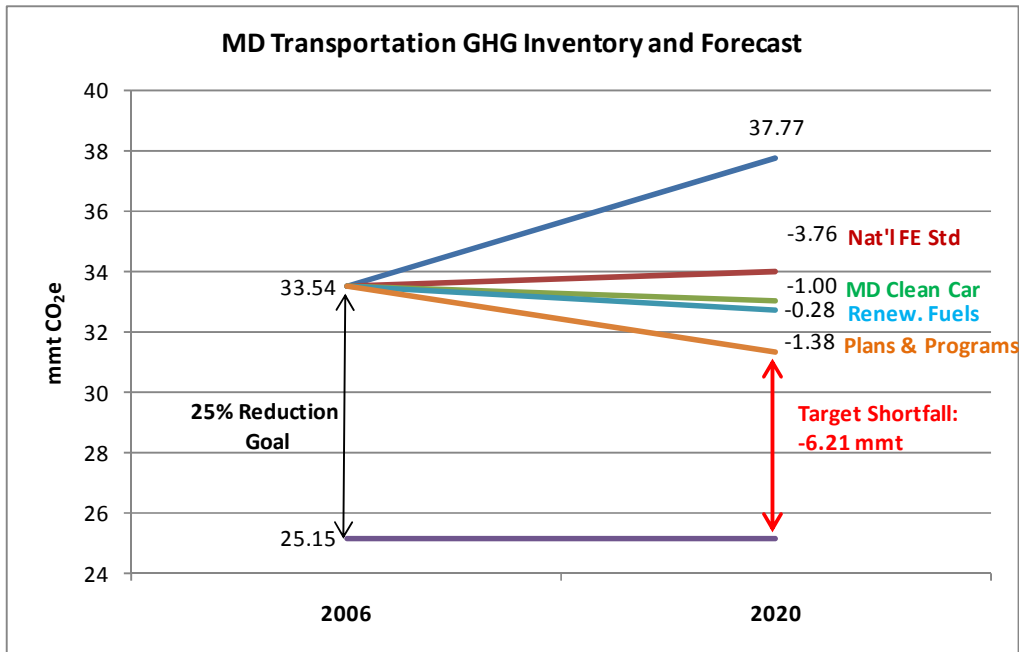
The total cost of the subset of projects contributing to changes in VMT growth in the MPO long range plans is \$7.84 billion. This set of projects includes construction of the Purple Line between Bethesda and New Carrollton (\$1.52 billion), construction of the Corridor Cities Transitway (\$0.87 billion), construction of the MTA Red Line (\$1.54 billion) and major capacity adding projects in the Baltimore and Washington DC urbanized areas. Further financial analysis reflecting updated costs and project assumptions will be included in Phase III of the study.

The total cost of the subset of projects contributing to changes in VMT growth, from the complete State capital program, 2009 - 2020, is \$13.30 billion (approximately 50 percent of the capital program 2009 - 2020).

Results

The total transportation sector 2020 base GHG emission inventory, including off-road emissions (ports, rail, airports) is 37.77 mmt (Figure 3.2). The GHG emissions associated with the funded programs results in 2020 GHG emissions of 36.39 mmt. This represents a 1.38 mmt reduction in GHG emissions. Figure 3.2 presents this reduction in comparison to the reductions from the vehicle technology and fuels strategies presented in Section 3.1. Implementation of the technology and fuel strategies, plus currently funded transportation plans and programs through 2020, accounts for 51 percent of the 2020 target shortfall of 12.62 mmt.

Figure 3.2 Maryland Transportation Sector GHG Emissions - Existing Funded Plans and Programs



3.3 TRANSPORTATION EMISSION REDUCTION MEASURES (TERMs)

Overview

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 mobile emission budget established 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 emission-reduction benefits. These measures are assessed in conformity documentation and include specific information on the costs and expected air-quality benefits.

TERMs identified in the 2009-2014 CTP and MPO TIP and LRPs as well as continuation of current programs such as Commuter Connections, CHART, Metropolitan Area Transportation Operations Coordination (MATOC) are assessed to determine estimates of GHG emission reductions and costs through 2020.

The cumulative costs of capital investment in TERMs 2009 – 2020 are \$658.04 million. In 2020 this results in an annual GHG reduction of 0.73 mmt CO₂e.

Approach and Assumptions

The range of TERMS considered are diverse in strategy, scope and implementation requirements (refer to Appendix B for the complete list and associated TLU correlation). The TERMS were organized into eight unique categories of strategies:

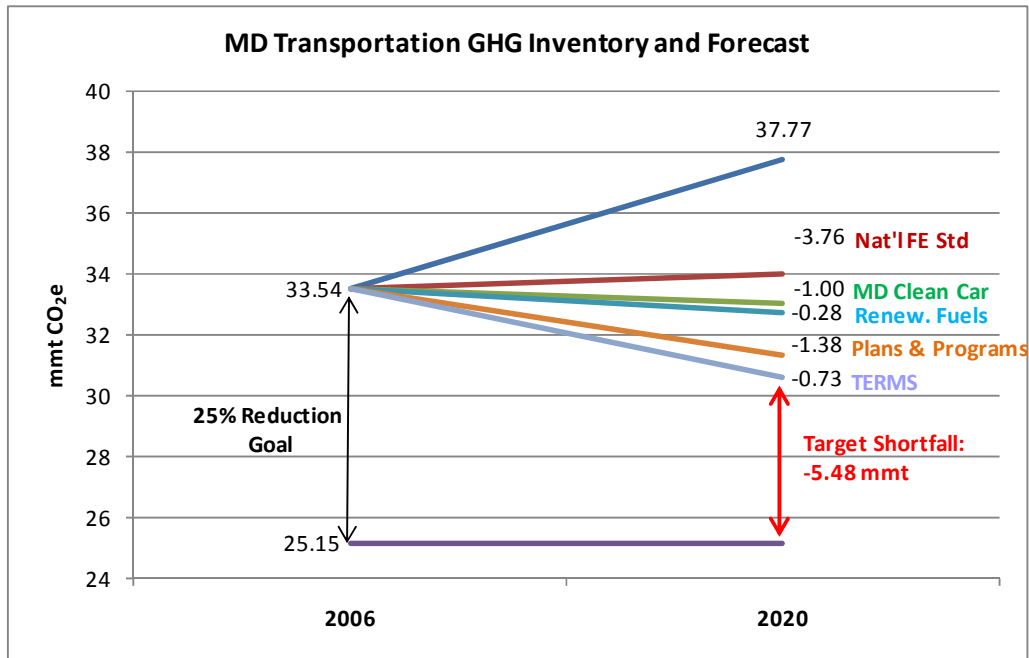
- **Clean Technology:** Truck idling (truck stop electrification or auxiliary power units), transit bus purchases, state fleet purchases
- **Commute Alternatives/Incentives:** Ridesharing (Commuter Connections), guaranteed ride home/fare-less cab, TDM program management and marketing, parking cash-out subsidies, transportation information kiosks, live-near-your work program, local carsharing programs, telework partnerships, parking impact fees, vanpool programs
- **Intelligent Transportation Systems:** CHART, MATOC, signal coordination/management
- **Outreach/Education Programs:** Clean Air Partners
- **Public Transit Amenities Improvement:** Station access improvements, bus stop programs, traveler information
- **Public Transit Service Improvement:** Activity center shuttle services, college pass program, state worker free transit program, free bus transfers and mid-day bus service, enhanced commuter and reverse commute service, added capacity at park-and-ride lots
- **Traffic Control:** Speed limit adherence, traffic signal LED upgrades
- **BWI Airport:** Aircraft taxi/idling/delay reduction strategies, vehicle fleet purchases, dedicated lanes, smart park facilities, APUs for ground service equipment, facility electricity usage

The air quality benefits of a large share of these strategies have been analyzed through BMC's and MWCOG's air quality conformity process. For these strategies, reductions in VMT or fuel consumption as estimated by BMC, MWCOG, MDOT and MDE are adjusted to reflect 2020 conditions and converted to GHG emission savings. For the strategies where a prior analysis 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.

Results

Figure 3.3 presents the results of the 2020 analysis, reflecting the GHG reduction from the combined effect of TERMS impact on VMT or fuel consumption. The equivalent total GHG reduction for each category is determined, resulting in a total 2020 GHG reduction of **0.73 mmt**. The TERM strategies are all exclusive of the VMT impacts and resulting GHG emissions from existing funded plans and programs analysis, ensuring that no double counting of benefits occurs. Implementation of the technology and fuel strategies, plus currently funded transportation plans and programs, including all TERMS, through 2020, accounts for 57 percent of the 2020 target shortfall of 12.62 mmt.

Figure 3.3 Maryland Transportation Sector GHG Emissions - *Transportation Emission Reduction Measures (TERMs)*



To date the GHG reduction benefits of projects planned at the Port of Baltimore have not been quantified. The majority of these strategies fall within either TLU-5 (Intercity) or TLU-10 (Transportation Technology). Potential projects to evaluate GHG emission reductions are:

- The EPA has awarded the MPA \$225,000 in grants for assessments of maritime vessel and drayage truck emission reduction technologies.
- Other priorities as listed in MPAs 2008 Strategic Plan that are anticipated to bring about GHG emission reductions in the future include:
 - Purchasing vehicles and equipment with the cleanest technology available.
 - Investigating other regional approaches to resolving congestion.
 - Investigating options for high-cube, double-stack rail service to terminals.

These strategies will be addressed and added into the transportation sector GHG emission reductions.

Implementation of many of the TERMS requires capital investments along with annual administrative and operations costs. The costs included in Table 3.3 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 in Table 3. The cumulative TERM implementation costs from 2009 to 2020 total **\$658.04 million**.

These costs are identified in three primary sources – 2009-2014 CTP, 2010-2015 MWCOG TIP, and BRTB 2010-2013 TIP. Total costs for annual programs such as CHART, Commuter Connections, Ridesharing, and Guaranteed Ride Home from these sources are annualized, and then expanded to obtain a cumulative 2009-2020 cost estimate.

Table 3.3 2020 TERMS GHG Reductions and 2009-2020 Costs

Project Type	Annual GHG (mmt)	Total Cost 2009-2020 (million \$)	TLU
Clean Technology	0.13	\$7.34	TLU-10
Commute Alternatives/Incentives	0.30	\$147.35	TLU-9
ITS - CHART/MATOC, Signal Systems	0.15	\$91.95	TLU-10
Outreach/ Education Programs	0.01	\$2.75	TLU-10
Public Transit Amenities Improvement	0.001	\$21.11	TLU-3
Public Transit Service Improvement	0.05	\$359.19	TLU-3
Traffic Control	0.07	\$28.35	TLU-10
BWI Airport	0.02	-	TLU-5
Total	0.73	\$658.04	

3.4 TRANSPORTATION AND LAND USE POLICY OPTIONS – IMPLEMENTATION STRATEGY DEVELOPMENT AND ANALYSIS

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 TLUs, and is a primary supporting agency on the two others. MDOT’s policy options are primarily focused on reducing GHGs emissions through vehicle miles of travel (VMT) reductions and technology improvements.

MDOT developed a multi-phase approach in order to address the responsibility of acting as the implementing agency for the TLU policy options. This section outlines the first two phases of MDOT’s on-going process to develop the MDOT Climate Action Implementation Plan. Phase I focused primarily on developing strategies under each policy option and conducting preliminary analyses of those strategies. The preliminary analysis conducted under Phase I was utilized to prioritize the strategies and identify those that would be the focus of more detailed analysis under Phase II of MDOT’s implementation efforts. Overviews of Phases I and II of MDOT’s Climate Action Implementation Plan are provided below.

The benefit of the 44 TLU strategies (Table ES.1) evaluated in Phase II is a 1.6 mmt to 3.2 mmt GHG reduction in 2020. The initial implementation cost estimate (capital costs only) of the Phase II TLU strategies from 2010 to 2020 is \$4,796 to \$6,002 million over the existing funded transportation plans and programs through 2020.

Approach & Assumptions

The goal of Phase I was to define, evaluate, rank, and determine the feasibility of a series of transportation strategies and actions, consistent with the Climate Action Plan, to assist Maryland in achieving GHG reduction targets while doing no social, economic, or environmental harm to Maryland and its citizens.

Phase I of MDOT’s implementation efforts began in January 2009 with establishing eight Working Groups, tasked with identifying implementation strategies for the TLU policy options, and a Coordinating Committee to oversee the process. The Coordinating Committee membership was designed to ensure full representation of all MDOT modal agencies, other relevant State agencies, along with providing local representation through the participation of MPOs and local governments. Working Group membership was designated based on (1) agency relevance to the topic area, (2) to ensure broad cross-sectional representation among State, regional and local agencies, and (3) to maintain a manageable size and focus to each Working Group.

From February 2009 through May 2009, over 50 unique participants attended a total of 21 meetings. The working groups identified and considered 72 policy option implementation strategies. The strategies focused on reducing greenhouse gases through improving transportation systems and operational efficiency, reducing the growth of VMT, transitioning to lower GHG fuels, and improving vehicle technologies. The range of strategies considered included policy and process changes, land use, technological advancements, pricing measures, travel demand management, and multi-modal infrastructure investment.

The working groups and the Coordinating Committee evaluated all 72 strategies qualitatively, considering each individual strategy's implementation timeframe, GHG reduction potential, implementation cost, and ease of implementation. Based on this set of criteria, the strategies were prioritized into three categories:

- Critical - those strategies essential to meeting the GHG reduction goal;
- Important - strategies that support the critical strategies in meeting the goal; and
- Value added, representing strategies, which add value but are not essential to achieving the goal at this time.

Strategies which were determined to have implementation timeframes within the short- to mid-term (2020 or before) and were prioritized as critical or important strategies were recommended by the Coordinating Committee for further analysis. A total of 44 of the 72 strategies developed under Phase I were recommended for further analysis under Phase II.

A complete copy of MDOT's Phase I Implementation Status Report, submitted to MDE on May 22, 2009, can be found in Appendix A.

The following text provides a brief description of each policy option, the strategies evaluated under Phase II and the primary challenges and opportunities envisioned when considering implementing these strategies. More detailed information, regarding the strategy analysis approach and assumptions can be found in Appendix B.

TLU-2 Land Use and Location Efficiency

The goal of TLU-2 is to identify strategies that result in the implementation of comprehensive, statewide land use planning and development, e.g. tools, policies, regulations, etc., which will reduce VMT and corresponding greenhouse gas emissions. In Phase I, the TLU-2 Working Group identified three primary strategy areas: energy conservation and location efficiency; integrated transportation, land use and development planning; and, statewide smart growth policy and legislation. The Working Group recognized that the greenhouse gas emission benefits of significant changes in statewide land use and location efficiency are unlikely to be realized by 2020. The Phase II approach considers the short-term impact of the following key strategy:

- Integrated Transportation, Land Use and Development Planning

TLU-3 Public Transportation

Consistent with the Maryland Climate Action Plan, this policy option identifies public transit strategies to reduce GHG emissions by doubling transit ridership in Maryland by 2020, and continuing that same growth rate beyond 2020. In order to achieve this growth, actions to increase the attractiveness and convenience of transit, improve the operational efficiency of the system, as well as adding capacity are required. Policies also involve supportive actions with regard to land use planning and policy, pricing (auto disincentives), and bike and pedestrian access improvements. Policies to reduce GHG produced by public transportation services are also included. The following strategies, defined by the TLU Working Group, are used to support the transit ridership goal defined in the Climate Action Plan (e.g. a doubling of 2000 transit ridership by 2020):

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

TLU-5 Intercity 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 rail corridors and enhanced intermodal freight connections at Maryland’s intermodal terminals and ports. In Phase I, the TLU-5 working group identified the following strategy as the primary pre-2020 strategy for analysis under Phase II:

- Improving Passenger Convenience for Intermodal Connections at Airports, Rail Stations, and Major Bus Terminals

TLU-6 PAYD Insurance

For TLU-6, 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 by 2012. In Phase I, PAYD Insurance was carried forward as a priority pre-2020 TLU strategy.

TLU-8 Bike and Pedestrian

This policy option seeks to increase the bicycle and pedestrian mode share to 15 percent of all trips in urbanized areas. The policy includes infrastructure design and construction policies and funding, regulatory and land use strategies improving bike and pedestrian amenities, and education and marketing measures. Increasing the number of trips made on foot or bicycle will reduce the number of vehicle trips, resulting in a reduction in GHG emissions. This policy also recognizes that local governments are responsible for the design and maintenance of approximately 80 percent of roads in Maryland. The following strategies were considered for implementation prior to 2020 through the Phase II analysis:

- Promote Use and Regular Review/Updates to Existing Manuals and Standards
- Complete Streets – Improve Bike/Pedestrian Access and Mode Options
- Update Existing Land Use Policy Guidance
- Bike Facility Placement at Strategic Locations
- Provide Funds for Low-Cost Safety Solutions
- Increase Funds for Capital Projects
- Education and Encouragement of Non-Motorized Modes

TLU-9 Pricing

This policy option addresses pricing and incentives, transportation choices and identifies alternate funding sources for GHG beneficial programs. Evaluating pricing and incentive options will reflect the true environmental and social costs of our transportation choices. These strategies can amplify GHG emission reductions by supporting Smart Growth incentives and transit investments. The draft MDOT policy design, developed by the TLU-9 working group in Phase I, considers four potential strategy areas combined with an education component for state and local officials: VMT fees, congestion pricing and managed lanes, parking impact fees and employer commute incentives. The following strategies were considered in the Phase II analysis:

- VMT Fees
- Parking Impact Fees
- Congestion Pricing / Managed Lanes
- Commuter Incentives
 - Provision of Alternative Mode Information
 - Provision of Transit Subsidies

- Ridesharing / Ridematching Programs and Incentives
- Vanpools
- Guaranteed Ride Home Statewide
- Telecommuting
- Alternate Work Schedules
- Trip Reduction Requirements

TLU-10 Transportation Technologies

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 evaluated under Phase II:

- Active Traffic Management and Traffic Management Centers
- Traffic Signal Synchronization / Optimization
- Initiate Marketing and Education Campaigns to Operators of On- and Off-Road Vehicles
- Timing of Highway Construction Schedules
- Green Port Strategy
- Reduce Idling Time in Light Duty Vehicles, Commercial Vehicles, Buses, Locomotives, and Construction Equipment
- Promote and Incentivize Fuel Efficiency Technologies for Medium and Heavy Duty Trucks
- Incentivize Fuel Efficient and Low GHG Vehicle Purchase (On-Highway Vehicles)

TLU-11 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 TLU 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

Strategy Implementation Barriers & Opportunities

It is important to note that the strategies outlined above will generate opportunities as well as presenting challenges or barriers, which must be addressed in order for the strategies to be implemented as evaluated in this Phase II analysis. Several of those implementation barriers and opportunities are outlined below.

Financial – In a time of budget shortfalls, a significant increase in current funding would be necessary to effectively implement many of the strategies outlined above. In addition to increased funding needs, MDOT must also address a loss in revenue generated by the state’s gasoline tax resulting from vehicle technology improvements and decreases in VMT. The impact of this loss will worsen as the TLUs are implemented, particularly if the issue goes unaddressed by either a compensating increase in the state gasoline tax or the implementation of a new/complimentary revenue generating mechanism.

Social – The social, environmental, and economic impacts of the TLU strategies will be distributed differently among the socioeconomic groups in Maryland. With sufficient political will and careful consideration of the program design—the TLU strategies can avoid social, environmental or economic harm.

Programmatic – Some of the implementation strategies will face programmatic challenges surrounding changes or workarounds to current policy and operations. In order for effective strategy implementation, some strategies will require the state and locals to forge new and innovative working relationships. In addition, some of the strategies will require the development of new tracking or accounting mechanisms.

Political – Taxes, especially given the current economy, are difficult to institute or change. Increases in fees, taxes, and tolls will face challenging political barriers. While the strategies were mindfully developed with consideration of environmental justice and equity concerns, there may be some strategies that by their very nature could pose challenges.

Opportunities –The implementation of several of the policy options would also afford MDOT opportunities to realize co-benefits within the transportation sector, such as a reduction in criteria air pollutants, safety enhancements, and energy security. In addition, MDOT, and the State of Maryland, has positioned itself to take a leadership-by-example role, which can facilitate interaction in the national climate change policy debate as legislation and policy are formed.

Results

This section presents the results of the Phase II TLU strategy analysis (Table 3.4). The GHG reduction estimates summarized here are assumed to represent GHG reductions beyond the benefits of the currently funded state transportation program. The preliminary cost estimates of the TLUs included in this analysis represent additional capital costs that are not included in any state or MPO plan. 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.

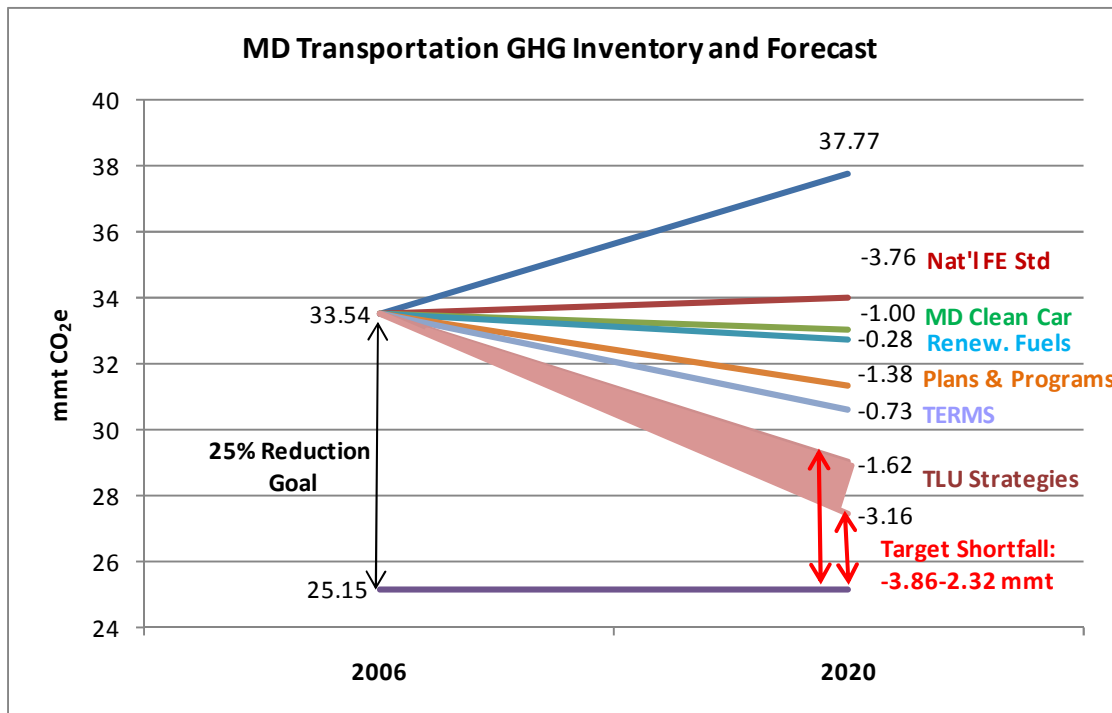
A more detailed summation of the analysis conducted for each policy option, including an overview and definition of the TLU policy option, approach to the analysis, assumptions and results, is provided in Appendix B.

Table 3.4 TLU Policy Options – 2020 Emission Reduction and Cost Summary

GHG Reduction Strategies	GHG Reduction (mmt CO₂e)	Total Additional Cost 2010 -2020 (million \$)
<i>TLU-2 Land Use and Location Efficiency</i>	0.18 – 0.24	N/A
<i>TLU-3 Public Transportation</i>	0.45	\$1,550.0 – \$1,740.0
<i>TLU-5 Intercity Travel</i>	0.02	N/A
<i>TLU-6 PAYD Insurance</i>	0.26	N/A
<i>TLU-8 Bike and Pedestrian</i>	0.10 – 0.15	\$597.0 - \$817.0
<i>TLU-9 Pricing</i>	0.41 – 1.84	\$2,599.0 - \$3,395.0
<i>TLU-10 Transportation Technology</i>	0.20	\$50.0
<i>TLU-11 Evaluate GHG Impacts of Major Projects & Plans</i>	N/A	N/A
Total 2020 GHG Reduction	1.62 – 3.16	\$4,796 – \$6,002.0

The benefit of the TLU strategies evaluated in Phase II is a **1.6 mmt to 3.2 mmt** GHG reduction.

Figure 3.4 Maryland Transportation Sector GHG Emissions - Transportation and Land Use Policy Options



After accounting for the GHG reduction benefits of vehicle technology and fuel strategies, currently funded transportation plans and programs, and TERMS, the remaining target shortfall in 2020 is 5.48 mmt. Implementation of the eight TLU policy options at different levels of deployment create a range from a 1.62 to 3.16 mmt reduction in 2020, thus accounting for 30 to 60 percent of the target shortfall. At the highest level of potential TLU strategy deployment through 2020, plus the benefits of the existing statewide transportation sector strategies, the transportation sector can achieve a reduction of 82 percent of the 2020 shortfall. In other words, compared to the Climate Action Plan and Maryland GHG Emission Reduction Act goal of a 25 percent reduction of 2006 emissions in 2020, the transportation sector could reduce GHG emissions by 20.4 percent in 2020.

The initial cost estimate of the TLU strategies as identified in Table 3.4, add total implementation costs (capital investment only) of **\$4,796 to \$6,002 million** over the existing funded transportation plans and programs through 2020. As a point of reference, the existing funded transportation plans and programs 2009-2014 total \$12,301.9 million. Therefore, this potential level of investment represents roughly a 40 to 50 percent increase in funded transportation system capital investment in the 2009-2014 CTP.

4.0 Next Steps

The remainder of the Phase II process will include supporting MDOT, the modal agencies, MPOs, local jurisdictions and MDE in presenting the results of the work program and making any refinements necessary to support the overall Commission schedule. Any refinements to the report resulting from the Coordinating Committee meeting or the Commission meeting will be made prior to the November 2009 annual submittal to the Governor and General Assembly.

Based on the MDOT, MDE and the Commission review, there may be several subsequent actions that will continue to refine this work, and to meet the deadlines included in the Greenhouse Gas Reduction Act of 2009. These actions could include:

- Refining the transportation sector baseline and forecast inventories for 2006 and 2020, based on further Federal or State guidance.
- Developing and testing logical strategy “bundles” that could obtain more significant long-term GHG emission reductions.
- Detailing the potential equity impacts, including economic, development and environmental justice considerations.
- Documenting the co-benefits, including the effects the strategies will have on criteria air pollutants and mobile source air toxics; safety; congestion; and energy security.
- Identifying barriers to implementation, including political and legislative obstacles, and realistic strategy implementation timeframes.
- Focusing more intently on strategies that will do more to address future years (2030 and 2050) GHG emission reduction targets.
- Continuing outreach and coordination activities with the modal agencies, MPOs, other state agencies and the local jurisdictions to build consensus, gain buy-in and assist in the planning and implementation of the transportation sector climate change related strategies.

It is important to recognize that the mandated GHG emission reduction by 2020 represents a starting point to achieve climate change goals established in the Act, which will also set a target reduction for 2050. Continued refinement of this work will allow MDOT focus on defining an overall transportation investment program that will help support the State’s GHG emission reduction targets over both the short and long term. Recognizing the key program elements that will help support the State goals and understanding the barriers to implementation will ensure that the GHG emission reduction strategies are thoughtfully prioritized and ultimately address the fundamental goals and objectives of the Maryland Statewide Transportation Plan, MPO plans or the roles of MDOT modal agencies.