Maryland Climate Action Plan

Draft Maryland Department of Transportation Implementation Status Report

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Maryland Climate Action Plan – Draft Implementation Status Report

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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 GHG 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. 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 to work with the Maryland Insurance Administration (MIA) to expand deployment of Pay-as-You-Drive (PAYD) insurance in Maryland and to work with 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 and other relevant State agencies. The Working Groups provided technical guidance and included local representation though the participation of the Baltimore Metropolitan Council (BMC), the Metropolitan Washington Council of Governments (MWCOG), Montgomery County and the City of Baltimore. Membership in each Working Group (see Appendix E) was determined based on (1) assuring agency relevance to each specific topic area, (2) ensuring broad cross-sectional representation among State, regional and local agencies, and (3) maintaining a manageable size and focus for 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. The 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 the 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 (see Appendix A for the strategy listing). 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
Total	***35***	***22***	***15***	***72***

PHASE II

Phase II began 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 the 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 percent 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, which was formally proposed by USEPA and USDOT on September 15, 2009.
2. **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.
3. **USEPA's proposed National Renewable Fuels Standards** program for 2010 and beyond, which requires new volume standards to be used for renewable transportation fuels.
4. **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.
5. **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.
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 Reduction Summary

Program Element	Annual Year 2020 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 the transportation infrastructure program and the TERMs represent a combined $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 percent increase over the current transportation system capital investment identified in the CTP through 2014.

The GHG emission reductions documented in Table ES.2 account for 70 percent to 80 percent of the 2020 GHG emission reduction target goal (12.62 mmt). This represents a significant reduction in GHG emissions from the transportation sector. Attaining this level of reduction requires successfully implementing plans and programs, obtaining 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 combining 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 for 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 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, and will report each year in November 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 Insurance Administration (MIA) on expanding deployment of Pay-As-You-Drive insurance and to work with 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 conducted 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 percent 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 Prograrm (CTP), Metropolitan Planning Organizations (MPOs) Transportation Improvement Programs (TIPs) and Long-Range Plans (LRPs) 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 forecasts of GHG emissions reductions 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 the 2006 baseline and the 2020 base forecast year. The inventory was calculated by estimating emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) then converting those emissions to carbon dioxide equivalents that are measured in the units of million metric tons (mmt CO_2e). Carbon dioxide represents about 97 percent of the transportation sector's GHG emissions. The 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 are 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 CO_2 emissions factors to support TLU strategy analyses.

EPA's State Inventory Tool (SIT) was used to calculate estimates for on-road CH_4 and N_2O emissions based on the input of actual VMT and SIT defaults for fleet characteristics and vehicle technology. The VMT estimate 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 CO_2 emissions. The original Maryland CAP forecast was based on HPMS historical growth rates only. Through consultation with MDE, it was determined 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. 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 the Maryland CAP. Fuel economy values were adjusted to reflect actual on-road performance (typically 15 percent lower) using degradation factors provided in the Annual Energy Outlook 2009 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 included in HMPS and from recent MPO plan forecasts. 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 is forecast 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 land use policy based future regional demographic projections from each MPO region 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 for VMT is forecast 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%***

Table 2.2 Maryland 2006 and 2020 Base VMT Forecast

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

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 CO_2, CH_4 and N_2O emissions. The SIT methodologies for estimating CO_2 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 CO_2 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 CH_4 and N_2O 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's (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 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

TRANSPORTATION SECTOR INVENTORY RESULTS

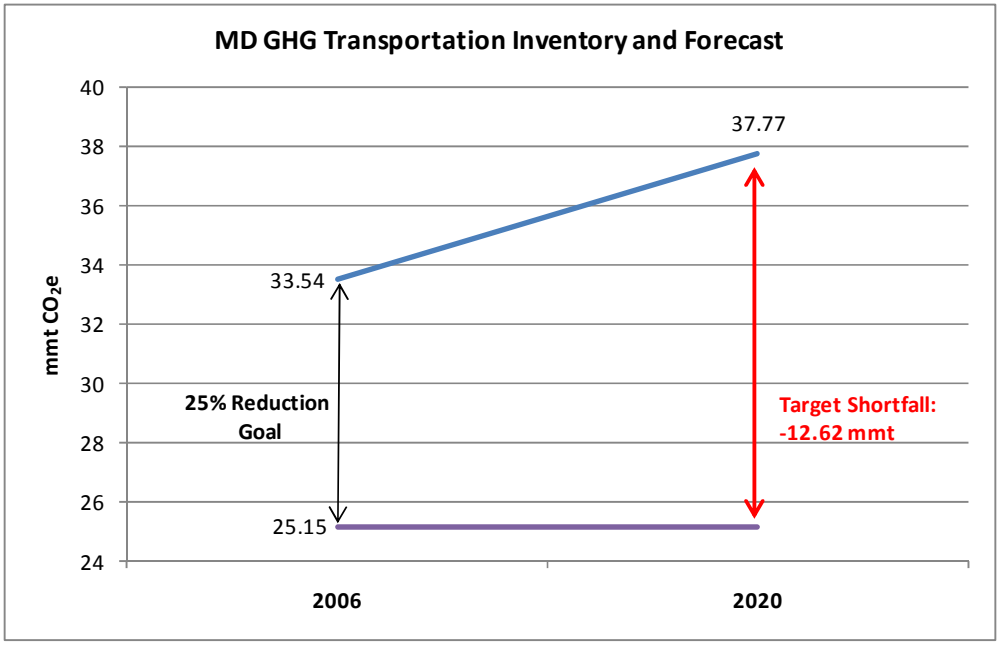
The 2006 baseline and 2020 base transportation sector GHG emissions forecast are summarized in Table 2.4. The on-road analyses include data, methods, and procedures approved by MDE during the consultation process of developing the inventory methodology. Recent fuel economy trends not contained within 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 CO_2e (2020 base forecast minus the 25 percent goal).

Table 2.4 Maryland 2006 and 2020 GHG Emissions Reduction Goals

GHG Emissions (mmt CO2e)	**2006 Baseline**	**2020 Base Forecast**
On-Road	30.51	34.67
Light Duty	23.37	25.78
Medium/Heavy Duty Truck & Bus	7.14	8.89
Off-Road	3.03	3.10
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 current 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's Maryland Transportation Plan (MTP) leads 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 - 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. 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 2010 are covered under existing CAFE 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 (NHTSA).
- *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 CO_2 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 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*", February 25, 2008 and May,

2008 Addendum. These standards are consistent with the national program but include several key differences: an earlier phase-in by 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 CO_2 emissions in 2030. For this analysis, a 1 percent overall reduction in 2020 on-road emissions was assumed to result from the implementation of the 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.

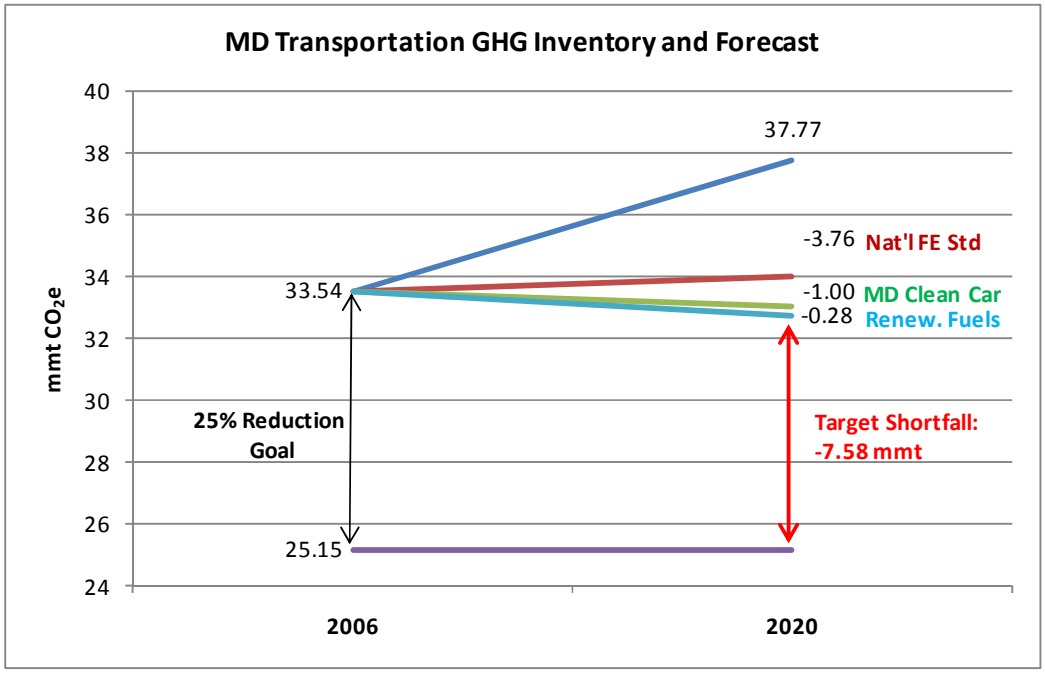
Results

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 CO_2e 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_2e)
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 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. The goal of the TLU 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 (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 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's proposed transportation investments through 2020.

- Maryland 2009-2014 CTP
- Baltimore Regional Transportation Board (BRTB) 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 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.

The reduced forecasted rate of growth in VMT contributes to a 1.38 mmt reduction in GHG emissions by 2020 compared to the 2020 base forecast. 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 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.

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 MPO 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. Project level analyses were not performed. The systemwide GHG reductions in 2020 are equiavalent to the VMT difference between the base VMT growth rate (1.8 percent) and the 1.4 percent VMT growth rate.

The majority of the transportation funding that supports the approved transportation program is summarized in the Maryland 2009-2014 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 2030 CLRP, $7.59 billion in the BRTB 2035 LRP and $0.46 billion in other Maryland MPO long range plans.

The total fiscally constrained Maryland capital investment program, including the CTP and MPO LRPs, 2009 – 2020, is estimated to be $26.68 billion.

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 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 illustrates groupings of applicable 2009-2014 CTP projects by TLU policy option.

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 the 2009-2014 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 and/or system efficiency in the MPO long range plans is $7.84 billion. This set of projects include 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 and/or system efficiency, from the complete State capital program, 2009 – 2020, is $13.30 billion (approximately 50 percent of the capital program 2009 – 2020).

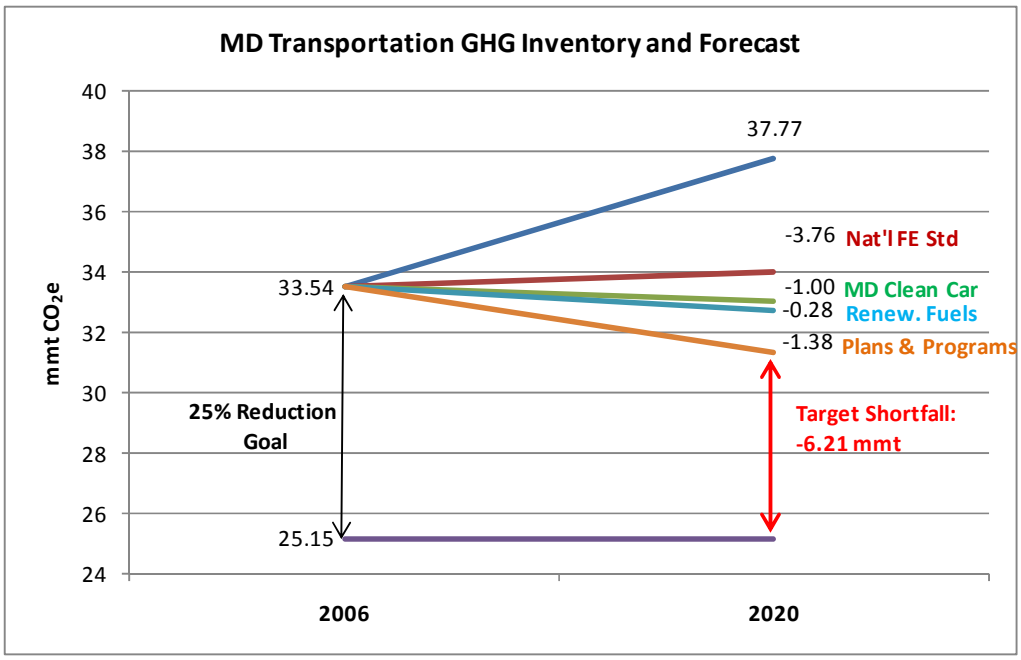
Results

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 existing plans and programs results in a 2020 VMT reduction of 3.294 billion vehicle miles traveled and a GHG emissions reduction of 1.38 mmt. Table 3.3 provides a VMT summary and Figure 3.2 presents the 1.38 mmt GHG emissions reduction in comparison to the vehicle technology and fuels strategies presented in Section 3.1. Implementation of the technology and fuel strategies, plus existing transportation plans and programs through 2020, accounts for 51 percent of the 2020 target shortfall of 12.62 mmt.

Table 3.3 Maryland 2020 Base Compared to 2020 Plans & Programs VMT

Scenario	2020 Base Forecast	2020 Base Forecast less Plans & Programs
Annual VMT (millions)		
Light Duty	63,878	60,884
Medium/Heavy Duty Truck & Bus	6,775	6,475
TOTAL VMT (in Millions)	70,653	67,359

Figure 3.2 Maryland Transportation Sector GHG Emissions - *Existing 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 the mobile emission budget established for the criteria pollutants such as NOx, 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.

TERMs identified in the 2009-2014 CTP and MPO TIPs and LRPs to meet criteria pollutant targets, 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 CO_2e.

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

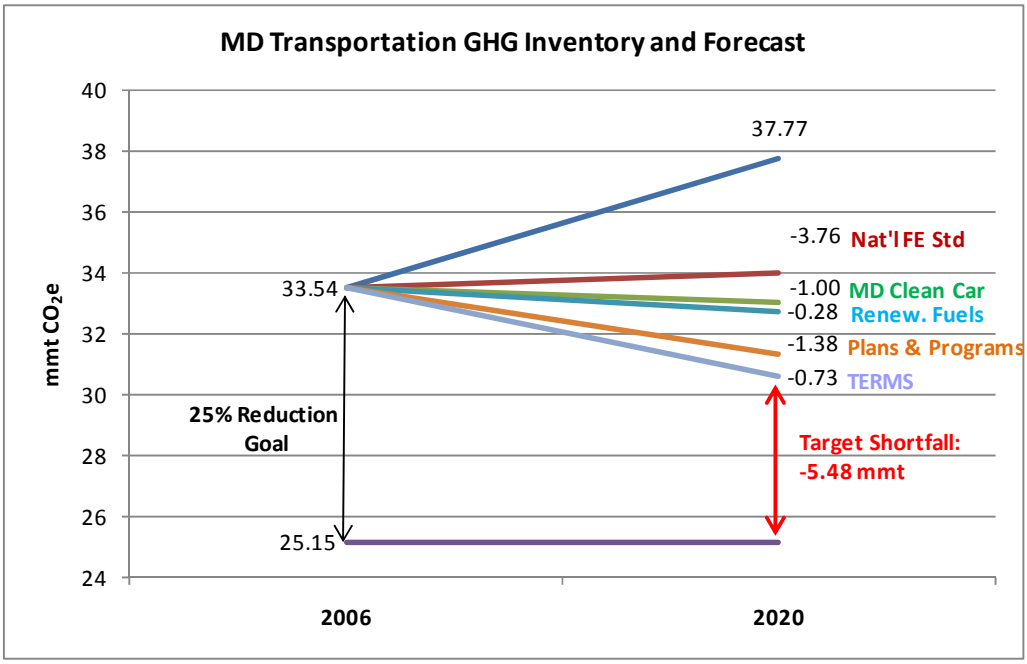
- **Traffic Control**: Speed limit adherence, traffic signal LED upgrades
- **Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall)**: Aircraft taxi/idling/delay reduction strategies, vehicle fleet purchases, dedicated lanes, smart park facilities, APUs for ground service equipment, facility electricity usage
- **Maryland Port Administration (MPA)**: Cargo handling equipment replacements and engine repowers and truck replacements and engine repowers

The criteria pollutant reductions of a large share of these strategies are included in BRTB's and MWCOG's air quality conformity process. 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.

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 plans and programs analysis, ensuring that no double counting of benefits occurs. Implementation of the technology and fuel strategies, plus current 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)*



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 3.4. Table 3.4 also shows the equivalent TLU policy option for each of the TERM project types, since these already committed TERM measures do fit into the TLU policy option definitions. 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 3.4 2020 TERMs GHG Reductions and 2009-2020 Costs

Project Type	Annual GHG (mmt)	Total Cost 2009-2020 (million $)	TLU Policy Option
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 Marshall Airport	0.02	-	TLU-5
Maryland Ports Administration	0.002	-	TLU-10
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 GHG 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 to 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 incremental 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 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 and other relevant State agencies. The Working Groups provided technical guidance and included the participation of MPOs and local governments. Working Group membership was designated based on (1) assuring agency relevance to each specific topic area, (2) ensuring broad cross-sectional representation among State, regional and local agencies, and (3) maintaining a manageable size and focus for 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 transportation 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 public transportation, 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/complementary 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 3.5). The GHG reduction estimates summarized here are assumed to represent GHG reductions beyond the benefits of the current 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.

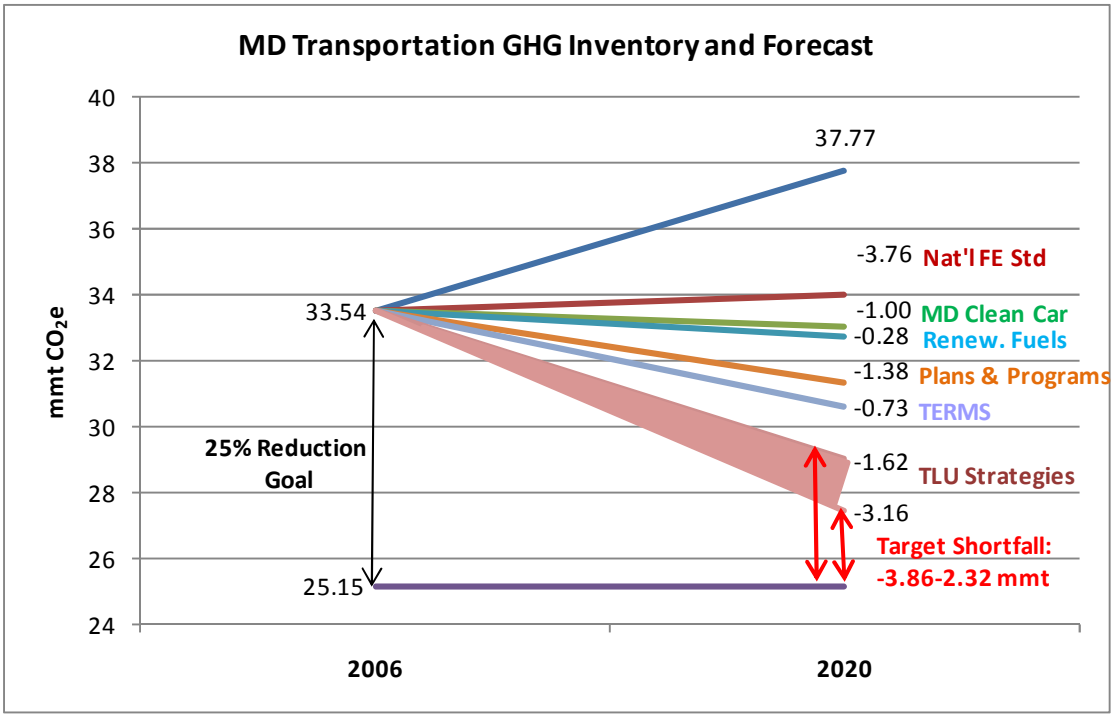
A more detailed summation of the analysis conducted for each policy option, including an overview and definition of the TLU policy option, approach to the analysis, assumptions and results, is provided in Appendix B.

Table 3.5 TLU Policy Options – 2020 Emission Reduction and Cost Summary

GHG Reduction Strategies	GHG Reduction (mmt CO_2e)	Total Additional Cost 2010 -2020 (million $)
TLU-2 *Land Use and Location Efficiency*	0.18 – 0.24	N/A
TLU-3 *Public Transportation*	0.45	$1,550.0 – $1,740.0
TLU-5 *Intercity Travel*	0.02	N/A
TLU-6 *PAYD Insurance*	0.26	N/A
TLU-8 *Bike and Pedestrian*	0.10 – 0.15	$597.0 - $817.0
TLU-9 *Pricing*	0.41 – 1.84	$2,599.0 - $3,395.0
TLU-10 *Transportation Technology*	0.20	$50.0
TLU-11 *Evaluate GHG Impacts of Major Projects & Plans*	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, existing fiscally constrained 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 3.5, add total implementation costs (capital investment only) of **$4,796 to $6,002 million** over the existing transportation plans and programs through 2020. As a point of reference, the existing 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 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.
- Refining the TLU GHG reduction estimates through the continued collaboration with the modal agencies, MPOs, local governments and other State agencies.
- 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 to focus on developing a transportation investment program that will help support the State's GHG emission reduction targets over the short and long term. Recognizing the key program elements to support the State's GHG reduction goals through 2020 will lead to the thoughtful prioritization of future strategies and ultimately guide the fundamental goals and objectives of Maryland's statewide transportation planning process.

Maryland Climate Action Plan - Appendix

Draft Maryland Department of Transportation Implementation Status Report

Martin O'Malley, Governor

Anthony G. Brown, Lt. Governor

Beverley K. Swaim-Staley, Secretary

Revised November 4, 2009

Maryland Department of Transportation

Maryland Climate Action Plan – Draft Maryland Department of Transportation Implementation Status Report

Appendices

prepared for

Maryland Climate Change Commission

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Appendices

The appendices are designed to provide the information, data and methods used during the assessment phase of this work program and to support the initial findings documented in the **Draft MDOT Implementation Status Report (Draft Report).** The appendices are organized into five distinct sections.

A. Phase I TLU Implementation Status Report

B. TLU Detailed Analyses

C. List of Maryland Plans and Program Projects

D. List of TERMS

E. Coordinating Committee and TLU Working Group Members

Appendix A includes the Phase I report that documents all the activities and findings of Phase I from February 2009 through May, 2009. This includes a summary of working group meeting participation and findings, TLU strategy prioritization and final TLU status/implementation reports as submitted to MDE on May 22, 2009.

Appendix B provides the technical approach, assumptions, GHG emission reduction and costs analysis for each TLU policy option analyzed as part of the work program. This section provides background material that supports the findings in Section 3.4 of the **Draft Report**.

Appendix C provides a list individual projects included in the following transportation plans and programs.

- 2009-2014 CTP
- Baltimore Regional Transportation Board (BRTB) 2010-2013 TIP and 2035 LRP
- Metropolitan Washington Council of Governments (MWCOG) 2010-2015 TIP and 2030 CLRP
- Hagerstown/Eastern Panhandle MPO (HEPMPO), Salisbury/Wicomico MPO, and Wilmington Area Planning Council (WILMAPCO) TIPs and LRPs

These projects are included in the 2020 GHG emissions and cost analysis in Section 3.2 of the **Draft Report.**

Appendix D includes a list of the Maryland TERMS included in the 2020 GHG emissions and cost analysis in Section 3.3 of the **Draft Report**. Appendix D also includes a summary of the assumptions and methodology used to assess the GHG reductions of TERMs not included in BRTB or MWCOG conformity documentation.

Appendix E includes the Coordinating Committee and Working Group member lists as of September 30, 2009.

A. Phase I Report

The purpose of this memorandum is to provide an update on the Office of Planning and Capital Programming (OPCP's) work to develop the Maryland Department of Transportation's (MDOT's) response to the Maryland Commission on Climate Change (The Commission), Climate Action Plan document completed in August 2008. The Commission's Climate Action Plan identified eight specific Transportation and Land Use (TLU) greenhouse gas (GHG) mitigation policy options and designated MDOT as the implementation agency for the six of the TLUs. MDOT is also identified as the supporting agency on the two remaining TLUs. In January 2009, MDOT engaged in a multi-phase work plan to define specific programs, actions and strategies to address the mitigation policy options.

Phase I (January – May, 2009)

Through The Commission's Climate Action Plan, 42 mobile and non-mobile GHG "mitigation" policy options were defined to support the effort to achieve specific GHG reduction targets established for 2020 and 2050. These included a reduction in GHGs from 2006 levels by at least 25 percent by 2020 and 90 percent by 2050. While many State agencies are involved, MDOT was designated as the implementing agency for six TLUs, and is a primary supporting agency on two others. MDOT's policy options are primarily focused on reducing GHGs emissions through vehicle miles of travel (VMT) reductions and technology improvements.

The Maryland Department of the Environment (MDE) is designated as the lead implementing agency for the Climate Action Plan and is directly responsible for managing the process, providing progress reports to the Governor's office and ensuring all other designated State agencies are actively pursuing the assigned mitigation and policy options. MDOT and other designated state agencies submit report updates and actions plans through MDE. MDE summarizes all information to report to the Governor's office and provides updates to the Commission members.

To date, the MDOT work program has focused on fulfilling critical milestone dates define by MDE, while engaging in a logical and inclusive process for developing the MDOT GHG reduction implementation plan. The Phase I Work Program report (Status/implementation plan) was due to MDE by the end of May 2009 and was provided on time. So far, MDOT has met all MDE related reporting requirements and was recently recognized by Secretary Wilson for the detail and quality of information submitted.

MDOT Phase I Work Program Summary

Starting in January, 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 Phase I work program was designed to comply with the reporting requirements defined by MDE.

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 though the participation of BMC, MWCOG 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 unique staff participated from 19 different agencies (see Attachment 1) 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 timeframe and costs
- *Strategy Prioritization* –
    - Critical - essential to meeting the GHG reduction goal (*will be carried into Phase II),*
    - Important – supports critical strategies in meeting goal (*will be 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)*

A summary of the overall strategy ranking is listed in Table 1. A detailed summary of all strategies assessed is attached (see Attachment 2). Of the 72 strategies considered, 57 were considered critical or important and 44 capable of implementation by 2020 (see shaded cells in Table 1). These strategies will be refined in Phase II and Phase III of the work program.

Table 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
Total	35	22	15	72

A Coordinating Committee meeting was held on May 14, 2009 where the TLU strategy assessment summaries were presented and discussed. The Coordinating Committee provided comments and minor modifications were made to address those comments. A TLU status summary was developed and submitted to MDE on May 22, 2009 (see Attachment 3). The TLU summary information was presented at a MDE sponsored meeting on May 28, 2009.

Next Steps: Phase II (June – September 2009)

The Phase II work plan focuses on conducting a more detailed GHG emissions analysis and support MDOT in the continued refinement of the MDOT Climate Action Plan Implementation activity. Specific work program elements include:

- Establishing an updated business as usual (BAU) GHG emissions forecast for 2020 and 2050 using the latest models and socio-economic data for Maryland.

- Quantifying GHG reductions from projects and programs in the Maryland Consolidated Transportation Plan, Metropolitan Planning Organizations (MPOs) Long-Range Transportation Plans (LRTP) and recommended TLU strategies identified in Phase I as well as projects that have been open or programs that have been initiated since 2006.

- Tracking all 57 recommended "critical or important" TLU strategies forecast emissions reductions and implementation requirements through 2050.

Phase II will also develop costs through 2020 for the TLU strategies, evaluate co-benefits, consider the implementation timeline through 2020 to achieve the benefits and identify key implementation barriers.

Phase III (Post September 2009)

This effort will be a logical continuation of the efforts of Phase II. Phase III will develop "bundles" or logical combinations of strategies implemented together to obtain more significant long-term GHG reductions. Phase III will also develop in more detail a discussion of TLU strategy co-benefits and equity impacts and consider potential changes in the fundamental goals and objectives of the Maryland Statewide Transportation Plan, MPO plans or the roles of MDOT modal agencies in achieving current and future GHG reduction targets.

Future Federal and State GHG Actions

Introduced on January 23, 2009 Senate Bill 278 titled the *Greenhouse Gas Emissions Reduction Act of 2009* sets forth very specific actions and an associated timetable for reducing GHG emissions in Maryland. Specifically, the Bill designates MDE as the lead agency in submitting a proposed plan to the Governor and General Assembly by December 31, 2011 that will reduce GHG emissions by 25 percent from 2006 levels by 2020. This is separate from the charge of the Climate Change Commission. MDOT will be able to use the input from the Climate Change Commission report and Climate Action Plan work currently underway as input into the required 2011 plan.

The proposed plan will be made available to the public and MDE must convene a series of public workshops to review and comment on the proposed plan. MDE must finalize the plan by December 31, 2012. Passage of Senate Bill 278 sets into motion a legislative process that formalizes the 2020 GHG emission target defined in The Commission's Climate Action Plan.

ATTACHMENTS:

(1) Phase I Participating Agencies

(2) TLU Multi-Attribute Matrix

(3) TLU Status/Implementation Reports

Attachment 1

Phase I Participating Agencies

1. MDOT – OPCP, OFL, Policy and Government Affairs, Office of the Secretary
2. MTA
3. MDP
4. DHCD
5. MWCOG
6. BMC
7. WMATA
8. SHA
9. MAA
10. MIA
11. MVA
12. MPA
13. MdTA
14. BWI Business Partnership
15. MEA
16. MDE
17. DBED
18. Baltimore City
19. Montgomery County

Attachment 2

TLU Multi-Attribute Matrix

TLU-2 Land Use and Location Efficiency

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
TLU-2.1	Energy Conservation and Location Efficiency	Long	Medium	Low	Easy	Critical	1
TLU-2.2	Integrated Transportation, Land use and Development Planning	Mid	Medium	Low	Easy	Critical	1
TLU-2.3	Develop Smart Growth Development Packages	Long	High	Low	Easy	Critical	1
TLU-2.4	Statewide Smart Growth Policy and Legislation	Long	High	Low	Hard	Critical	3

Definitions:

Implementation Timeline: Short (2010 - 2012), Mid (2013 - 2020), Long (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. GHG Reduction Potential based on 2020 estimates.

Implementation Costs (capital, annual O&M and administrative): High > $100m, Medium > 20m, Low < 20m

Ease of Implementation: Based on combination of implementation timeline and costs. Other factors, such as regulatory or political feasibility also considered. Generally follows the following guidelines: Easy - one or more factors short or low. Hard - One or more factors long or high.

Strategy Prioritization: Critical - essential to meeting the CAP's GHG reduction goal. Important - supports Critical strategies in meeting goal. Value Added - adds value but is not essential to achieving the goal at this time.

Bins: High GHG Reduction Potential / Easy Implementation (Bin 1)

Low GHG Reduction Potential / Easy Implementation (Bin 2)

High GHG Reduction Potential / Hard Implementation (Bin 3)

Low GHG Reduction Potential / Hard Implementation (Bin 4)

TLU-3 Transit

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
TLU-3.1	Additional Capacity on Existing Transit Routes	Short	Medium	High	Easy	Critical	1
TLU-3.2	Expanded Park and Ride Capacity	Short	Medium	Medium-High	Easy	Critical	1
TLU-3.3	Increase Coverage of Transit Services—New Commuter/Intercity Bus Routes	Short	Medium	Low	Easy	Critical	1
TLU-3.4	Implement Bicycle and Pedestrian Improvements to Support Transit	Short	Low	Low	Easy	Critical	2
TLU-3.5	Reduce Transit GHG Production	Short	Low	Low	Easy	Critical	2
TLU-3.6	Bus Priority Improvements	Short	Medium	Medium	Hard	Critical	3
TLU-3.7	Increase Coverage and Interconnectivity of Transit Services—New Rail/BRT Routes	Long	High	High	Hard	Critical	3
TLU-3.8	Implement Land Use Planning Policy Change to Support Transit	Long	Low	Low	Hard	Critical	4
TLU-3.9	Provide Pricing Incentives to Help Support Transit Ridership Growth	Long	Low	Low	Hard	Critical	4
TLU-3.10	Plan Transit in Conjunction with Land Use	Short	Low	Low	Hard	Critical	4
TLU-3.11	Increase Frequencies of Transit Services Statewide	Short	Low	High	Easy	Important	2
TLU-3.12	Increase Coverage of Transit Services—New Local Bus Routes	Short	Low	Medium	Easy	Important	2
TLU-3.13	Expanded Service Hours of Transit Services	Short	Low	High	Easy	Value Added	2
TLU-3.14	Improve the Quality and Convenience of Transit Services	Short	Low	Medium	Easy	Value Added	2
TLU-3.15	Reduce GHGs Produced by School (Student) Transportation	Short	Low	Low	Hard	Value Added	4

TLU-5 Intercity

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
TLU-5.1	Improve freight rail capacity constraints	Short-Long	Medium	High	Hard	Critical	3
TLU-5.2	Improve passenger rail capacity constraints	Short-Long	Low	High	Hard	Critical	4
TLU-5.3	Address Passenger/Freight Rail Conflicts	Short-Long	Low-Medium	Low-High	Hard	Critical	4
TLU-5.4	Coordinate development of freight intensive land uses.	Long	Medium	Low	Hard	Important	3
TLU-5.5	Improve efficiency of intermodal freight movement	Long	Medium	High	Hard	Important	3
Local and Through Bottlenecks							
TLU-5.6a	Reduce local truck congestion resulting from capacity constraints.	Mid-Long	Low	Low-High	Hard	Critical	4
TLU-5.6b	Reduce interstate/ through truck congestion resulting from capacity constraints.	Mid-Long	Low	Low-High	Hard	Important	4
Passenger Intermodal Connections:							
TLU-5.7a	Improve Passenger convenience for intermodal connections at airports, rail stations, and major bus terminals.	Short	Low	Low	Easy	Important	2
TLU-5.7b	Supporting Auto-free Tourism (visitors and Maryland residents)	Mid	Low	Low	Easy	Value Added	2

TLU-8 Bike and Pedestrian

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
Strengthen Implementation of Roadway Planning & Design Regulations & Policies:							
TLU-8.1a	Manual/Standards - Promote Use & Regular Review / Updates	Short	Low	Low	Easy	Critical	2
TLU-8.1b	Complete Streets - Improve Bike/Ped Access & Mode Options	Short	Low	Low	Easy	Important	2
Land Use Policy Guidance:							
TLU-8.2a	Update Existing Land Use Policy Guidance	Mid	Low	Low	Easy	Critical	2
TLU-8.2b	Bike Facilities at Strategic Locations	Mid	Low	Low	Easy	Critical	2
Funding Allocations:							
TLU-8.3a	Provide Funds for Low-cost safety solutions	Short	Low	Low	Easy	Critical	2
TLU-8.3b	Increase Funds for Capital Projects	Short	Low	Low	Easy	Important	2
TLU-8.3c	Review local government funding strategies	Short	Low	Low	Easy	Value Added	2
TLU-8.4	Education & Encouragement of Non-Motorized Modes	Short	Medium	Low	Easy	Important	1
TLU-8.5	Develop an Intermodal, Inter-Connected Bicycle/Pedestrian network	Mid	Low	Medium	Hard	Value Added	2

TLU-9 Pricing

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
VMT Based Fees:							
TLU-9.1a	Gas Taxes	Short	High	Low	Easy	Important	1
TLU-9.1b	VMT Taxes	Mid	High	High	Hard	Important	3
TLU-9.1c	Parking Impact Fees	Mid	Low	Low	Easy	Important	2
TLU-9.1d	Cordon Pricing	Mid	Low	High	Hard	Value Added	4
TLU-9.1e	Congestion Pricing / Managed Lanes	Mid	Medium	High	Hard	Critical	3
Parking Fees:							
TLU-9.2a	Park once	Mid	Low	Low	Easy	Important	2
TLU-9.2b	Elimination of Employer Parking Subsidy	Short	Low	Low	Easy	Value Added	2
TLU-9.2c	On-Street Parking Fees	Mid	Low	Low	Easy	Value Added	2
TLU-9.2d	SOV Versus Rideshare fee differential	Short	Low	Low	Easy	Value Added	2
TLU-9.2e	"Unbundling" parking costs	Mid	Low	Low	Easy	Value Added	2
TDM Strategies:							
TLU-9.3a	Provision of alternative mode information	Short	Low	Low	Easy	Critical	2
TLU-9.3b	Provision of transit subsidies	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3c	Ridesharing/ride matching programs and incentives	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3d	Vanpools	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3e	Guaranteed Ride Home	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3f	Telecommuting	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3g	Alternative Work Schedules	Short	Low-Medium	Low	Easy	Critical	2
TLU-9.3h	Trip Reduction Requirements	Short	Medium	Low	Easy	Important	1

TLU-10 Transportation Technologies

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
TLU-10.1	MD Clean Car Program	Short	High	Low	Easy	Critical	1
TLU-10.2	Active Traffic Management and Traffic Management Centers	Short-Mid	High	Low	Easy	Critical	1
TLU-10.3	Traffic Signal Synchronization/ Optimization	Short	Med	Low	Easy	Critical	2
TLU-10.4	Initiate marketing and education campaigns to operators of on-and off-road vehicles	Short-Mid	Low	Low	Easy	Critical	2
TLU-10.5	Timing of Highway Construction Schedules	Short	Low	Med	Easy	Important	2
TLU-10.6	Green Port Strategy	Short-Mid	Low	High	Easy	Important	2
TLU-10.7	Reduce idling time in light duty vehicles, commercial vehicles, buses, locomotive, and construction equipment.	Short-Mid	Low	Med-High	Easy	Important	2
TLU-10.8	Incentivize Demand for Alternative Fuels	Mid-Long	Low	High	Hard	Value Added	3
TLU-10.9	Promote and incentivize fuel efficiency technologies for medium and heavy duty trucks.	Short-Mid	High	Low	Easy	Important	1
TLU-10.10	Incentivize Fuel-Efficient and Low GHG Vehicle Purchase (on-highway vehicles)	Short-Mid	High	Med-High	Easy	Important	1
TLU-10.11	High Efficiency / Low Rolling Resistance Tires for HDDV	Short	Low	Low	Easy	Value Added	2
TLU-10.12	Encourage Retrofit and /or Replacement of Non-highway Diesel Engines	Mid	Low	High	Easy	Important	2
TLU-10.13	Support Research and Development	Long	Med-High	Med	Hard	Value Added	4

TLU-11 Evaluate GHG Impacts of Major Projects/Plans

ID	Strategies	Implementation Timeline (Short/Mid/Long)	GHG Reduction Potential (High/Medium/Low)	Cost (High/Medium/Low)	Ease of Implementation (Easy/Hard)	Strategy Prioritization	BIN
TLU-11.1	Inform Federal Policy	Short	NA	NA	Easy	Critical	NA
TLU-11.2	Evaluation of GHG emissions through the NEPA process	Short-Mid	Low-Medium	Low-Medium	Hard	Important	2
TLU-11.3	Statewide / Regional Planning Evaluation	Short-Mid	Low-Medium	Low	Hard	Important	4

Attachment 3

Maryland Climate Action Plan:
Implementation Template

Policy Name: ***Transportation and Land Use (TLU-2) – Land Use and Location Efficiency***

Policy Description: This policy option identifies packages of Smart Growth strategies that result in implementation of comprehensive statewide, regional and local land use planning and development that, in combination with transportation strategies, reduces the number of vehicle miles traveled (VMT) and corresponding greenhouse gas emissions.

Lead Agency(s): MDOT, MDP

TLU Committee Stakeholders: OPCP, OPGA, MTA, MDP, DHCD, DBED, MWCOG, BMC, Baltimore City, Montgomery County, MSDE

Implementation Process:

- The TLU-2 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. MDOTs policy design will consider four potential strategy areas. These strategies will lead to the development of smart growth development packages that will address barriers to smart growth implementation in different geographic and economic areas within Maryland.

    - **Energy Conservation and Location Efficiency** – Strategies address workforce housing needs, the combined cost burden of housing, transportation and energy to Maryland residents and location efficiency of public, institutional, and private facilities. Strategies include a mix of carrots (expanded incentives and/or tax credits for smart location) and sticks (expanded development review and GHG impact fees).

    - **Integrated Transportation, Land use and Development Planning** – Strategies provide for an incremental approach of local and regional support to continue and enhance the process of fully integrated transportation and land use planning. The support process for local, regional and state agencies include education on existing regulations and new tools, provision of expanded or new technical resources, and development and deployment of existing and new smart growth planning and implementation tools. This strategy area also considers improved enforcement and tracking of compliance with existing policies and regulations.

    - **Statewide Smart Growth Policy and Legislation –** The support process identified above (Integrated Transportation, Land use and Development Planning) guides longer term shifts in policy and legislative priorities including new state and local planning and development policy, new integrated land use

and transportation planning and development processes, and defined implementation and performance-based tracking. Smart growth policies and legislation considered will be consistent with and augment the work of the Task Force on the Future for Growth and Development. This strategy area also includes a continued focus and support of existing Smart Growth planning regulations and policies.

- **Develop Smart Growth Development Packages (Visions) –** Developing a range of Smart Growth packages that support GHG reduction goals will be critical to linking growth and development to GHG reduction. These packages will be designed to portray a variety of different settings in Maryland that include urban, rural, new development and re-development opportunities.

  The packages will be developed to:
  - Facilitate local and regional visioning exercises,
  - Respond to and support the new 12 Planning Visions,
  - Identify tools and mechanisms to evaluate development policies and decisions from a GHG reduction standpoint,
  - Estimate transportation, environmental, GHG emission reductions and other co-benefits,
  - Test the impact on land cost and affordable housing,
  - Understand the level of incentives to encourage Smart Growth development,
  - Test the planning and regulatory process.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Policy Name: ***Transportation and Land Use (TLU-3) – Transit***

Policy Description: 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, 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.

Lead Agency: MDOT

TLU Committee Stakeholders: OPCP, OPGA, SHA, MTA, MDP, BMC, WMATA

Implementation Process:

- The TLU-3 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. MDOT's policy design will target two strategy areas – potential strategies to increase transit ridership and potential strategies to increase fuel efficiency and minimize emissions from transit operations:

  Doubling Transit Ridership:

  Additional Capacity on Existing Transit Routes – Add transit capacity on existing routes and services.

  Increase Frequency of Transit Services – Additional frequencies (particularly during peak hours) on existing routes and services.

  Expanded Park and Ride Capacity – Add park and ride capacity at SHA, MTA, and other transit multipurpose parking facilities.

  Expand Service Hours of Transit Services – Additional service hours for transit (earlier morning, later evening, weekend services).

  Bus Priority Improvements – Improve speed and reliability of bus services in high ridership corridors, known as bus priority corridors or bus rapid transit (see WMATA's Bus Priority Corridors plan for 16 high-ridership corridors as example).

  Increase Coverage and Interconnectivity of Transit Services: New Local Bus Routes – Provide new local bus services (WMATA, MTA, LOTS) as a transit option in unserved areas.

  Increase Coverage and Interconnectivity of Transit Services: New Commuter Bus Routes – Provide new longer-distance commuter/ intercity bus services to provide transit options for long-commutes in areas not served by rail.

  Increase Coverage and Interconnectivity of Transit Services: New Rail/BRT Routes – Additional rail or BRT routes on separate right-of-way to provide high-capacity, auto competitive transit alternative to private vehicles. Examples in the

planning stage include the Red Line in Baltimore, the Purple Line and the Corridor Cities Transitway in the Washington suburbs.

Improve the quality and convenience of transit services – Implement measures that help boost transit ridership, such as increasing safety and security related to using transit services and improving or expanding transit marketing and information.

Implement land use planning policy changes to support transit – Focus development at transit stations, increase densities and provide for a mix of uses, while potentially reducing parking supply to support transit ridership growth and reduce VMT.

Pricing incentives to help support transit ridership growth – Implement higher prices for vehicle usage. Potential options include parking surcharges, congestion pricing, pay-as-you-drive insurance, etc. combined with discounted transit fares to make transit more attractive in terms of out-of-pocket costs to the user.

Implement bicycle and pedestrian improvements - Support increased transit ridership by facilitating safe access to transit stops and combined bicycle-transit tripmaking (through secure bicycle parking, bicycle rental, bicycle racks on transit vehicles, etc.).

Reducing Transit GHG Emissions:

Reduce GHGs Produced by Transit Systems – Reduce GHG production by transit operations and facilities with low-emission vehicle technologies.

Reduce GHGs produced by school (student) transportation - Reduce GHG production through a combination of improved vehicle technology, pedestrian improvements, and land use strategies. New schools should be located to minimize the need for private vehicle transportation, with pedestrian connections that provide safe routes to school, and if school buses are required, they will have minimal GHG impact.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Policy Name: ***Transportation and Land Use (TLU-5) – Intercity Travel***

Policy Description: 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.

Lead Agency: MDOT

TLU Committee Stakeholders: OPCP, OPGA, OFL, MAA, MTA, MPA, MDP, BMC

Implementation Process:

- The TLU-5 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. MDOTs policy design considers potential strategies that provide cobenefits for intercity passenger and freight transportation across seven strategy areas.
    - **Passenger and Freight Rail Capacity Constraints** – Passenger and freight rail capacity enhancements include technology improvements such as signal system upgrades and infrastructure and capacity projects relieving critical bottlenecks. Priority rail capacity constraints are identified in the Maryland Freight Plan and target critical bottlenecks such as bridges, insufficient vertical clearances, Baltimore tunnels and additional main lines in the I-95 corridor.
    - **Passenger and Freight Rail Conflicts** – Improve shared use through short term policy revision and mutually beneficial capacity enhancements, and long-term separation of passenger and freight tracks.
    - **Passenger Intermodal Connections** – Improve passenger convenience, access, facilities and navigational aids for intermodal connections. Provide enhanced traveler information services, real time arrival, and departure data at major intermodal facilities.
    - **Coordinated Development of Freight Intensive Land Uses** – Improve coordination of freight-intensive land use development with appropriate transportation infrastructure to support freight vehicle access.
    - **Local and Through Truck Bottlenecks –** Reduce delays through improved capacity constraints and system inefficiencies on intermodal connectors and key interchanges.
    - **Intermodal Freight Activity –** Reduce idling and fuel consumption of freight vehicles and infrastructure at intermodal facilities through improved connections and technology/policy.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Policy Name: ***Transportation and Land Use (TLU-8) – Bike and Pedestrian Infrastructure and Programs***

Policy Description: 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, regulatory and land use, funding, and encouragement 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.

Lead Agency: MDOT

TLU Committee Stakeholders: SHA, MTA, MDP, OPCP, MdTA, BMC, MWCOG

Implementation Process:

- The TLU-8 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. The draft MDOT policy design considers six potential strategy areas:

    - **Roadway Planning and Design Regulations, Policies, and Guidelines –** Strengthen implementation of current policy of *considering* bicycle and pedestrian accommodations on road and bridge improvement projects. Consider *requiring* bicycle and pedestrian accommodations (on- and off-road) accommodations on all road and bridge projects with limited exception. Review current design guidelines and standards, and policy language. Increase use of the state's bicycle and pedestrian design standards by local governments.

    - **Land Use Policy Guidance –** Promote planning and design policies that support bicycle and pedestrian travel. Strengthen requirements for non-motorized transportation elements in local plans. Create and promote model ordinances (such as the existing Bicycle and Pedestrian Access Model Ordinance) for use by local jurisdictions. Consider parking maximum's as an option for reducing parking at public and private developments.

    - **Revise Regulations for Incorporating Bicycle Services at Strategic Locations –** Strengthen existing regulations addressing bicycle supportive services (showers, lockers, parking, etc.) in State buildings and institutions and public schools (of all levels). Award tax credits or other incentives for private buildings and projects that provide qualifying bicycle services.

    - **State Funding Allocations –** Identify opportunities to allocate more funding to projects that improve the bicycle and pedestrian network and/or promote relatively low-cost safety solutions. Modify rules governing state bicycle/pedestrian infrastructure funding programs to allow more flexibility.

    - **Local Revenue Sources –** Identify local revenue opportunities for improving local pedestrian bicycle networks (consider minimum percentage from highway

user funds, speed camera and/or red light camera fines, etc.). Increase allocations from existing funding sources.

- **Education and Encouragement –** Conduct a social marketing campaign aimed at encouraging more people to make short trips on foot or bicycle and combine nonmotorized modes with transit for longer trips. Campaign should also encourage local governments to prioritize non-motorized travel.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Policy Name: ***Transportation and Land Use (TLU-9) – Incentives, Pricing, and Resource Measures***

Policy Description: 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. This effort should amplify GHG emission reductions by supporting Smart Growth incentives and transit investments.

Lead Agency: MDOT

TLU Committee Stakeholders: OPCP, OPGA, SHA, MDTA, MTA, MVA, MDP, MWCOG, BMC, Montgomery County, BWI TMA

Implementation Process:

- The TLU-9 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. The draft MDOT policy design considers four potential strategy areas combined with an education component for state and local officials:
    - **VMT fees** – Establish GHG emission-based road user fees statewide by 2020 to complement or replace motor fuel taxes, with revenues used to fund transportation improvements and systems operations meeting state 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 meeting state goals.
    - **Parking Impact Fees** – 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.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives. For pricing strategies, this may include initiating pilot studies or programs and discussion of priorities for future legislature sessions.

Policy Name: ***Transportation and Land Use (TLU-10) - Transportation Technologies***

Policy Description: This policy option seeks to reduce GHG emissions from on-road and off-road vehicles / engines through deploying technology designed to cut GHG emission rates per unit of activity as well as improving transportation system efficiencies. The goals include:

1. Reduce emissions from on-road engines / vehicles by an additional 7.5 percent by 2020 from current adopted baseline policies (particularly including the MD Clean Car Program) through more efficient technologies and traffic operations.
2. Reduce emissions from off-road transportation sources through use of more efficient technologies and operations by 15 percent by 2020.
3. Improve traffic operational efficiency by 5 percent on state advertised projects for transportation system improvements measured by delay reductions and fuel savings.
4. Initiate / enhance marketing and public outreach efforts in order to reach goals 1 -3.

Lead Agency(s): MDOT, MDE

TLU Committee Stakeholders: OPCP, MDE, MAA, MTA, SHA, MPA, MEA, MWCOG, MSDE

Implementation Process:

- The TLU-10 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations for this TLU. The draft MDOT policy design considers 13 potential implementation strategies:
    - **Maryland Clean Car Program -** Implement MD Clean Car Program beginning with model year 2011.
    - **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
    - **High Efficiency / Low Rolling Resistance Tires:** Evaluate further the use and efficiency of low rolling resistance tires for HDDVs (includes transit vehicles) where appropriate.
    - **Technology Advances for Non-highway Vehicles -** Encourage / Incentivize retrofits and/or replacement of old, diesel-powered non-highway engines like switch-yard locomotives with new hybrid locomotives. Targeted engines could include state-owned switchers (MARC) and providing outreach to private operators (e.g. Amtrak, CSX, Norfolk Southern, and Canton Railroad).

- **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.

- **Reduce Idling Times -** Reduce idling time in light duty vehicles, commercial vehicles, buses, locomotive, and construction equipment.

- **Green Port Implementation Strategy -** Develop and implement a "Green Port Strategy" consistent with industry trends and initiatives including EPA's Strategy for Sustainable seaports.

- **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.

- **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

- **Market and Education Campaigns -** Initiate marketing and education campaigns to operators of on-and off-road vehicles

- **Support Research and Development -** Support initiatives to improve and advance on- and off-road vehicle technologies and traffic operations and flow efficiencies. Support improved data collection efforts in order to better understand the effectiveness of the strategies on GHG emission reductions. Support initiatives to develop advances in low-carbon fuels.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Policy Name: ***Transportation and Land Use (TLU-11) - Evaluate the Greenhouse Gas (GHG) Emission Impacts of Major Projects and Plans***

Policy Description: This policy option focuses on the process of evaluating the 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.
Lead Agency: MDOT

Supporting Agencies: MDE, SHA, MTA, MPA, MdTA, DNR, BMC, and DGS

Implementation Process:

- The TLU-11 Working Group began the process by initially considering the Climate Change Commission policy option implementation recommendations. The draft MDOT policy design considers the potential following strategies:

    - **Actively Participate in Framing National GHG Emissions Evaluation Policy –** Given the recent EPA proposed ruling that carbon emissions endanger Americans' health and well-being, Maryland should actively participate in framing national policy rather than implementing specific, state guidance requiring GHG emissions evaluation of all major projects on both the NEPA and statewide/regional planning level.

    - **Evaluation of GHG Emissions through the NEPA Process –** The impact of GHGs on major capital projects through the current NEPA decision-making process should be encouraged. GHGs should be considered during the impact assessment phase when conducting alternatives analyses for all major capital projects. Where appropriate, the alternatives analysis should be accompanied by analysis of potential alternatives, such as transit-oriented land use and investment; adding toll lanes and express bus; express toll lanes; a hybrid transit-oriented express toll lane; or a rail and express bus scenario. Where the proposed projects may lead to increased GHG emissions, mitigation measures should be considered. The GHG analysis should be included as part of the Air Quality Technical Report and should allow for the demonstration of GHG benefits as well as impacts through both quantitative and qualitative components with the understanding that appropriate and/or approved emissions models and methodologies may not be available. The GHG analysis would be required:

        - If there is an Environmental Impact Statement (EIS) or an Environmental Assessment (EA). Categorical Exclusions (CE's) will be screened out.
        - For any roadway capacity enhancement project which is identified for analysis through interagency consultation.
        - For active projects that have yet to receive federal sign-off on draft NEPA documents. It is recommended that any project with approved NEPA draft documents would be "grandfathered" through the process.

- **Evaluation of GHG Emissions through Statewide/Regional Planning –** The impact of GHGs should be addressed in the statewide and/or regional planning processes.
    - The process would be similar to the current conformity process for ozone and PM; however, instead of setting a budget, a mechanism for tracking GHG emissions reductions would be established.
    - Regional level analyses (determining the GHG impacts on a larger scale than just the project level) account for control strategies that are in place such as fleet make up, analysis years, VMT increases, etc.

Future Actions (Post November 2009): Following submittal in November 2009 of the Final 2009 TLU status/implementation report to MDE, MDOT and partner agency staff will meet to discuss the next steps guiding implementation based on The Greenhouse Gas Emissions Reduction Act of 2009 and/or future State and Federal policy directives.

Next Steps for Each of the TLUs

- Implementation steps between now and November 2009, when the Final 2009 TLU status/implementation report will be submitted to MDE, will be accomplished concurrently and include the following:
    - Working Group/Coordinating Committee interim strategy definition and recommendations for further analysis;
    - Research on potential strategy GHG reduction benefits, costs, co-benefits (other environmental impacts, equity, revenue) and barriers to implementation;
    - Development of initial qualitative strategy benefits analysis;
    - Initiate quantitative technical analysis of GHG reduction benefits, costs and co-benefits;
    - Working Group review and refinement of technical tools and analysis;
    - Working Group discussion and compilation of co-benefits, barriers to implementation, implementation timelines, strategy grouping and synergies and equity considerations;
    - Presentation of strategy analysis results to Coordinating Committee.
    - Compilation of strategy specific technical findings and co-benefits, implementation requirements and equity impacts into Draft 2009 TLU status/implementation report;
    - Coordinating Committee review of Draft report; and
    - Complete Final 2009 TLU status/implementation report.

- Breakdown of tasks required to reach the November 2009 deadline.
    - (May) Complete May 2009 status/implementation report summarizing the findings of the TLU Working Group to date
    - (May) Present May 2009 status/implementation report to the Coordinating Committee; receive recommendations for further study
    - **(May 28) Submit Status/Implementation Report to MDE**
    - (May – Sept.) Conduct strategy development and analysis
    - (May – October) Conduct TLU Working Group meetings as needed
    - (August) Present strategy analysis results to Coordinating Committee
    - (Sept.) Produce Draft 2009 TLU status/implementation report
    - (Sept. – Oct.) TLU Working Group and Coordinating Committee review of Draft November 2009 TLU Status/Implementation report
    - **(Oct. to Nov.) Prepare and submit Final November 2009 TLU Status/Implementation report to MDE**

- Planned meetings between now and November 2009 include:
    - Coordinating Committee meeting (May 2009) to review May 2009 status/implementation report recommendations
    - Periodic TLU Working Group meetings to review technical results and discuss strategy implementation issues;
    - Periodic Coordinating Committee meetings (MDOT, SHA, MVA, MdTA, MPA, MDE, BMC, MAA, MEA, DNR, DBED, DHCD, MDP)

Deliverables:

- May 09 – May 2009 status/implementation report
- May 09 – Presentation of May 2009 status/implementation report to the Coordinating Committee
- July 09 - Draft strategy GHG reduction results and cost estimates for ongoing process
- August 09 – Draft strategy co-benefits, implementation timeline and equity analysis
- August 09 – Briefing on strategy analysis results to the Coordinating Committee
- September 09 – Draft 1 November 2009 TLU Status/Implementation report
- October 09 – Draft 2 November 2009 TLU Status/Implementation report
- **November 09 – Final November 2009 TLU Status/Implementation report**

B. TLU Strategy Assumptions and Methodology

TLU-2: Land Use and Location Efficiency

Approach

The TLU-2 working group identified three strategies for short-term implementation. These strategies support actions that can be implemented by 2020 and focus on developing a process that provides an incremental approach of support for fully integrated statewide transportation and land use planning. Based on the TLU-2 working group the support process initially will include:

- State agency and local government education on best practices,
- Provision of staffing and technical resources to State and local governments, and
- Development and implementation of expanded existing and new smart growth planning and implementation tools for local governments (models, guidelines and incentives developed together to fit within local comprehensive planning).

Specific near term actions for consideration (consistent with approaches identified by the Task Force for Future Growth and Development) will include a focus on successful application of recent state legislation and proposed future legislative or regulatory action on:

- Expanded Open Space Preservation Programs (Rural Legacy, Agricultural Reserve, Carbon-sinks program)
- Educate, Encourage and Incentivize TOD Supportive Planning and Zoning
- Continue & Expand Tax Credit Programs (Heritage Structure Rehabilitation, etc...)
- Increase Resources to Support Affordable/Workforce Housing
- Refine State Level Joint Development Policies and Transportation Public-Private Partnership Guidelines
- Expand Commute Trip Reduction Programs
- Expand State and Local Access Management Program
- Expand Context Sensitive Design Programs

- Build Local and State Consensus on Comprehensive Planning Roles & Responsibilities
- Continue State Growth Visioning, Civic Engagement and Scenario Testing
- Expand availability of on-line webtools/databases to assist in information sharing and planning activities

The quantification of the TLU-2 strategies through 2020 relies on a study of VMT per capita compared to population growth trends by census tract population density ranges. The analysis is based on the following information:

- **2006** - Current VMT per capita in Maryland (based on 2007 VMT and population data) is 10,057 annual vehicle miles per person. This compares to 9,496 annual vehicle miles per person in 2000.
- **2020 Base** - Maryland's forecast population in 2020 is 6.39 million. VMT is projected to increase 1.8 percent annually from present day to 2020 (1.8 percent is the baseline growth rate from HPMS data), resulting in total VMT in 2020 of 70,653 million. The VMT per capita in 2020 is 11,057 annual vehicle miles per person. The 1.4 percent VMT growth rate incorporates demographic projections from both BMC and MWCOG that show a trend towards greater population densification and increased transit usage.
- **2020 Plans and Programs** - Maryland's forecast population in 2020 is 6.39 million. VMT is projected to increase 1.4 percent annually from present day to 2020 (1.4 percent is the plan and program growth rate from the combination of the MPO plans and HPMS data), resulting in total VMT in 2020 of 67,359 million. The VMT per capita in 2020 is 10,548 annual vehicle miles per person. The 1.4 percent VMT growth rate incorporates demographic projections from both BMC and MWCOG that show a trend towards greater population densification and increased transit usage.

To reduce VMT per capita, a combination of increased population growth in higher density census tracts (greater than 4000 persons per square mile (ppsm), roughly 3 dwelling units per acre) with a mix of uses, overlaid with increased transit access, and enhanced bike and pedestrian infrastructure is required.

Assumptions

The Center for Urban Transportation Research (CUTR) at the University of South Florida developed a VMT forecasting model based on the 2001 National Household Travel Survey data. The model provides forecasts of annual VMT per capita based on various ranges of population density. The CUTR model shows that at the highest range of population density (greater than 10000 ppsm, high density urban development), VMT per capita is 60 percent less than VMT per capita at densities less than 500 ppsm (exurban/rural development).

The observed relationship between per capita VMT and population density is a proxy for the overall effects of "smart growth" development. Increases in population density are typically associated with overall shorter trip making. Areas with higher population densities are more likely to have pedestrian-friendly design and support transit service. Recent studies conclude that vehicle-travel was reduced by approximately 20 to 40 percent for residents of "compact" neighborhoods compared to residents of "sprawl" neighborhoods (Ewing et al., 2007). [1]

By redistributing population growth into denser census tracts, average statewide VMT per capita should decrease. Land use change can also occur as obsolete building stock is replaced. *Growing Cooler* estimates that 6 percent of the U.S. housing stock and 20 percent of the commercial building stock is torn down and rebuilt each decade.[2]

Two scenarios were developed that redistribute 2020 population growth based on the population distribution forecasts included in the BRTB 2035 LRP and MWCOG 2030 CLRP. Outside of BRTB and MWCOG modeling domains, 1990 to 2000 census population growth rates were used. The base assumption and scenarios are based on the following:

- **Base Assumption (using current MPO plan data)** - In 2020 42 percent of Maryland's population lives in census tracts with a density greater than 4000 ppsm (3 dwelling units/acre). This compares to a census 2000 share of 39 percent.
- **Scenario 1** - In 2020, 45 percent of Maryland's population will live in higher density tracts. The scenario assumes that 59 percent of the population growth from 2015 to 2020 will occur in high-density tracts. This compares to 55 percent of the growth 2010 to 2020 as forecast in the MPO land use assumptions.
- **Scenario 2** - In 2020, 47 percent of Maryland's population will live in higher density tracts. The scenario assumes that 64 percent of the population growth from 2015 to 2020 will occur in high-density tracts.

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[1] Ewing, R.; R. Pendall and D. Chen (2003). *Measuring Sprawl and Its Impacts*. Transportation Research Record 1831.

[2] Ewing, R., et al. (2008). *Growing Cooler: The Evidence on Urban Development and Climate Change.* Urban Land Institute, Washington, D.C.

Results

The redistribution of population in both scenarios will reduce VMT per capita and total VMT in Maryland. In Scenario 1, the 2020 VMT per capita decreases to 10,465 annual VMT per capita, representing a decrease of 82 annual VMT per capita from the 2020 base forecast. In Scenario 2, the 2020 annual VMT per capita decreases to 10,434 annual VMT per capita, representing a decrease of 113 annual VMT per capita from the 2020 base forecast. The reduction in VMT per capita results in an annual VMT decrease in 2020 of 526 million for Scenario 1, and 723 million for Scenario 2. This equates to GHG reductions of **0.18 mmt to 0.24 mmt**.

Land use planning and infrastructure planning activities will incur administrative costs for the development and implementation of incentives, regulations, along with several planning and administrative functions. Based on a review of past and ongoing regional and statewide planning efforts, estimated costs of a regional visioning and scenario planning effort (planning activities only) are about $1 million per year in a large metropolitan areas or on a statewide level. This only represents a portion of the potential cost associated with this assessment. Since this assessment relies on education and outreach activities along with the development and training on land use tools, additional public costs will be incurred.

Based on "smart growth" communities, other public-sector costs will increase–notably investment in transit and nonmotorized infrastructure. Achieving the benefits of infill development may involve the cleanup and reuse of "brownfield" sites (contaminated) or "greyfield" sites (subject to prior use). Land assembly, demolition of existing structures, and detailed permitting processes can also increase the cost of infill development versus greenfield development. Cost differentials may require subsidies or tax incentives by government agencies to stimulate private investment in particular areas. Because of the range of variables to consider, a single cost for TLU-2 strategies through 2020 is not estimated in this phase of work.

Summary

To achieve the GHG reduction from alternative land development by 2020 will require a comprehensive and focused set of approaches by state, regional and local agencies. The changes in VMT per capita included in this TLU assessment are relatively minor and do not reflect the longer term benefits land use strategies can realize.

The total GHG reduction in 2020 from the scenarios tested are summarized in Table 1.

Table B.1 TLU-2 GHG Reduction and Costs (2020)

TLU-2	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
Land Use and Location Efficiency	0.18 – 0.24	N/A

TLU-3: TRANSIT

Approach

The Climate Action Plan refers to MTA's 2001 Maryland Comprehensive Transit Plan (MCTP) goal of doubling transit ridership by 2020 from a 2000 baseline by increasing funding 42 percent. The TLU-3 strategies identified in Phase I fell into three distinct strategy groups, all with the intent of achieving the MCTP goal.. These strategy groups are: (1) increased capacity and revenue miles across all transit modes, (2) enhanced transit level of service, and (3) improved access and increased development adjacent to stations. Increased levels of investment in capital expansions, improved operations and technology, and enhanced access will be combined with incentives for increased TOD to meet the ridership goals and obtain reductions in VMT and GHG emissions.

To quantify the incremental increase in ridership required to meet the MCTP ridership goal, and the associated GHG reductions along with the investment required to get there, an existing trend in ridership growth projected to 2020 is developed. The plans and programs trend will account for all recent transit expansions as well as those fiscally constrained transit investments in the Maryland CTP and MPO TIPs and LRPs through 2020.

Assumptions:

There are two primary sources in Maryland for tracking transit ridership data: the National Transit Database administered by FTA and the Maryland Annual Attainment Report. Data for both of these sources are obtained by operator tracking of daily system use. Future ridership projections are generated by transit agencies and modeled by MPO's based on socioeconomic assumptions and expansion of the transit system.

To develop a ridership forecast for Maryland through 2020 the following information is used:

- From 1998 to 2007, the National Transit Database (NTD) indicates an average annual ridership growth rate across all Maryland transit systems of 1.5 percent. This includes an annual growth rate outside of Baltimore of 2.3 percent and in the Baltimore region of -0.1 percent, (Baltimore transit includes MTA local bus, Metro Rail and light rail).
- From 2001 to 2007, the Maryland Annual Attainment Report (AAR) also indicates an average annual ridership growth rate of 1.5 percent. This includes an annual growth rate outside of Baltimore of 3.2 percent, in Baltimore of -1.4 percent. The more notable decrease in Baltimore is partly due to light rail system closures due to the double tracking project and service cuts to the local bus system.

- From 2005 to 2007, transit ridership in Baltimore has shown a rebound, increasing at a rate of 2.2 percent per year.
- The BRTB and MWCOG LRPs indicate average annual ridership growth rates through 2030 of 0.6 percent and 1.5 percent, respectively. These modeled growth rates account for changes in land use and transit system expansion. This equates to an urbanized area growth rate in Maryland of 1.3 percent annually.
- 2008 and 2009 ridership reports from the American Public Transportation Association (APTA) indicate that in CY 2008 compared to CY 2007, WMATA ridership increased 3.25% and MTA ridership increased 8.13% (excluding demand response service).
- However, the APTA reports also indicate that through June 2009, compared to same period in 2008, WMATA increased 0.59% and MTA decreased 0.16% (excluding demand response service).

Table 2 summarizes transit ridership growth trends and forecasts in Maryland.

Table B.2 Maryland Transit Ridership Trends

Scenario	Annual Growth Rate	2020 Ridership Forecast (million unlinked trips)	MCTP 2020 Goal Differential (million unlinked trips)	Equivalent mVMT Reduction
NTD (1998-2007)	1.5%	322.8	136.2	533.3
AAR (2001-2007)	1.5%	315.9	143.1	560.5
MPO Plans	1.3%	305.6	153.5	601.0
Plans & Programs (2010 – 2020)	2.4%	353.2	105.8	414.3
CAP 2020 Goal	5.3%	459.0	--	--

The MCTP goal (doubling 2000 ridership by 2020) results in a target ridership in 2020 of **459.0 million**. To achieve the 2020 goal requires an average annual ridership growth of **5.3 percent** from 2010 to 2020.

The ridership growth rate representing transit projects and programs funded through 2020 equals a 2.4 percent annual increase. The assumptions generating this growth rate include:

1. Implementation of all 2009-2014 CTP transit projects and TERMs
2. MPO long range transit projects included in modeling assumptions by 2020 (includes Purple Line, Corridor Cities Transitway, Red Line, etc…)

3. This higher growth rate results from applying the Attainment Report ridership trends outside of Baltimore from 2001 to 2007 (3.2 percent annually), and a ridership growth rate in the Baltimore region from 2005 to 2007 (2.2 percent annually).
4. Excluding ridership data available to date on 2008 and 2009 ridership growth rates, particularly given the notable interaction between high fuel prices and increased transit ridership in 2008.

The TLU-3 strategy focus is on the difference between the 459.0 million 2020 goal from the CAP and the 2020 transit ridership forecast of 353.2 million. The difference represents 105.8 million unlinked transit trips. This approach ensures no overlap or double counting of transit trips or GHG emission reductions and strictly accounts for the incremental growth required to achieve the MCTP goal.

To translate unlinked transit trips to VMT, an average vehicle occupancy and average transit trip length is utilized. Average auto occupancy of 1.43 persons per vehicle from the 2001 National Household Travel Survey assumes that:

- 60 percent of new transit trips were home based work vehicle trips with an average occupancy of 1.14
- 40 percent of the new transit trips were non-work vehicle trips with an average occupancy of 1.84

Each unlinked trip is multiplied by an average transit trip length of 5.6 miles per trip based on the weighted average of Maryland 2007 NTD data.

The method for estimating the costs associated with these strategies is based on the incremental investment needed to increase annual transit ridership growth from the plans and programs to achieve the MCTP goal. Therefore, the TLU-3 costs are beyond transit projects identified in the plans and programs (all CTP and MPO LRP projects).

The additional revenue miles required to accommodate the ridership growth by mode to reach the 2020 goal were estimated by using existing transit trip rates per revenue mile (based on Maryland specific 2007 data). These trip rates are:

- Heavy rail – 2.7 trips per revenue mile (89.7 million passenger trips and 33.5 million revenue miles)
- Commuter rail – 1.5 trips per revenue mile (7.5 million passenger trips, 5.0 million revenue miles)
- Light rail – 2.4 trips per revenue mile (6.7 million passenger trips, 2.8 million revenue miles)
- Local bus – 3.6 trips per revenue mile (118.1 million passenger trips, 33.2 million revenue miles) (only includes WMATA and MTA bus services in Maryland)

- Commuter bus – 0.7 trips per revenue mile (3.4 million passenger trips, 4.7 million revenue miles)

An estimate of the 2007 revenue miles per vehicle for each mode was used to determine the additional number of vehicles needed to accommodate the ridership growth for each mode (Table 3). The revenue miles per vehicle for each mode were calculated using 2007 revenue miles and numbers of vehicles available for maximum service. The capital cost per mode was calculated using standard costs per vehicle type (also see Table 3). Note that the costs for the local and commuter buses represent estimates for hybrid-electric transit buses. Data sources for this information included 2007 NTD data and WMATA and MTA plans and projects.

Table B.3 Revenue Miles per Vehicle and Cost per Vehicle

Mode	2007 Revenue Miles per Vehicle	Cost per Vehicle
Heavy Rail	69,999	$3,000,000
Light Rail	52,787	$3,870,000
Commuter Rail	32,666	$2,800,000
Local Bus	27,470	$650,000
Commuter Bus	24,134	$650,000

The estimated incremental costs to achieve the MCTP goal were calculated twice, based on two different assumptions – 2007 actual and 2020 forecasted transit mode splits were used to estimate the additional ridership growth needed by mode.[3] The estimated additional ridership, revenue miles, and additional vehicles by mode in 2020 are in Table 4. The numeric ranges in the table represent estimates based on both the 2007 and 2020 transit mode splits.

Table B.4 Expansion Requirements Above Baseline by Mode to Attain 2020 MCTP Ridership Goal

Transit Mode	Additional Ridership	Additional Revenue Miles	Additional Vehicles

[3] The 2007 mode splits, based on NTD and MWCOG model data, were 33.6 percent heavy rail, 2.5 percent light rail, 2.8 percent commuter rail, 59.8 percent local bus, and 1.3 percent commuter bus. The 2020 mode splits, forecasted based on 2001 to 2007 NTD and MWCOG model data, were 38.7 percent heavy rail, 3.2 percent light rail, 3.7 percent commuter rail, 52 percent local bus, and 2.4 percent commuter bus. The 2020 light rail mode share was adjusted to maintain the 2001 percentage (since the share actually decreased between 2001 and 2007), and the local bus mode share was accordingly decreased.

	(millions)	(millions)	
Heavy Rail	42.7 – 49.2	16.0 – 18.4	228 – 263
Light Rail	3.2 – 4.1	1.3 – 1.7	25 – 32
Commuter Rail	3.6 – 4.7	2.4 – 3.1	73 – 96
Local Bus	66.1 – 76.1	18.6 – 21.4	678 – 779
Commuter Bus	1.7 – 3.0	2.3 – 4.3	96 – 177
Total	**127.2**	**43.4 – 46.1**	**1,201 – 1,245**

Results

In 2020, an additional 105.8 million unlinked transit trips reduces VMT by 414.3 million. The change in VMT results in an annual GHG reduction of **0.45 mmt** (accounting for both the reduction in VMT and the reduction in highway delay because of mode shift).

Meeting the MCTP 2020 goal will require a comprehensive and strategic investment plan. A combination of enhancing access to transit, improving speeds and reliability, increasing frequencies, expanding service and creating incentives for riding transit or disincentives for driving alone are all required.

The total estimated cumulative capital costs from 2010 to 2020 range from **$1.55 to $1.74 billion** to achieve the MCTP ridership goal.

The capital cost estimates to attain the MCTP ridership goal are based on vehicle procurement only. These capital cost estimates reflect service improvements within the existing transit network. The additional commuter rail vehicles, for example, could be used on existing MARC lines and provide the increased daily seating capacities through 2020, outlined in the MARC Growth and Investment Plan.

The actual capital costs will be significantly higher due to related capital needs such as ROW and construction or additional rail, maintenance/storage facilities, park and ride lots/structures, shelters, etc.

Summary

The total GHG reduction in 2020 from attaining the MCTP ridership goal compared to the baseline and the associated additional costs are in Table 5.

Table B.5 TLU-3 GHG Reduction and Costs (2020)

TLU-3	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)

Public Transportation	0.45	$1,550.0 – $1,740.0

Achieving this level of increase in ridership compared to the baseline will require bus system expansion and increased rail capacity, combined with enhanced level of service and transit oriented development. The total costs from the analysis reflect the TLU-3 strategies that were identified by the Working Group as critical or important in Phase I. However, some of the TLU-3 strategies that go beyond service improvements, such as expanded park and ride capacity, will have costs beyond this capital estimate, which was based on vehicle procurement.

The following six strategies were considered pre-2020 and included in this short to medium range analysis for TLU-3. The projects listed under each strategy are planned but currently unfunded, and could help promote transit ridership growth by 2020.

TLU-3.1 Additional Capacity on Existing Transit Routes: Improvements to existing lines beyond the first phase of the MARC Growth and Investment Plan (MGIP), capital assistance to small urban transit systems (LOTS)

TLU-3.2 Expanded Park and Ride Capacity

TLU-3.3 Increase Coverage of Transit Services—New Commuter/Intercity Bus Routes: WMATA Regional Bus Study, MWCOG Priority Bus Network (J Line, Route 1 (MD) Line, Eastover to Addison Road and Addison Road to Southern Avenue)

TLU-3.12 Increase Coverage of Transit Services—New Local Bus Routes: Operating and capital assistance to the LOTS could fund new local routes

TLU-3.6 Bus Priority Improvements: WMATA running way improvements/priority corridors in Montgomery and Prince George's Counties (MD 97, MD 193, MD 4, US 1, MD 210, etc…)

TLU-3.11 Increase Frequencies of Transit Services Statewide: Frequency improvements on MARC lines beyond the first phase of the MGIP, operating and capital assistance to the LOTS could increase frequencies of local services.

Bike and pedestrian access to transit and transit supportive development are also included as pre-2020 strategies. They are shared strategies with TLU-2 and TLU-8. Therefore, the GHG emissions and costs associated with these strategies are estimated in these other TLUs.

TLU 3.4 Implement Bicycle and Pedestrian Improvements to Support Transit: Shared with TLU-8 strategies supporting investment near transit stations.

TLU 3.10 Plan Transit in Conjunction with Land Use: Current priority joint development/TOD opportunities in Maryland include Laurel, Wheaton, Odenton, Savage, Naylor Road, and State Center.

Long-range strategies beyond 2020, not included in this analysis are:

TLU-3.7 Increase Coverage of Transit Services—New Rail/BRT Routes: Purple Line Extension - New Carrollton to Branch Avenue, Green Line Extension to Laurel/BWI, Baltimore METRO Green, Purple, Blue, Yellow and Orange lines (Baltimore Regional Rail System Plan)

TLU 3.8 Implement Land Use Planning Policy Changes to Support Transit Use: Policies that promote density and mixed-uses and provide for dedicated transit lanes, which will help achieve time savings compared to driving, or at least make the modes comparable.

TLU 3.9 Provide Pricing Incentives to Help Support Transit Ridership Growth: Incentives to promote shifts from SOV to transit including increased gas taxes or VMT fees, congestion pricing and higher parking costs.

Note that the strategy identified by the TLU-3 Working Group, **TLU-3.5 Reduce Transit GHG Emissions**, did not fit neatly within a category, but was indirectly addressed through capital expansion, which was assumed to include hybrid-electric buses and other clean technology to reduce the GHG emissions from transit vehicles.

The direct benefits of the transit/land use and transit/facility pricing interactions have not been considered in the Phase II analysis – analysis in future phases of this study will evaluate these relationships.

TLU-5: INTERCITY TRAVEL

Approach

Improvements to intermodal facilities and information help minimize time, costs, and inconvenience that make it easier to for people to utilize the most efficient mode for each segment of a trip. Examples of specific intermodal improvements might include:

- Intermodal transportation centers that provide a central exchange point for different modes,
- Integrated fare payment systems,
- Multimodal traveler information systems,
- "First and last mile" programs that focus on ways to get people from their origin or destination to line-haul transit stations (e.g., bikes on transit, station cars, local flex-route transit), and
- Programs that support alternative mode by providing backup travel options when necessary, such as guaranteed ride home programs or occasional-use parking passes for employees receiving transit benefits.

Maryland has already implemented a number of these strategies for improved intermodal connections and passenger convenience. For example, Maryland is one of only six states in the country where all Amtrak intercity rail terminals (Aberdeen, Baltimore Penn Station, BWI Marshall, Cumberland, Rockville, New Carrollton) are served by other modes[4]. In addition, multiple MARC stations are also served by more than one rail mode (Rockville, Silver Spring, College Park, Greenbelt, New Carrolton). In addition, Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall), which is the only major commercial airport in the state, is served by intercity rail, commuter rail, light rail transit, and bus transit. Analysis for greenhouse gas reductions in Maryland will focus on improving the transit mode share for trips to/from BWI Marshall, and increasing ridership on Amtrak intercity rail service.

In Phase I, the TLU-5 working group identified TLU strategy 5.6A (improve passenger convenience for intermodal connections at airports, rail stations and major bus terminals as a critical, short-term strategy to be assessed during this

[4] Bureau of Transportation Statistics. Special Report. Making Connections: Intermodal Links in the Public Transportation System. September 2007. http://www.bts.gov/publications/bts_special_report/2007_09_18/pdf/entire.pdf

phase of the work program. The TLU strategy is organized into two specific programs that all improve intermodal connections in Maryland. The TLU does not focus on strategies associated with local and regional transit use included in the Transit TLU- 3.

Increased Transit Mode Share to/from BWI Marshall

A number of measures can increase transit mode share for trips to and from BWI Marshall airport[5].

- Provide direct connections to all forms of transit from the airport. While the light rail is directly accessible from the terminal, passengers must currently take a shuttle to access the MARC commuter rail and Amtrak service. Consider providing an enclosed structure or conveyance (people mover type system) or by relocating the station to provide direct access to the main airport terminal.
- Market transit service to travelers with trip ends downtown and in transit-friendly areas. The ability to walk from transit stations to the final destination is important.
- Market transit service to business or other travelers with few checked bags. Consider providing off-airport baggage check in locations.
- Provide travel times in major travel corridors that are better than vehicular-based highway travel.
- Provide frequent service. Waiting times of 10 minutes or less are preferred. Expand service times (off-peak service) and days of operation as needed.
- Provide transit information that is easy to understand even for those unfamiliar with transit schedules and purchasing tickets.

BWI Marshall already has a number of these services in place and implemented successfully. These measures are related to the transit-airport connection, and the regional transit system.

Increased Ridership on Amtrak

Less than one percent of long distance trips in the U.S. occur on trains.[6] Recent efforts at the state, regional and federal level have resulted in increased attention on strategies to increase the efficiency and use of the existing intercity passenger rail network.

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[5] Based on recommendations from Airport Cooperative Research Program (ACRP) Report 4: Ground Access to Major Airports by Public Transportation.

[6] Bureau of Transportation Statistics. National Transportation Statistics. Table 1-39

- "The Future of the Northeast Corridor" - Regional Plan Association recent study through the Business Alliance for Northeast Mobility to urge Congress to increase funding for intercity passenger rail in the stimulus and future transportation bills "The Future of the Northeast Corridor".[7]
- "High Speed Rail and Greenhouse Gas Emissions in the United States" - Center For Clean Air Policy led study of the feasibility and GHG reduction potential of high-speed rail service between major urban transit corridors. The result is a corridor-by-corridor estimate of the potential annual greenhouse gas benefits-from emissions reductions-of high-speed rail systems in the U.S. based on current plans for high-speed rail development in the federally designated high-speed rail corridors. [8]
- Passenger Rail Working Group for the National Surface Transportation Policy and Revenue Study Commission [9]
- American Recovery and Reinvestment Act – Intercity/High-Speed Rail Provisions: The ARRA allocates $9.3 billion for the development of intercity and high-speed passenger rail. Of this total, $1.3 billion is available for capital improvements and security upgrades for Amtrak. The remaining $8 billion is provided for the development of new intercity and high-speed rail passenger service. The grants will be distributed under the Intercity Passenger Rail Grants to States and the High Speed Corridors grant programs authorized in the 2008 Rail Safety Improvement Act.
- AMTRAK FY 2010 Legislative and Grant Request: Summary of recent operational improvements and outline of Amtrak's views on the need for passenger rail growth, and overview of FY 2010 funding request.[10]

Assumptions

To quantify the greenhouse gas reduction associated with implementing the TLU strategies, it is assumed that BWI Marshall can increase its transit mode share from 11.4 percent to 20 percent by implementing these strategies. The mode share assumptions are based on:

- 12 percent is the existing public access mode share at BWI Marshall according to the 2008 ACRP Report. Public transportation is defined in this report as rail, bus and shared ride vans, but excludes single-party limousines, courtesy shuttles, and charter operations.

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[7] http://www.rpa.org/pdf/RPANECfuture012309.pdf

[8] http://www.cnt.org/repository/HighSpeedRailEmissions.pdf

[9] http://www.dot.state.wi.us/projects/state/docs/prwg-report.pdf

[10] http://www.amtrak.com/pdf/FY10GrantLegislativeRequest.pdf

- Table 10 in the 2007 Washington-Baltimore Regional Air Passenger Survey indicates that the average share of public mode of access in 2002, 2005, and 2007 is 11.4 percent.[11] Public mode of access includes rail services and airport bus, van or limo.
- San Francisco International Airport's (SFO) public access mode share of 23 percent, which is currently the highest in the U.S. based on 2005 data included in the referenced ACRP report. SFO has access from multiple rail transit modes, and has slightly more expensive daily/long-term parking fees of $14 per day. There are of course other factors resulting in the high public access mode share at SFO
- 20 percent is chosen as a reasonable target mode share for BWI Marshall in 2020, in order to estimate the potential for GHG reductions.

Passenger-miles for trips to and from the airport are estimated by multiplying the number of passengers arriving by ground transportation by 2 (assuming they make a transit round trip). The passenger trips are multiplied by 21.5 miles (assuming the average trip distance equals the average of the distance from BWI Marshall to downtown Baltimore (11 miles) and to downtown Washington DC (32 miles)).

Passenger trips for 2020 are obtained by extrapolating historic growth trends in total annual enplanements, which yielded an annual 2 percent growth rate (based on 2002 - 2007). [12] Total passenger miles to/from BWI Marshall and then broken down into the current and target mode splits between private and public modes. These are multiplied by greenhouse gas emission factors to complete the estimate of greenhouse gas emissions for the current and target mode splits. The difference between the two highlights the potential GHG savings by increasing the transit mode share to 20 percent. These results are included in Table 5.

Results

Increased Transit Mode Share to/from BWI Marshall

The difference between current transit access mode share at BWI Marshall and an increased mode share in 2020 of 20 percent results in GHG emission savings. Total GHG emissions reduction in 2020 could be as high as **0.012 mmt** because of the modal shift of travelers at BWI Marshall. These results are in Table 6.

[11] http://www.mwcog.org/uploads/committeedocuments/lF5dXlhf20081003124339.pdf

[12] Obtained from Table 4 of 2007 Washington-Baltimore Regional Air Passenger Survey by National Capital Region Transportation Planning Board, et al.

Table B.6 Estimated Passenger Mile Reductions from Increased Transit Mode Share at BWI Marshall

BWI Marshall Access Trips	2020
Total Passenger-Miles (millions)	494.71
Current Mode Split	
Cars (89.5%)	442.77
Transit (11.5%)	56.94
Target Mode Split	
Cars (80%)	395.77
Transit (20%)	98.94

Costs for the deployment of these measures at BWI Marshall from 2010 to 2020 are highly variable based on the measures chosen and the level of new infrastructure required. Bond proceeds or Federal Aviation Administration AIP grants support the majority of capital funding at airports. Passenger facility related charges or "pay as you go" funding from other federal or state grants represent less than a third.[13]

Examples of costs associated with providing in-terminal/in-station kiosks or other display boards of real-time transit arrival information are available via a number of recent studies through FHWAs Research and Innovative Technology Administration (RITA). In 2006, the Federal Transit Administration (FTA) sponsored a study to analyze the return-on-investment for real-time bus arrival time information systems. The Transit Tracker system deployed in the Tri-County Metropolitan Transportation District of Oregon (TriMet), deployed in 2001, was evaluated. The system provides riders with a real-time estimate of the expected time the next transit vehicle will arrive at a specific bus stop or rail station. Information is provided to riders via electronic information displays, a dedicated phone line, and a Web site.

An estimate of the cost of the field equipment (designing, purchasing, and installing the dynamic message signs at 13 bus stops and all rail stations),

[13] Airport Cooperative Research Program (ACRP) Report 4: Ground Access to Major Airports by Public Transportation. 2008

servers, and Web development was $1.075 million. Operating and maintenance costs for Transit Tracker are estimated to be roughly $94,300 per year.[14]

This level of investment at the scale of the Baltimore system would be significantly higher (TriMet example is deployed to all 12 light rail stations in the Portland system). Software development costs could go also support expansion of the existing BWI Ground Access Information System to include all modes of access to BWI., including Amtrak and MTA bus and light rail in Baltimore.

Providing a direct connection to the BWI Amtrak/MARC station via a automated people mover system is a significantly more expensive, capital intensive option to generate increased transit arrival mode shares. The under construction consolidated rental car facility people mover at Hartsfield Jackson Atlanta International Airport (ATL) has an estimated capital cost of $286.5 million for a 1.5 mile system. BWI Marshall to the BWI Amtrak/MARC Station is approximately 2 miles.

Increased Ridership on Amtrak

Table 7 includes all intercity Amtrak stations in Maryland. As noted earlier, all stations have at least one other mode servicing the stations. All six stations have bus transit serviced, and four of them have either heavy or light rail transit service. New Carrollton and Rockville stations are specifically designed as intermodal facilities and have five and four modes represented.

Possible improvements to increase Amtrak ridership include:

- Provide direct connections to intercity bus service at Rockville station and Penn Station in Baltimore
- Improving the connection between the BWI Marshall rail station and the main terminal either by providing a enclosed structure or conveyance (people mover type system) or by relocating the station to provide direct access to the main airport terminal
- Improve traveler information for making intermodal connections before the trip (via interactive mapping websites) and traveler information in the airport terminals.

To determine greenhouse gas reductions from these improvements, an analysis was conducted and is based on the assumption that these strategies could

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[14] http://www.itscosts.its.dot.gov/its/benecost.nsf/SingleCostTax?OpenForm&Query=Transit%20Management

increase ridership by 5 percent to 10 percent. This translates into an increase in 2020 of 221,500 intercity rail trips.

Based on the 2001 National Household Travel Survey, the average length of a long distance rail trip is 192 miles. Given Maryland's location in the Northeast Corridor, and that the majority of Amtrak trips in this corridor are between DC, Baltimore, Philadelphia and New York, the average Maryland Amtrak trip distance is estimated at 150 miles. The total reduction in annual VMT for trips originating in Maryland in 2020 is 33.2 million.

Table B.7 Maryland Intercity Rail Stations

Facility Name	FY08 Amtrak Boardings	Intermodal Connections
New Carrollton Station	203,449	PG County TheBus, METRO Bus, METRO Rail, MARC , Amtrak
Rockville Metro/MARC Station	3,178	METRO Bus, Ride-On, METRO Rail, MARC, Amtrak
Aberdeen Amtrak/ MARC Station	45,052	Bus Transit, MARC, Amtrak
BWI Marshall Rail Station	644,640	Bus Transit, MTA Light Rail, MARC, Amtrak, Air
Penn Station	1,020,304	MTA Bus, MTA Light Rail, MARC, Amtrak
Cumberland Amtrak Station	11,257	Bus Transit, Amtrak

Sources: BTS. Passenger Connectivity Database. Amtrak Fact Sheet.

Summary

Table 8 includes total GHG reduction estimates for in 2020 for the intercity passenger specific TLU-5 strategies.

Table B.8 TLU-5 GHG Reduction and Costs (2020)

TLU-5	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
Increased Passenger Convenience/Improved Transit Access at BWI Marshall	0.012	N/A
Increased Passenger Convenience at Intercity Rail Stations	0.011	N/A

There are other TLU strategies identified by the working group in Phase I that provide cobenefits for intercity passenger and freight transportation across six strategy areas. These strategies were identified as longer-term strategies beyond the 2020 timeframe.

- **Passenger and Freight Rail Capacity Constraints –** Passenger and freight rail capacity enhancements include technology improvements such as signal system upgrades and infrastructure and capacity projects relieving critical bottlenecks. Priority rail capacity constraints are identified in the Draft Maryland Freight Plan and target critical bottlenecks such as bridges, insufficient vertical clearances, Baltimore tunnels and additional main lines in the I-95 corridor. The 2009-2014 CTP includes a MTA sponsored project totaling $82.1 million over 6 years, which improves MARC service through targeted investment in passenger rail corridor infrastructure. These improvements are implemented through CSX and Amtrak operating agreements.
- **Passenger and Freight Rail Conflicts –** Improve shared use through short-term policy revision and mutually beneficial capacity enhancements, and long-term separation of passenger and freight tracks.
- **Coordinated Development of Freight Intensive Land Uses –** Improve coordination of freight-intensive land use development with appropriate transportation infrastructure to support freight vehicle access.
- **Local and Through Truck Bottlenecks –** Reduce delays through improved capacity constraints and system inefficiencies on intermodal connectors and key interchanges.
- **Intermodal Freight Activity –** Reduce idling and fuel consumption of freight vehicles and infrastructure at intermodal facilities through improved connections and technology/policy.

There is a prioritized listing of freight projects in the Draft Maryland Freight Plan. However, the prioritization is not based on a timeline. Highway projects in this list are from the CTP, highway needs inventory, and multiple agency feedback. The CTP projects from this list are all identified as TLU-5 projects in the funded plans and programs analysis in Section 3.2. Both freight and

passenger rail project needs are identified from the MAROps study, MARC Growth and Investment Plan, or through outreach with CSX, Norfolk Southern and other freight rail operators. A large number of the projects identified would benefit both freight and passenger rail operations, particularly in the Northeast Corridor from DC to Baltimore to Wilmington, DE.

Environmental stewardship is a factor that accounts for 10 percent of the freight plan prioritization framework. In the highway project prioritization, environmental stewardship refers to location of the projects in priority funding areas (PFAs) and thereby providing an emphasis on directing new development in PFAs and sites with adequate infrastructure. In the case of rail projects however, since rail is considered a more fuel-efficient and more environmentally friendly alternative to truck transport, they are all prioritized high environmental stewardship. Port projects were prioritized based on MPA priorities and information in the MPA Strategic Plan.

TLU-6: PAY-AS-YOU-DRIVE (PAYD) INSURANCE

Approach

Pay-As-You-Drive (PAYD) insurance ties a substantial portion of consumer insurance costs to a variable cost with respect to actual motor-vehicle travel use. The cost of insurance is more directly related to hours or miles driven, with adjustment for other rating factors, such as driving record, age, and the vehicle driven. Typically, miles driven is only a minor rating factor in insurance policy pricing. PAYD Insurance is designed to provide a price signal to encourage a reduction in miles driven, while allowing insurance companies to make premiums more accurate actuarially.

Currently, the only insurer in Maryland offering a form of PAYD insurance is Progressive Insurance through *MyRate*. In June 2008, Progressive announced a national rollout of the *MyRate* insurance program. For Maryland consumers, *MyRate* was available starting in September 2008. Based on Maryland Insurance Administration (MIA) data, Progressive has the sixth highest market share of auto insurance providers in Maryland. Under *MyRate*, cars driven less often, in less-risky ways, and at less-risky times of day can receive a lower premium. Defensive drivers have a good driving record, drive less than 10,000 miles per year, rarely drive after midnight and are the most likely to save money compared to their existing premiums. According to the Progressive website, the impact on premiums could be anywhere from a 60 percent discount to a 9 percent surcharge.

MDOT, in consultation with MIA, is considering a range of levels of deployment for PAYD Insurance in Maryland through 2020. Since the insurance premium, cost is tied directly to vehicle miles driven, primary benefit of PAYD insurance is the reduction in VMT associated with insurance premium structure.

Assumptions

Other examples of auto insurance based on mileage monitoring do exist and provide useful information to assess the potential benefit of PAYD Insurance programs. A Texas based start-up insurance firm, MileMeter, allows individuals to go online and purchase a specific number of miles of insurance coverage. A driver would not be covered in the event of an accident if the car's odometer indicated that the driver had exceeded the amount of insurance purchased, which negates the need for odometer audits. In addition, established companies also use monitoring technology to offer mileage discounts on insurance premiums. General Motors Acceptance Corporation (GMAC) Insurance offers mileage-based discounts to OnStar subscribers located in thirty-four states including Maryland.

Pilot projects have recently been completed or are underway in a number of regions. A FHWA sponsored PAYD insurance pilot program in Seattle, WA is underway with expected completion in 2012. In 2006, the North Central Texas Council of Governments entered into a partnership with Progressive Insurance Company to offer a mileage-based pricing option to its customers and track the effect of the pricing on customer mileage. The findings for the PAYD insurance pilot included: a decrease in miles driven by an average of 5 percent, or 560 miles per year; 37 percent of post-pilot survey respondents reporting a reduction in mileage driven; and most reductions in driving reported to occur in commute and mid-day hours.[15]

Only one auto insurance provider in Maryland currently has a PAYD insurance option available, and this provider represents less than 10 percent of total Maryland based policies. Based on a recent Brookings Institution report, the first 2 percent of customers signing up for PAYD policies will be the low-risk, low-mileage drivers that have a financial incentive to do so.[16] Given the Brookings report finding, the assumption of the deployment of PAYD insurance is 2 percent of 10 percent of all Maryland policies, or .2 percent of all Maryland drivers in 2010.

Results

A maximum assumption for the impact of the set of strategies to help increase deployment of PAYD insurance in Maryland plus drivers who would be expected to switch for financial reasons alone is 20 percent of all Maryland drivers adopting PAYD policies by 2020**.** This assumes 2 percent of Maryland drivers switch to PAYD each year 2010 to 2020. This level of penetration of PAYD in Maryland would require most of the major insurance companies to offer PAYD, plus implementation of pilot programs and incentives at the State level.

The 20 percent target does not represent a commitment by Maryland Insurance Administration (MIA). This target will be reconsidered in future phases of this work ahead of preparation of the draft implementation plan to the Governor and Legislature by December 31, 2011 and the final implementation plan by December 31, 2012.

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[15] *Pay-As-You-Drive Insurance Pilot Program – Phase II Final Project Report*. Progressive County Mutual Insurance Company and North Central Texas Council of Governments, November 2008. http://www.nctcog.org/trans/air/programs/payd/FinalPAYDReport_11-05-2008.pdf

[16] *Pay-As-You-Drive Auto Insurance: A Simple Way to Reduce Driving-Related Harms and Increase Equity*. Bordoff and Noel, The Brookings Institution. July 2008.

Lower targets are tested of 5 and 10 percent deployment by 2020, which assumes a more steady deployment, consistent with current conditions given the economic environment and rate of adoption of PAYD seen currently by insurance providers.

Based on State and MPO transportation and land use plan forecasts, total annual state vehicle miles of travel in 2020 is 67.4 billion. Table 9 presents ranges of VMT and GHG reduction estimates in 2020 based on the percentage of PAYD insurance policies.

To illustrate the potential range of GHG emission benefits, three levels of market penetration of PAYD Insurance are included (5, 10, and 20 percent) along with two levels of effectiveness in reducing VMT (5 and 10 percent per driver).

The 5 percent estimate is based on findings from the NCTCOG study referenced earlier. This is a conservative estimate of the VMT effect. Research studies have indicated as high as a 15 percent reduction in VMT per driver as a result of a shift to a PAYD based insurance premium (Climate Action Plan used this rate). 10 percent is a high-end VMT effect as based on research estimates from both the Brookings Institution report and Victoria Transportation Policy Institute.[17]

Table B.9 Range of PAYD Insurance Deployment in 2020

Percent of Policies by 2020	Change in Annual VMT per Policy (Effectiveness Rate)	Statewide Annual VMT Reduction (million VMT)	GHG Reduction (mmt CO_2e)
5%	5%	168.40	0.057
10%	5%	336.80	0.114
20%	5%	673.59	0.260
5%	10%	336.80	0.114
10%	10%	673.59	0.227
20%	10%	1347.18	0.454

Summary

Table 10 presents the results of the TLU-6 GHG emissions reduction analysis assuming the maximum 20 percent penetration rate be 2020. It is assumed that there are minimal public sector costs associated with PAYD insurance. The majority of the costs are assigned to the insurance provider and the driver.

[17] http://www.vtpi.org/tdm/tdm79.htm

Table B.10 TLU-6 GHG Reduction and Costs (2020)

TLU-6	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
Pay-as-you-drive Insurance	0.26	N/A

TLU-8: BICYCLE AND PEDESTRIAN

Approach

The TLU policy option discussed during Phase I of the work program seeks to increase the bicycle and pedestrian mode share to 15 percent of all trips in urbanized areas. According to the MDOT Annual Attainment Report, bicycle and walking mode share for commute trips in 2006 is 2.9 percent (.3 percent biking, 2.6 percent walking). Per the 2001 National Household Travel Survey, for the combined Baltimore and Washington urbanized area, combined bicycling and walking mode share for all trips is approximately 10 percent.

The focus of the analysis of TLU-8 strategies is to determine the mode shift implications and resulting GHG emission reductions of building out the *Maryland Trails* plan. A secondary analysis considers the mode shift and resulting GHG emission reductions from a comprehensive improvement in pedestrian infrastructure on urban roadways in areas adjacent to activity centers, transit stations and schools in Maryland.

In the summer of 2009, MDOT wrapped up the plan development portion of a statewide trail planning effort. *Maryland Trails: A Greener Way to Go* is Maryland's coordinated approach to developing a comprehensive and connected statewide, shared-use trail network. This plan focuses on creating a state-wide *transportation trails* network. These are hard-surfaced multi-use paths designed to be used by bicyclists, pedestrians and people with disabilities that accommodate trips to and from destinations, as opposed to recreational loops or spurs. The *Maryland Trails* plan identifies approximately 820 miles of existing *transportation trails* and 770 miles of priority *missing links* (160 trail segments) that, when completed will result in a statewide trails network providing travelers a non-motorized option for making trips to and from work, transit, shopping, schools and other destinations. Significant portions of these priority *missing links* are located in the more densely populated portions of the state.

According to the *Maryland Trails* plan, approximately 40 percent of the state's population lives within one mile of an existing *transportation trail.* An additional 13 percent live within one mile of a priority missing link in the trail network. The greenhouse gas reduction potential of building out this network is significant - especially when considering the potential to shift trips from cars to walking or walking combined with transit.

The 2001 Baltimore Metropolitan Commission (BMC) Household Travel (HHT) Survey was analyzed to ascertain the potential impact of trail availability on

travel modes in the study area.[18] Whereas the Travel to Work data gathered by the US Census captures only trips to work, the HHT Survey asks respondents to record data on all trips, including work, shopping, recreation and leisure.

- Throughout the BMC region, the mode share percentages for walking are significantly higher than those for bicycling.
- For areas within one mile of an existing *transportation trail, a*pproximately 24 percent of all trips are taken by walking, bicycling or a combination of walking or bicycling with transit.
- At population densities greater than 10000 ppsm, combined bicycle and walking mode share is 21.7 percent. At lower densities, for example less than 4000 ppsm, combined bicycle and walking mode share is 3-4 percent.

Assumptions

Maryland Strategic Trails Plan

To calculate the VMT reduction potential of building out the statewide strategic trails plan, GIS analysis was used to calculate mode share percentages across the BMC planning area, within one mile of an existing transportation trail and within one mile of a priority missing link. This mode share data was then extrapolated to all urban areas statewide to calculate the VMT shift potential of building out the state's transportation trails network.

Throughout the BMC planning area, 9.75 percent of all trips are taken by walking alone. This increases to approximately 12.9 percent of all trips when combined with walking trips to transit and bicycling. However, the percentage of trips taken by foot almost doubles to 17.3 percent in areas that are within one mile of an existing transportation trail (see Table 11).

[18] Note: This analysis relies on data obtained from the Baltimore Metropolitan Commission. Updated Household Travel Survey Data for the Metropolitan Washington Council of Governments (MWCOG) region is not anticipated to be available until late September 2009 at the earliest. A refinement of the figures and analysis contained within is recommended upon obtaining the MWCOG data.

Table B.11 BMC Household Travel Survey Walk and Bike Mode Shares

Area	% Walk	% Walk & Transit	% Bicycle	% Bike & Transit	% Other
Entire BMC	9.7	2.8	0.4	0.0	87.2
W/in one Mile of Existing Trail	17.3	6.4	0.5	0.0	75.8
W/in one Mile of Priority *Missing Link*	6.0	1.2	0.4	0.0	92.4

The potential for capturing trips currently taken by car becomes more pronounced when comparing areas with existing access to a trail to areas within one mile of a priority missing link. According to the data, 92 percent of all reported trips in these areas were taken by car and only 6 percent were taken by walking (7.2 percent when combined with walk and transit trips).

It should be acknowledged that these mode share percentages cannot be entirely attributed to the presence or absence of a transportation trail. Other elements, such as distance between origins and destinations (i.e. the mix of uses or density), the relative bike or pedestrian "friendliness" of an area, access to transit, local encouragement efforts, and other factors contribute to travel mode choice.

Comprehensive Pedestrian Strategy

The pedestrian analysis was conducted using population density data by the five density ranges used in the TLU-2 analysis. The deployment assumptions for adding pedestrian amenities through 2020 are:

1. All new developments having buffered sidewalks on both sides of the street, marked/signalized pedestrian crossings at intersections on collector and arterial streets, and street lighting.
2. New or fully-reconstructed streets in denser neighborhoods (>4,000 persons/sq mi and business districts) incorporate traffic calming measures.
3. "Complete Streets" policies are adopted by Maryland state and local transportation agencies, requiring appropriate pedestrian accommodations on all roadways.
4. By 2020, 50 percent of existing streets within ¼ mile of transit stations, schools, and business districts are audited for pedestrian accessibility and retrofitted with curb ramps, sidewalks, and crosswalks.

The basic method is to apply an elasticity of VMT with respect to a Pedestrian Environment Factor (PEF). PEFs represent an index reflecting qualities and deficiencies of pedestrian infrastructure. Elasticities from a 2001 study by Reid Ewing and Robert Cervero are applied to example changes in the PEF because of pedestrian improvements.[19] Two PEF change levels were run that include different assumptions about the geographic scope of deployment (w/in ¼ mile of all transit stations/activity centers to within ½ mile). As Table 12 shows, VMT changes range from -1.5 percent in suburban areas (where it is assumed that a greater relative level of pedestrian improvement could be implemented) and -0.5 percent in urban areas.

Table B.12 Application of Pedestrian Environment Factor (PEF) Elasticities to VMT

	Suburban		Urban	
Portland PEF factors	**Base**	**Alt**	**Base**	**Alt**
Sidewalk availability	1	3	2	3
Ease of street crossing	1	2	2	2.5
Connectivity of street/ sidewalk system	1	1	3	3
Terrain	3	3	3	3
PEF score	6	9	10	11.5
% change in PEF		50%		15%
% change in VMT:		-1.5%		-0.5%

The "suburban" percentage VMT reduction is applied to density ranges 1 - 3 (<4,000 ppsm), the urban reduction to range 5 (<10,000 ppsm), and a mid-point reduction (1.4 percent) applied to range 4.

The VMT change was not applied to all population; instead, it was applied to an estimate of the population affected by the relevant pedestrian improvements. This estimate varies by census tract density range, based on the estimated land area covered by the improvements (Table 12). The pedestrian strategy assumes pedestrian improvements only in certain areas, such as transit stations, school zones, and business districts, as it would probably be cost-prohibitive and not very effective to make such improvements to all neighborhoods, everywhere. The following assumptions are made about the number of each type of area:

[19] Ewing, R. and R. Cervero (2001) Travel and the Built Environment. *Transportation Research Record 1780*, 87-114.

- Schools – 1,446 total K-12 schools in Maryland (National Center for Educational Statistics, 2005-06) * 5/6 of population (schools) in metro areas = 1,200 schools. These were distributed across all density ranges, based on population.
- Transit stations: 104 transit stations in Maryland. These were distributed across the three highest density ranges, based on population.
- Business districts: Total population of 5,841,356 in 2010. Total business districts estimated at 413. Multiple estimation methods used:
    - One for each of the 368 cities, towns, and villages in the Maryland as defined in the 2000 Census.
    - One per 15,000 people (approximately the market area for a grocery store) yields 390 districts.
    - One per 5,000 people (market area for a convenience store), considering only urban population in areas w/>4,000 ppsm, yields 482 districts. These were distributed across the four highest density ranges, based on population.

In Table 13, the percentage of total land area in Maryland affected is calculated based on improvements within a ¼ mile radius to a ½ mile radius. All numbers are increased from 2010 to 2020 based on an average annual population growth rate from 2000 to 2020 of .94 percent.

Table B.13 Percent Population Living in Area with Pedestrian Improvements (2020)

	Total Improved Areas			% of Total Area Affected	
Pop/ sq mi	**Schools**	**Transit**	**Business Districts**	**1/4 mi**	**1/2 mi**
0 – 499	307			0.7%	3.0%
500 -1,999	288		100	7.9%	31.7%
2,000 - 3,999	340	34	117	24.2%	96.8%
4,000 - 9,999	472	34	168	52.4%	100%
10,000+	180	36	68	100%	100%
Total	**1,588**	**104**	**454**	**4.3%**	**17.3%**

Results

Maryland Strategic Trails Plan

Using the BMC survey data expanded to all urban areas in Maryland, the existing VMT by mode for areas within one mile of a priority *missing link*, as well

as the mode shift potential incurred by building out the proposed *transportation trail* network is determined. For the purposes of this section, statistics derived from BMC data have been extrapolated to all *missing links* that are located within Maryland's urbanized areas.

It is difficult to distinguish the effects on travel behavior of bike/pedestrian improvements apart from the effects of a mixed-use environment and higher density. The willingness to bike or walk is most heavily influenced by proximity to generators – i.e., a trip has to be short enough to be competitive with alternatives (the average length of a bike trip in Maryland is 1.9 miles). This is a function of the density of development, mix of uses, and connectivity of the street/pedestrian network. There does appear to be some influence of design factors (availability of sidewalks, safe street crossings, etc.), while holding the built environment constant. This analysis is directed at determining the impacts of buildout of the trail plan alone, within a fixed land use context.

This analysis was performed by applying the mode split percentages calculated for areas within one mile of an existing *transportation trail* to the areas within one mile of a priority *missing link.* By building out the *transportation trail* network, in 2020 up to 400.4 million vehicle miles could be shifted from car to nonmotorized modes of transportation, or a combination of walking or bicycling with transit. This change results in a GHG emissions reduction of **0.08 mmt**.

Table B.14 2020 Greenhouse Gas Reductions from Buildout of Trail Plan

Mode	PMT by Mode Pre-Trail Plan Buildout (millions) [1]	PMT by Mode Post-Trail Plan Buildout (millions) [2]
Walk	36.5	105.4
Walk & Transit	6.7	9.1
Bike	7.2	39.0
Bike & Transit	0	0.1
Other	8.881.9	7,280.4
VMT Shift (millions) [3]		**(400.4)**
GHG Reduction (mmt)		**0.08**

Notes:

[1] 2020 PMT by mode derived by applying 1.4 percent annual VMT growth rate to 2001 household travel survey data in areas within 1 mile of a priority *missing link*.

[2] 2020 PMT by mode derived by applying 1.4 percent annual VMT growth rate to 2001 household travel survey data in areas within 1 mile of an existing *transportation trail*.

[3] VMT shift by mode extracts the VMT shift associated **only** with the provision of new transportation trails, not the impact of land use change. The assumption is that 15 percent of the mode shift is attributed to the provision of trail infrastructure.

An alternative approach to estimate the increase in bicycling that might take place with buildout of the trail plan uses a simple model based on data in a paper by Dill & Carr (2003) examining bicycle commuting and facilities deployment in 42 U.S. cities. Their analysis found that for more typical U.S. cities with at least 250,000 population, each additional mile of bike lanes per square mile is associated with a 1 percent increase in bike commuting.[20] This percent increase was applied to a baseline commuting percentage in Maryland (2001 NHTS) of 0.3 percent and 0.34 miles of bike lanes per sq. mi. (data from Dill & Carr, 2003). The resulting increase in bike commuting mode share is translated to VMT savings and thus greenhouse gases, resulting in a GHG savings in Maryland of 0.05 mmt.

The VMT reduction from the buildout of the trails plan could increase significantly (by as much as 85 percent) with corresponding land use policies encouraging mixed use development in transportation trail corridors. While land use change and new development will take a longer timeframe to recognize benefits (ie beyond 2020), this relationship is key to consider in future iterations of the implementation plan.

Planning level estimates put the cost of building all priority *missing links* at approximately **$378 million** (2009 dollars). It should be noted that under current planning processes, trail construction is primarily county-led, although significant funding is available from the state through the Transportation Enhancements Program and the Recreation Trails Program. The *Maryland Trails Plan* does not attempt to prioritize individual trail projects, although it does offer several criteria that can be used for prioritization such as cost, population within proximity of a trail, length, feasibility, ability to address significant barriers, and other factors.

Comprehensive Pedestrian Strategy

A range of pedestrian infrastructure improvements in all urban census tracts by 2020 results in additional reductions in VMT (Table 15). Total GHG reductions range from **0.03 mmt to 0.08 mmt** in 2020. These reductions come at a capital cost

[20] Dill, J., and T. Carr (2003). "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them – Another Look." *Transportation Research Record* No. 1828, National Academy of Sciences, Washington, D.C.

of **$219.9 - $439million** over 10 years of implementation, or an average annual cost of $22 to $43.9 million (Table 16).

Table B.15 Comprehensive Urban Area Pedestrian Improvements GHG Reductions

2020 PPSM	% of Total Area		VMT Reduction for Impacted Population (million)		1/4 mi GHG (mmt)	1/2 mi GHG (mmt)
	1/4 mi	1/2 mi	1/4 mi	1/2 mi		
0 – 499	0.7%	3.0%	0.76	3.05	0.00	0.00
500 -1,999	7.9%	31.7%	7.27	29.09	0.00	0.01
2,000 - 3,999	24.2%	96.8%	24.85	99.39	0.01	0.03
4,000 - 9,999	52.4%	100%	49.96	95.26	0.02	0.03
10,000+	100%	100%	9.29	9.29	0.00	0.00
Total	**4.3%**	**17.3%**	**92.13**	**236.07**	**0.03**	**0.08**

Table B.16 Comprehensive Pedestrian Strategy Costs

Area Type	Total #	Cost per Area		Total Cost ($millions)	
		1/4 mi	1/2 mi	1/4 mi	1/2 mi
Schools	1,588	$191,000	$382,000	$151.6	$303.3
Transit Stations	104	$191,000	$382,000	$9.9	$19.0
Business Districts	454	$257,000	$514,000	$58.4	$116.7
Total 10-year capital ($millions)				**$219.9**	**$439.0**
Cost per Year, 2010-2020				**$22.0**	**$43.9**

Summary

Table 17 presents a summary of TLU-8 GHG emission reductions and costs in 2020.

Table B.17 TLU-8 GHG Reduction and Costs (2020)

TLU-8	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
Buildout of Maryland Trails Plan	0.08	$378.0
Activity Center/Schools/Transit Station Pedestrian Improvements	0.03 – 0.08	$219.0 - $439.0

Actual mode shift in different areas around the state will vary based on the quality of the local nonmotorized transportation network, terrain, proximity between origins and destinations, trail access and continuity, connections to transit, local encouragement efforts, and a variety of other factors. As such, the resulting shift to nonmotorized modes of travel and greenhouse gas reduction potential should be refined once better localized data is available. In the Baltimore and Washington urbanized areas, per 2001 NHTS data, this analysis results in an increase in bicycle and pedestrian mode share for all trips of 10 percent to 12.1 percent.

The draft MDOT policy design considers six potential strategy areas. In total, deployment of these six approaches will result in increases in bike and pedestrian mode shares. Four or the six represent expansion of existing networks and services through revised regulations and guidelines and increased funding. These are:

Roadway Planning and Design Regulations, Policies, and Guidelines – Strengthen implementation of current policy of *considering* bicycle and pedestrian accommodations on road and bridge improvement projects to *requiring* accommodations with limited exceptions.

Revise Regulations for Incorporating Bicycle Services at Strategic Locations – Strengthen existing regulations addressing bicycle supportive services in State buildings and institutions and public schools (of all levels). Award tax credits or other incentives for private buildings and projects that provide qualifying bicycle services.

State Funding Allocations – Identify opportunities to allocate more funding to projects that improve the bicycle and pedestrian network and/or promote relatively low-cost safety solutions. Modify rules governing state bicycle/pedestrian infrastructure funding programs to allow more flexibility.

Local Revenue Sources – Identify local revenue opportunities for improving local pedestrian bicycle networks (consider minimum percentage from highway user funds, speed camera and/or red light camera fines, etc.). Increase allocations from existing funding sources.

The other two strategy areas deal with land use policy and education.

Land Use Policy Guidance – Promote planning and design policies that support bicycle and pedestrian travel. Strengthen requirements for non-motorized transportation elements in local plans. Create and promote model ordinances (such as the existing Bicycle and Pedestrian Access Model Ordinance) for use by local jurisdictions. Consider parking maximum's as an option for reducing parking at public and private developments.

Education and Encouragement – Conduct a social marketing campaign aimed at encouraging more people to make short trips on foot or bicycle and combine nonmotorized modes with transit for longer trips. Campaign should also encourage local governments to prioritize non-motorized travel.

Starting with the analysis performed for this section, a new criterion addressing a potential project's ability to reduce greenhouse gas emissions could be developed. This factor could then be applied in the trail project prioritization process to foster projects that have the greatest potential to promote and accommodate shifts from cars to walking and bicycling.

TLU-9: PRICING AND TRAVEL DEMAND MANAGEMENT

Approach

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 –** Establish GHG emission-based road user fees statewide by 2020 to complement or replace motor fuel taxes, with revenues used to fund transportation improvements and systems operations meeting state 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 meeting state goals.

- **Parking Impact Fees –** 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.

VMT Fees

VMT fees are a different form of a usage fee compared to current per mile gas taxes. Table 18 presents the current motor fuel taxes in Maryland and adjacent states. This helps set a context for the magnitude of the VMT fees tested for this TLU. Alternative VMT fees ranging from $0.01 per mile to a high of $0.05 per mile are evaluated in Maryland for the year 2020. Assuming 27 mpg average on-road fuel economy in 2020, these equate to an equivalent gas tax increase of $0.27 to $1.37 per gallon.

Table B.18 State and Federal Motor Fuel Taxes

State	State Tax	Federal Tax	Total
Maryland	$0.235	$0.185	$0.420
Delaware	$0.230	$0.185	$0.415
Pennsylvania	$0.323	$0.185	$0.508
Virginia	$0.191	$0.185	$0.376
Washington DC	$0.200	$0.185	$0.385
Average among selected states	***$0.236***	***$0.185***	***$0.421***

Congestion Pricing and Managed Lanes

In 2007, congestion (based on wasted time and fuel) cost $2.76 billion in the Washington DC region and $1.27 billion in the Baltimore region. Compared to 2000 conditions, as estimated by the Urban Mobility Report, annual cost of congestion per peak traveler in 2007 has increased 48 percent in the Washington DC region and 68 percent in the Baltimore region. [21] This results in an annual cost of $1,271 per peak traveler in the Washington DC region and $982 per peak traveler in the Baltimore region.

There are a total of 3,140 interstate and expressway lane miles in Maryland. Based on the 2008 Annual Attainment Report, 30.4 percent of freeway lane miles are congested daily in 2006. BMC and MWCOG travel demand models forecast 40 percent of freeway miles will be congested in 2020. Table 19 presents proposed ranges of deployment of congestion pricing in 2020.

Table B.19 Maryland Congestion Pricing Deployment Levels

Percentage of Lane Miles to Apply Congestion Pricing	2020 Target
1. Half of congested areas, 1 lane each direction	7.5%
2. All congested areas, 1 lane each direction	15.0%
3. Half of congested areas, all lanes in both directions	20.0%
4. All congested areas, all lanes in both directions	40.0%

[21] *2009 Urban Mobility Report* Texas Transportation Institute Urban Mobility Study, http://tti.tamu.edu/documents/mobility_report_2009_wappx.pdf

- **1. (Lowest Level) – Half of congested areas, 1 lane in each direction.** The percentage for this scenario will be 7.5 percent in 2020, which is about 1/5 of 40% - the maximum percentage in Scenario 4.
- **2. (Mid-Level) – All congested areas, 1 lane in each direction.** The maximum percentage will be 15.0 percent in 2020, which is about 2/5 of the maximum from Scenario 4. Two-fifths is used because the average number of lanes is slightly above 5 and congestion pricing will be applied on 2 of those lanes.
- **3. (Mid-Level) - Half of congested areas, all lanes in both directions.** The maximum percentage will be 20.0 percent in 2020, which is exactly half of the maximum for Scenario 4.
- **4. (Maximum) – All congested areas, all lanes in both directions**. The maximum percentage for this scenario will be 40 percent in 2020, which is calculated above.

To maintain level-of-service (LOS) of D condition on the priced facilities, an estimated congestion fee (cost per mile) ranging from $0.25 to $0.30 is required.

Parking Impact Fees

Most parking management strategies are under the domain of local government. In most U.S. cities, parking supply is constrained or priced only in the central business district (CBD) and possibly a few other major activity centers, primarily as a result of market forces that establish a strong premium on land costs. Outside of these areas, parking supply is generally plentiful, due to long-established planning and zoning regulations that require developers to provide ample parking, and free.[22]

A recommendation of the TLU-9 working group is that Maryland should encourage testing of parking impact fees in transit-served metropolitan communities. These fees would be waived for employers who offer cash-in-lieu-of-parking and transit benefits. Parking impact fees serve as a disincentive for employers who choose not to offer parking and/or transit benefits to employees. As a result, it is considered as a potential action within the analysis of parking pricing and transit benefits. The strategy is also tied to the overall goals of TLU-2.

Employer Commute Incentives

Efforts to reduce commute trips by single-occupancy vehicle (SOV) have long been a staple of transportation demand management (TDM) in Maryland. Commute-focused trip reduction initiatives include alternative mode

[22] Shoup, D. (2005). *The High Cost of Free Parking.* APA Planners Press, Chicago, Illinois.

information, transit subsidies, ridesharing/ride matching programs and incentives, vanpools, parking management (including pricing and cash-out), telework, alternative work schedules and guaranteed ride home.

With statewide deployment, this strategy will have significant benefits. The focus is primarily on large corporations and employment centers first where commute alternatives, such as transit are readily available. Existing programs such as Commuter Connections in the Washington DC region, MTAs Commuter Choice Program and the Commuter Choice Tax Credit already show significant levels of employer participation. The range of strategies considered here include:

- **Parking pricing and transit benefits**. The Climate Action Plan identifies a goal that all state agencies, state contractors, and state grantees offer transit benefits and cash-in-lieu parking benefits to their employees.

  Parking management involves changes to parking supply, pricing, or other management techniques to create disincentives to driving. Examples include: reducing parking requirements for new development; designing and locating parking to encourage pedestrian travel for short local trips; charging workers for parking or allowing them to "cash-out" the value of parking if they do not use it; "unbundling" residential parking costs from the cost of a lease or purchase; pricing to encourage "park-once" behavior; pricing to maintain vacant spaces in order to reduce parking search time; reducing on-street parking to make room for wider sidewalks and/or bike lanes; and using information technology to help drivers efficiently locate spaces.

- **Employer Support Programs (commute incentives & worksite trip reduction programs).** Worksite trip reduction programs may include either requirement for employers to reduce single-occupancy vehicle (SOV) trips by their employees, or outreach, assistance, and incentive programs to encourage them to do so.

  An expansion of current programs in Maryland could include development of employer-based trip reduction requirements, combined with existing supportive programs such as regional ridematching and vanpooling programs and assistance in developing worksite-level trip reduction plans. Of the various worksite-based strategies, financial incentives and disincentives, such as free or discounted transit passes and parking pricing or cash-out, generally have the greatest impact.[23] This means that programs focused on encouraging employers to offer subsidized or pre-tax transit

[23] Victoria Transport Policy Institute (VTPI) (2009). *TDM Encyclopedia: Commute Trip Reduction*. http://www.vtpi.org/tdm/tdm9.htm, accessed May 2009.

benefits, parking cash-out, and/or other incentives are likely to have a greater impact than those focused simply on providing information and coordination services. Transit agencies are typically key partners in making transit benefits easily available to employers and employees.

- **Telework and Alternative Work Schedules.** Estimates of the proportion of U.S. workers who telework on a regular basis vary, but this number has clearly been raising substantially as the technology to support teleworking has advanced and fuel prices have risen. Compressed work weeks have been applied successfully in the commercial, public, and manufacturing sectors for many years. With recent energy cost concerns some agencies and companies have expressed renewed interest in compressed work weeks; for example, in August 2008 the Utah state government implemented a mandatory four-day workweek.

  A review of national studies conducted in 2007 for the New York City Department of Transportation suggest the existing rate of telecommuting is about 8 percent, with 1.5 days per week being a typical average. The 2008 State of the Commute survey in the Metropolitan Washington, D.C. region estimated that 19 percent of regional employed workers telework at least occasionally, of which 56 percent telework at least once a week. Data from Phoenix (where trip reduction ordinances have been implemented) found that 13 percent of non-home-based commuters use a compressed work weeks (CWW), with 2 percent operating 9/80 (nine days and 80 hours every two weeks), 8 percent operating 4/40, and 3 percent (many police and fire) operating 3/12.

Assumptions

VMT Fees

To estimate the related GHG reduction of VMT fees, travel cost elasticities are applied to all relevant private vehicle travel in Maryland. Automobile travel is generally inelastic, meaning that a price change causes a proportionally smaller change in vehicle mileage. For example, a 10 percent fuel price increase only reduces automobile use by about 1 percent in the short run, and 3 percent over the medium run. A 50 percent fuel price increase, which is significant to consumers, will generally reduce vehicle mileage by about 5 percent in the short run. The effect over time though will increase as consumers take the higher price into account in longer-term decisions, such as vehicle purchases and where to live or work.

A combined long and short run elasticity estimate was applied for both the VMT fee and congestion pricing analysis of a -0.45 percent change in volume for each

1.0 percent change in trip cost. This elasticity is consistent with the range of estimates made by FHWA in the 2006 Conditions and Performance Report.[24]

Congestion Pricing

The same travel cost elasticity is applied for congestion pricing to estimate the reduction in VMT. For congestion pricing, an additional analysis is conducted to estimate the reduction in fuel consumption resulting from maintaining LOS D operations on the facility. This is accomplished by determining the change in hours of delay per 1000 VMT. HPMS data from FHWAs Highway Economic Reporting System (HERS) model is used to develop baseline statistics for Maryland interstates.

Employer Commute Incentives

A range of estimates is made for future participation in all employer based commute strategies. Data from national studies suggest that approximately 50 percent of the workforce could participate (based on job requirements) and 50 percent of workers offered the option would take advantage of it. Based on these assumptions, approximately 25 percent of the workforce could participate in some type of a commute program. Table 20 presents baseline, medium and high participation assumptions for 2020. As shown in Table 19, EPAs COMMUTER Model was applied with baseline work-trip mode shares and trip distances specific to Maryland.[25]

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[24] Cambridge Systematics and Harry Cohen, "Congestion Pricing and Investment Requirements", National Cooperative Highway Research Program Project 8-36, Task 85. Transportation Research Board, 2009. http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/NCHRP08-36(85)_FR.pdf

[25] The COMMUTER Model analyzes time and cost strategies using a "pivot-point" logit mode choice model, which uses the mode choice coefficients from regional travel models and applies a change in time and/or cost to "pivot" off of a baseline starting mode share to achieve a final mode share. http://www.epa.gov/OTAQ/stateresources/policy/pag_transp.htm#cp

Table B.20 Employer Based Commute Strategy Participation Assumptions

Scenario	Description	Employer Participation Rate		
		Baseline	Medium Scenario	High Scenario
Parking Pricing & Transit Benefits	Parking fees/transit passes	10%	15%	20%
Employer Support Programs, Percentage of Employers Participating	Level 1	5%	8%	10%
	Level 2	2%	2%	4%
	Level 3	1%	2%	3%
	Level 4	1%	2%	3%
Alternative Work Schedules	Flex Time	5%	8%	10%
	Compressed 4/40	5%	8%	10%
	Compressed 9/80	5%	8%	10%
	Staggered Hours	5%	8%	10%
	Telecommute	5%	8%	10%

Notes: The values in the table are all inputs into the USEPA Commuter Model. Level 1 includes a transit information center plus a transportation coordinator. Level 2 includes a transit information center and a policy of work hour's flexibility to accommodate transit schedules/delays, plus a transportation coordinator. Level 3 includes a transit information center and a policy of work hours flexibility, on-site transit pass sales, plus a transportation coordinator. Level 4 includes a transit information center and a policy of work hours flexibility, on-site transit pass sales, guaranteed ride home, and a full-time transportation coordinator.

Results

VMT Fees

The VMT reduction resulting from a statewide VMT fee in 2020 are illustrated in Table 21. Depending on the level of per mile fee (from $0.01 to $0.05), statewide GHG reductions range from 0.18 to 0.91 mmt in 2020, with revenue ranging from $678 million to over $3.4 billion. The VMT fees tested represent a significant increase in current Maryland motor fuel tax. Evaluating the total social cost of implementing a fee-based program will be required to understanding the potential negative social and economic impacts.

Table B.21 Alternative VMT Fee Greenhouse Gas Reductions (2020)

VMT Fee ($/Mile)	Equivalent Gas Tax ($/gallon)[1]	% VMT Reduction[2]	Absolute VMT Reduction (Millions)[3]	Revenue Collected ($ Million)	GHG Reduction (mmt)[5]
$0.01	$0.27	0.65%	439	$678	0.18
$0.02	$0.55	1.30%	879	$1,365	0.36
$0.03	$0.82	1.96%	1,318	$2,060	0.55
$0.04	$1.09	2.61%	1,757	$2,765	0.73
$0.05	$1.37	3.26%	2,196	$3,478	0.91

In order to estimate cost, two different alternatives are evaluated for instituting a distance-based pricing framework. These represent a low-technology (administrative reporting) and high-technology (wireless reporting) approach.

Administrative Reporting – Motor vehicle owners self-report mileage through motor vehicle registration and inspection process, or on-board odometer readings are recorded by inspectors. Under this scenario, the total cost is similar to costs for collecting state gas tax revenues. The cost assumptions for these strategies comes from a 2008 Cambridge Systematics white paper completed for FHWA on *Estimating the Cost of Systemwide Road Pricing*.

The State of Maryland collects motor fuel taxes from fuel distributors through the International Fuel Tax Agreement (IFTA). The Maryland Motor-Fuel, Alcohol, and Tobacco Tax (MATT) Regulatory Division, which is part of the Office of the Comptroller, administers the motor fuel tax. Maryland, which currently collects a 23.5 cents per gallon gasoline tax, received an estimated $765,100,000 in motor vehicle fuel tax and fees in 2007 (Maryland Department of Budget and Management, FY 2008 Operating Budget), but only $8,569,594 (about 1.125 percent of revenue) was returned to the Comptroller's office for compliance, regulatory, and enforcement activities related to the motor fuel tax. Revenue administration, operations and maintenance costs are estimated to account for 5 percent of revenue for distance-based pricing.

Using these assumptions, Table 22 presents annual revenue in 2020 and implementation costs. Implementation costs include annual administrative costs required for the program. The significant advantage of this approach is that there are no capital costs required, however there is the potential for lost revenue due to under-reporting of miles traveled.

Table B.22 VMT Fee Implementation Costs and Revenues (Administrative Reporting Scenario)

VMT Tax ($/Mile)	Equivalent Gas Tax ($/gallon)[1]	Revenue Collected ($ Million)	Admin. Costs ($ Million)	Net Cost ($ Million)
$0.01	$0.27	$678	$34	$644
$0.02	$0.55	$1,365	$68	$1297
$0.03	$0.82	$2,060	$103	$1957
$0.04	$1.09	$2,765	$138	$2627
$0.05	$1.37	$3,478	$174	$2204

Wireless Reporting – Under this scenario, motor vehicles will link to a receiver located at gas stations, where a RF (radio frequency) receiver picks up a transmission from an on-board unit (OBU) that provides the odometer reading since the last visit at a gas station.

The wireless reporting VMT fee system approach uses an on-board radio frequency (RF) transmitter connected to the vehicle odometer or to an electronic hub odometer. A recent paper on *Toll Collection Technology Considerations* estimated the price of GPS OBUs at $200 to $400.[26] For this evaluation, a cost of $400 per unit is assumed, including start up costs and installation.

Transceivers are located at gas stations and record mileage information between fill-ups. The estimate for these units from a recent paper on Vehicle Infrastructure Integration Benefit Cost Analysis is used.[27] The estimated unit cost is $1,000, with an additional $4,800 for installation. For number of gas stations, the number recorded from the 2002 Economic Census (1,735) was increased to an estimate of gas stations in 2020 based on a relationship of 3,067 persons per gas station in Maryland in 2002 (results in 2,082 gas stations in 2020).

Costs for electronic hub odometers, on-board units, and gas station RF receivers are presented in Table 23. Additional operating costs are approximated at 10 percent of the field equipment cost. Annual administrative costs, are estimated at 5 percent of revenue.

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[26] *Toll Collection Technology Considerations, Opportunities, and Risks*, Background Paper No. 8, Washington State Comprehensive Tolling Study, September 20, 2006 (IBI Group with Maryland Department of Transportation).

[27] *VII Initiative Benefit-Cost Analysis: Pre-Testing Estimates*, Draft Report, Sean Peirce and Ronald Mauri, John A. Volpe National Transportation Systems Center, Cambridge, Massachusetts, March 30, 2007.

Total vehicles registered in 2020 are estimated by applying the same ownership per capita as tracked in 2007 Maryland fleet data.

Table B.23 VMT Fee Implementation Costs (Wireless Reporting Scenario)

Item	Units	Cost per Unit	Cost Extended
Hub Odometers (Electronic) & Start Up	4.72 million	$400	1,888 million
OBU RF Transmitters	4.72 million	$100	472 million
RF Receivers at Gas Stations	2,082	$5,800	$12.1 million
Total Deployment Cost			**2,372.1 million**

Total VMT fee capital costs are $2,372.1 million. Table 24 illustrates total revenue collected in 2020 and total capital plus annual operations and maintenance costs in 2020.

Table B.24 VMT Fee Implementation Costs & Revenues (Wireless Reporting Scenario)

VMT Fee ($/Mile)	Equivalent Gas Tax ($/gallon)[1]	2020 Revenue Collected ($ Million)	Cumulative Capital/ Annual O&M Costs ($ Million)
$0.01	$0.27	$678	$2,407.1
$0.02	$0.55	$1,365	$2,441.5
$0.03	$0.82	$2,060	$2,476.7
$0.04	$1.09	$2,765	$2,511.5
$0.05	$1.37	$3,478	$2,547.1

Congestion Pricing and Managed Lanes

Table 25 presents results of the congestion pricing scenario analysis. Two ranges of VMT reduction are estimated based on a moderate and high projection of growth in congested lane miles by 2020. In 2020, the annual VMT reduction from congestion pricing ranges from 279 million to a high of 2,122 million.

Table B.25 Congestion Pricing Results

Congestion Pricing Scenario	2020 Moderate GHG (mmt)*
1. Half of congested areas, 1 lane each direction	0.13
2. All congested areas, 1 lane each direction	0.26
3. Half of congested areas, all lanes in both directions	0.34
4. All congested areas, all lanes in both directions	0.68

* Note: GHG reduction includes fuel savings from reduced delay. The GHG benefit from reduced delay represents 25 percent of the total GHG reduction.

Initial capital costs include the on-board units (OBU) and installation, enforcement requirements and central system development. According to a 2008 study by the Puget Sound Regional Council (PSRC), the total capital startup cost for regional congestion pricing is $748.5 million. The same PSRC study estimated annual system costs, which include OBU repair, enforcement, and data communications needs at $287.7 million annually in 2008 dollars. These costs are expanded on a per capita basis (based on 2006 census population of the Seattle region, 3.3 million) to cover deployment to the Baltimore and Washington DC regions (total 2020 population in Maryland of 5.6 million). Table 8 presents forecast 2020 revenues by scenario and total costs. These yields maximum (if all urban freeways had congestion pricing) capital costs of $1.278 billion and annual operating costs of $0.491 billion. These values are scaled down based on the percentages of miles of deployment by scenario.

The capital cost estimates assume that existing lanes are priced. Therefore, no additional road facilities or costs are assumed in this estimate.

Table 26 summarizes the total greenhouse gas reductions in 2020 based on VMT reduction and delay reduction, along with net cost after subtracting costs. Note that this cost analysis assumes all cumulative capital costs, annual operating and administrative costs and benefits in 2020.

Table B.26 Congestion Pricing 2020 GHG Reduction and Revenue

Congestion Pricing Scenario	Capital & Admin Cost (millions)	2020 Revenue (millions)	Net Cost/Revenue (millions)
1. Half of congested areas, 1 lane each direction	$132.0	$358.2	$226.2
2. All congested areas, 1 lane each direction	$263.7	$716.4	$452.7
3. Half of congested areas, all lanes in both directions	$345.1	$962.0	$616.9
4. All congested areas, all lanes in both directions	$707.9	$1,924.0	$1216.1

Employer Commute Incentives

The results of the two Commuter Model runs are listed in Table 27. The change in VMT represents an additional reduction over the benefits of the TERM strategy benefits analysis in 2020.

Table B.27 Employer Commute Incentives GHG Reductions (2020)

Employer Commute Incentives	Medium Scenario	High Scenario
Daily VMT Reductions	1,094,381	2,793,817
Annual VMT Reduction (millions)	279.1	712.4
2020 Emission Reductions (mmt CO2e)	**0.10**	**0.25**

The costs of demand management strategies include administrative costs to coordinate programs, which will be borne by employers and local or regional agencies; as well as capital costs for telecommuting equipment, vans, etc. Many demand management programs also involve transfer payments, such as transit fare subsidies provided by an employer or regional agency, or additional revenue gathered through parking charges, which may benefit or affect different people in different ways. The FY 2008 budget for the Metropolitan Washington Council of Governments' (MWCOG) regional Commuter Connections program was approximately $5 million, of which the largest expenses were $2.2 million for marketing and $1.0 million for employer outreach; other expenses included ridematching coordination and technical assistance ($0.6 million), a guaranteed ride home program ($0.5 million), a telework program, information kiosks, and evaluation.

The total statewide commute alternatives and incentives implementation cost through 2020 as evaluated through the TERM analysis is $136 million. The scope

of the medium and high scenario tested here roughly increase participation in these programs by 50 and 100 percent respectively. While specific costs associated with this level in 2020 are not estimated here in detail, it is expected that through 2020, they would be in the order of $60 to $140 million.

Summary

Table 28 presents a summary of TLU-9 GHG emission reductions and costs in 2020.

Table B.28 TLU-9 GHG Reduction and Costs (2020)

TLU-9	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
VMT Fees	0.18 – 0.91	$2,407.1 - $2,547.1
Congestion Pricing and Managed Lanes	0.13 – 0.68	$132.0 – $707.9
Employer Commuter Incentives	0.10 – 0.25	$60 - $140

TLU-10: TRANSPORTATION TECHNOLOGIES

Approach

The draft MDOT policy design identified the following strategies for further analysis and implementation under this policy option:

TLU-10.2 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)

TLU-10.3 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.

TLU-10.4 Marketing and Education Campaigns - Initiate marketing and education campaigns to operators of on-and off-road vehicles.

TLU-10.5 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.

TLU-10.6 Green Port Strategy - Develop and implement a "Green Port Strategy" consistent with industry trends and initiatives including EPA's Strategy for Sustainable seaports.

TLU-10.7 Reduce Idling Times - Reduce idling time in light duty vehicles, commercial vehicles, buses, locomotive, and construction equipment.

TLU-10.9 Technology Improvements for On-highway Vehicles - Promote and incentivize fuel efficiency technologies for medium and heavy-duty trucks (on-highway vehicles).

TLU-10.10 Incentives for Low-GHG Vehicles - Provide incentives to increase purchases of fuel-efficient or low-GHG vehicles / fleets.

TLU-10.12 Technology Advances for Non-highway Vehicles - Encourage / 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.

Assumptions

Due to a lack of data, emissions resulting from the implementation of TLUs 10.4 – 10.6 and TLU 10.10 were not analyzed at this time. Potential future analysis of TLU-10.6, the Green Port Strategy, could include the recent announcement that the Port of Baltimore will receive $3.5 million in Recovery Act funding to help clean the air in and around the Port. The Port will use the funds for clean-diesel technology in essential equipment used for harbor operations. The equipment is expected to consist of tugboats, locomotives, short haul trucks, and cargo handling equipment. The technologies, which will have an impact on GHG emissions, could include engine repowers, vehicle and equipment replacements, and installation of anti-idling devices. The Maryland Clean Car Program, TLU-10.1, was not analyzed as a strategy under this policy option, but was included in the baseline analysis which is outlined in Section II of this document. The assumptions used to arrive at the GHG emission reduction benefits and the estimated costs associated with implementation of the remaining strategies are outlined below.

TLU-10.2 Active Traffic Management (ATM) / Traffic Management Centers – The costs associated with the implementation of this strategy were calculated assuming an annual funding rate of $12,867,000, which was published in the FY2008-2013 MDOT Consolidated Transportation Program. The GHG emission benefits associated with this strategy were calculated based on 2008 data obtained from the CHART program, which were projected to 2020 utilizing the following assumptions:

- An average annual VMT growth rate of 1.11 percent, obtained from the BRTB 2035 LRP & 2010-2013 TIP (May 2009).
- A 2020 fleet mix of 90 percent LDV, 3 percent HDGV, and 7 percent HDDV.
- A 2008 average fuel economy (mpg) of 21.4 for LDVs, 8.0 for LDGVs, 8.3 for HDDVs, and 20.1 fleet-wide.
- A 2020 average fuel economy (mpg) of 29.4 for LDVs, 8.0 for LDGVs, 8.3 for HDDVs, and 27.3 fleet-wide.
- A 2008 annual fuel savings of 6.7 mgal.
- A delay reduction of 2.66 M veh-hr for trucks and 33.32 M veh-hr for cars.

- A fuel economy adjustment factor of 0.74.

TLU-10.3 Traffic Signal Synchronization / Optimization – The GHG emission benefits resulting from the implementation of this strategy were calculated using the same average annual VMT growth rate in the BMC region, fleet mix, and fuel economy adjustment factor, and 2008 and 2020 fuel economy, assumptions as those used to calculate the benefits of TLU-10.2. In addition an annual 2008 fuel savings of 856,266 gallons was, based on 2008 data from SHA, was used to project 2020 emissions benefits. In order to estimate the costs associated with implementing this strategy, cost estimates for updating signal timing per intersection and retiming traffic signals in the Washington, DC area were obtained from the National Traffic Signal Report Card, and ITS costs estimated by DOT, respectively.

TLU-10.7 Reducing Idling Times – The GHG emission benefits calculated from this strategy represent the sum of a reduction in 1) long term truck idling (overnight and loading), 2) transit bus idling, and 3) school bus operations.

Long Term Truck Idling – 3.4 percent of all class 8 truck CO_2 emissions were assumed attributable to long term idling. It was assumed that a 40 percent reduction in long-term truck idling could be achieved by 2020, resulting in a 1.36 percent reduction in class 8 truck GHG emissions. The costs associated with a decrease in Class 8 truck emissions was estimated based an assumed anti-idling equipment cost of $5,000 per truck and a fuel savings of $3/gal.

Transit Bus Idling – Based on a CARB study, it was assumed that 7 percent of transit operating time is attributable to idling in excess of 1 minute. The average emission rate at the average operating speed of 15 mph is equivalent to 3,070 g/mi, while the CO_2 idling emission rate equals 5,337 gal/hr. Assuming an 80 percent reduction by 2020 results in a 0.86 percent reduction in transit bus emissions. The costs associated with this reduction were estimated based on an assumed anti-idling equipment cost of $5,000 per transit bus and a fuel savings of $3/gal.

School Bus Idling – Based on a CARB study, 14 percent of school bus operating time is attributable to idling in excess of 1 minute. The average emission rate at the average speed of 15 mph equals 4.02 gal/hr. The average idling emission rate is equal to 0.5 gal/hr. Assuming a reduction in idling of 80 percent by 2020 results in a 1.98 percent reduction in all school bus emissions statewide. The costs associated with the reduction of school bus idling was based solely on a fuel cost of $3/gal.

TLU-10.9 Technology Improvements for On-highway Vehicles – EPA's SmartWay calculator was utilized to calculate the emission benefits from this strategy utilizing the following options: aluminum wheel sets for singlewide tires and automatic tire inflation. Bunker heaters and APUs were not included as they

are included in TLU-10.7. Based on these assumptions, the SmartWay calculator estimates a reduction in fuel burn of 4.6 percent. A 25 percent participation rate was anticipated, resulting in a 1.125 percent reduction in class 8 truck GHG emissions. The costs for this strategy were calculated assuming a $1,500 / truck incentive and the participation of 6,705 trucks in 2020. The participation rate is based on 2006 HDDV trucks registered in Maryland (43.18 percent of which are class 8 trucks) and a growth factor of 1.1897 based on regional travel demand models and 1990-2008 HPMS.

TLU-10.12 Technology Advances for Non-highway Vehicles – In order to calculate the benefits from this strategy, a 5 percent reduction in fuel use was assumed. Since retrofitting, or utilizing after treatment technologies, does not increase fuel efficiency and engine replacements are reflected in the inventory, it is assumed that the impact of this strategy will be relatively small. An average annual off-road diesel fuel usage of 40,780,000 gal was assumed based on 2002-2006 EIA data. The projected annual growth in fuel use across all sectors, which is assumed to be conservative for off-highway diesel, is assumed to be 1.05, resulting in a total fuel use reduction of 2,133,866 gallons per year.

Results

Based on the assumptions outlined above, the TLU-10 strategies will yield a 0.20 mmt reduction in GHG emissions in 2020 at a cost of approximately $50.0 million, without accounting for any estimated fuel savings. Table 29, below illustrate the fuel savings and GHG emission benefits.

Table B.29 TLU-10 GHG Emission Benefits (2020)

TLU ID	Strategies	Fuel Savings (mgal)		GHG (mmt)
		Gasoline	Diesel	
TLU-10.2	Active Traffic Management and Traffic Management Centers	5.2	0.4	
TLU-10.3	Traffic Signal Synchronization/ Optimization	0.21	0.49	
TLU-10.7	Reduce idling time in light duty vehicles, commercial vehicles, buses, locomotive, and construction equipment.			0.07
TLU-10.9	Promote and incentivize fuel efficiency technologies for medium and heavy-duty trucks.			0.05
TLU-10.12	Encourage Retrofit and /or Replacement of Non-highway Diesel Engines		2.13	
Total		**5.41**	**3.02**	**0.12**
GHG Reductions (mmt CO2e)		**0.05**	**0.032**	**0.12**

Summary

Table 30 presents a summary of TLU-10 GHG emission reductions and costs.

Table B.30 TLU-10 GHG Reduction and Costs (2020)

TLU-10	GHG Reduction (mmt CO_2e)	Total Cost 2010 - 2020 (million $)
Active Traffic Management and Traffic Management Centers	0.05	$12.87
Traffic Signal Synchronization/ Optimization	0.01	$2.36
Reduce idling time in light duty vehicles, commercial vehicles, buses, locomotive, and construction equipment.	0.07	$24.97
Promote and incentivize fuel efficiency technologies for medium and heavy-duty trucks.	0.05	$10.06
Encourage Retrofit and /or Replacement of Non-highway Diesel Engines	0.02	$0.50

TLU-11: EVALUATE THE GREENHOUSE GAS EMISSION IMPACTS OF MAJOR PROJECTS AND PLANS

Approach

The draft MDOT policy design considers the potential following strategies:

Actively Participate in Framing National GHG Emissions Evaluation Policy – Given the recent EPA proposed ruling that carbon emissions endanger Americans' health and well-being, Maryland should actively participate in framing national policy rather than implementing specific, state guidance requiring GHG emissions evaluation of all major projects on both the NEPA and statewide/regional planning level.

Evaluation of GHG Emissions through the NEPA Process – The impact of GHGs on major capital projects through the current NEPA decision-making process should be encouraged. GHGs should be considered during the impact assessment phase when conducting alternatives analyses for all major capital projects. Where appropriate, the alternatives analysis should be accompanied by analysis of potential alternatives, such as transit-oriented land use and investment; adding toll lanes and express bus; express toll lanes; a hybrid transit-oriented express toll lane; or a rail and express bus scenario. Where the proposed projects may lead to increased GHG emissions, mitigation measures should be considered. The GHG analysis should be included as part of the Air Quality Technical Report and should allow for the demonstration of GHG benefits as well as impacts through both quantitative and qualitative components with the understanding that appropriate and/or approved emissions models and methodologies may not be available. The GHG analysis would be required:

- If there is an Environmental Impact Statement (EIS) or an Environmental Assessment (EA). Categorical Exclusions (CE's) will be screened out.
- For any roadway capacity enhancement project which is identified for analysis through interagency consultation.
- For active projects that have yet to receive federal sign-off on draft NEPA documents. It is recommended that any project with approved NEPA draft documents would be "grandfathered" through the process.

Evaluation of GHG Emissions through Statewide/Regional Planning – The impact of GHGs should be addressed in the statewide and/or regional planning processes.

The process would be similar to the current conformity process for ozone and PM; however, instead of setting a budget, a mechanism for tracking GHG emissions reductions would be established.

Regional level analyses (determining the GHG impacts on a larger scale than just the project level) account for control strategies that are in place such as fleet make up, analysis years, VMT increases, etc.

Assumptions

While the strategies outlined above were determined by the TLU-11 Working Group and the Coordinating Committee to be either critical or important strategies in assisting MDOT in meeting its goals, these strategies were not quantified. The strategies under this policy option are assumed to contribute to the overall goal of reducing GHG emissions from the transportation sector, however, it is unclear what the GHG emissions impact of implementing these strategies will be at this time.

C. Existing Plans and Programs

GHG Reduction Estimates

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
- BRTB 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

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.

Table C.1 outlines the number of projects considered by TLU category.

Table C.1 Projects by TLU Category (2009-2020)

TLU	Projects
TLU-2 Land Use and Location Efficiency	1
TLU-3 Transit	62
TLU-5 Intercity	30
TLU-8 Bike & Pedestrian	41
TLU-9 Pricing	2
TLU-10 Transportation Technology	4
TOTAL	**140**

Source: MDOT 2009-2014 CTP, MWCOG 2010-2015 TIP & 2009 CLRP, BRTB Transportation Outlook 2035, HEPMPO, S/WMPO and WILMAPCO

COSTS

Table C.2 illustrates the total capital program investment from the MDOT 2009 – 2014 CTP and MPO LRPs.

Table C.2 Total Maryland Capital Program Investment (2009 – 2020)

Capital Program	$ billions
Maryland CTP (2009-2014)	$12.30
MWCOG 2010 – 2015 TIP, 2030 CLRP	$6.33
BRTB 2035 LRP	$7.59
Other MPO LRPs	$0.46
TOTAL	**$26.68**

Source: MDOT 2009-2014 CTP, MWCOG 2010-2015 TIP & 2009 CLRP, BRTB Transportation Outlook 2035, HEPMPO, S/WMPO and WILMAPCO

Table C.3 illustrates the share of projects determined to impact VMT growth rates and thus result in decreased in GHG emissions in 2020. All of these projects/programs are assigned to a specific TLU in Table C.4

Table C.3 GHG Beneficial Plans and Programs (2009 – 2020)

Capital Program ($ billions)	Roadway	Transit	Total
2009-2014 CTP	$3.38	$2.08	$5.46
MPO LRPs (2015 – 2020)	$3.67	$4.18	$7.84
TOTAL	**$7.04**	**$6.25**	**$13.30**

Source: MDOT 2009-2014 CTP, MWCOG 2010-2015 TIP & 2009 CLRP, BRTB Transportation Outlook 2035, HEPMPO, S/WMPO and WILMAPCO

This does not include capital costs associated with TERMs (see Appendix D).

Table C.4 Plans and Programs by TLU

TLU ($billions)	Roadway	Transit	Total
TLU-2 Land Use and Location Efficiency		$0.01	$0.01
TLU-3 Transit	$0.19	$5.94	$6.12
TLU-5 Intercity	$3.13	$0.09	$3.21
TLU-8 Bike & Pedestrian	$0.95		$0.95
TLU-9 Pricing	$2.77		$2.77
TLU-10 Transportation Technology	$0.01	$0.22	$0.23
TOTAL	**$7.04**	**$6.26**	**$13.30**

Individual project costs for transit projects are in Table C.5 and for roadway projects in Table C.6

D. TERMs

GHG REDUCTION

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 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.

Table D.1 summarizes reported reductions by strategy group (fuel consumption, GHGs or VMT) and total annual GHGs reduced in 2020. Table D.3 provides the project description and GHG reductions for each TERM analyzed.

Table D.1 2020 TERM/Off-Network Project/Program Benefits Summary

Project Type	Annual Fuel Savings (mgal)	Annual CO2 (mmt)	Annual VMT (millions)	Total Annual GHG (mmt CO2e)	TLU
Clean Technology		0.01	60.46	0.13	TLU-10
Commute Alternatives/ Incentives	1.75		831.96	0.30	TLU-9
ITS - CHART/MATOC, Signal Systems	15.87			0.15	TLU-10
Outreach/ Education Programs	0.74		18.54	0.01	TLU-10
Public Transit Amenities Improvement			3.50	0.001	TLU-3
Public Transit Expansion	0.58	0.01	122.93	0.05	TLU-3
Traffic Control	4.61			0.07	TLU-10
MAA Strategies		0.02		0.02	TLU-5
MPA Strategies		**0.002**		**0.002**	TLU-10
Total	**23.55**	**0.04**	**1,037.39**	**0.73**	

Baltimore Regional Transportation Board

In order to determine the emission reductions associated with the Transportation Emission Reduction Measures (TERMs) for the Baltimore Region, VMT and fuel consumption data, obtained from the Baltimore Regional Transportation Board (BRTB) TIPs, LRPs, and conformity documentation, were used to determine a reduction in GHG emissions in 2020. VMT and fuel consumption data were projected to 2020 utilizing local data obtained from the documentation and the MAQONE 5.1 Model, including: VMT growth rates; cooperative forecasts; and average trip lengths, speeds, and vehicle occupancy rates. Emission factors were generated using MOBILE6.2 and the MOVES2009 DRAFT model was used to adjust those emission factors by speed. Where VMT or fuel consumption data were not readily available, project-specific data, obtained from the documentation, was used as an input to conduct independent, off-network analyses. These analyses utilized proven methodologies including recent research and off-network tools, such as MAQONE 5.1 or the COMMUTER Model, in order to calculate a 2020 VMT or fuel consumption reduction. Emission factors were then applied to determine an emissions benefit. Table D.1 outlines the assumptions utilized in the independent, off-network analysis of the BRTB TERM projects.

Table D.2 BRTB TERM Analysis Assumptions

Project Type	Description	Assumptions
Commute Alternatives Incentive	Provide matching grant money to employees moving near their work	Participants = 1,260 Avg. work-trip length = 7.69 mi. 250 commute days Avg. trips/day = 1.8
Commute Alternatives Incentive	Johns Hopkins University FlexCar – car-sharing service to JHU students and people in the surrounding neighborhoods	Annual Flexcar fleet growth rate = 12.5% (based on 2007-2009 observed data) 31 cars available in 2020 Car ownership reduced per Flexcar = 15[1] Average annual VMT reduced/ownership reduced = 4,227[2]
Commute Alternatives Incentive	Bi-regional program to assist employers to establish home-based telecommuting programs for their employees	Off-network analysis tool – COMMUTER Model: Alternative Work Schedule Inputs: Potential market = 10% of 2020 total employment 30% employer participation
Commute Alternatives Incentive	Conduct marketing efforts to promote use of state and federal commuter choice tax benefits	Off-network analysis tool – COMMUTER Model: Alternative Work Schedule Inputs: Potential market = 10% of 2020 total employment 30% employer participation
Outreach/ Education	Clean Air Partners – Ozone Action Days	2020 employment forecast from BMC 2035 LRP MAQONE 5.1. defaults used for average auto trip lengths by jurisdiction 3% of drivers participate (based on Sacramento, CA survey data) Average trips reduced = 1.04 / Ozone Action Day Number of ozone action days = 20 based on Clean Air Partners FY2008 Annual Report
Public Transit Improvement	Purchase and use 50 bi-level coaches	2020 employment forecast from BMC 2035 LRP MAQONE 5.1. defaults used for average auto trip lengths by jurisdiction Avg. ridership increase / coach/day = 200 260 operating days/year
Public Transit Improvement	Hampden neighborhood shuttle	Ridership / day = 250 (Based on 2010-2013 Conformity) Avg. trip length = 2 miles 260 operating days/year
Public Transit Improvement	Reduced transit pass for area college students	Assumptions obtained from BMC 2001 RACM Analysis: 1-way school trip average length: 8 miles 1-way non-school trip average length: 4 miles Non-school trip participation: 15% 300 days/yr

Public Transit Improvement	Provide free service to state employees for MTA bus, light rail, some commuter buses, and Metro subway systems.	Off-network analysis tool – Commuter Model: Financial Incentives 100% employer participation rate State workers in 2020 = 70,527[3] Potential market = 28% of total state worker employment
Traffic Control	Traditional traffic signal heads are replaced with LED signal heads.	39,000 signals in Baltimore City Traditional signal power consumption = 150 (W) LED power savings = 90%

[1]Based on white paper: *Go To 2040 Regional Comprehensive Plan Strategy Analysis: CARSHARING*, Chicago Metropolitan Agency for Planning .

[2] Based on forecast of average miles traveled per vehicle data available on the Research and Innovative Technology Administration's Bureau of Transportation Statistics website:
http://www.bts.gov/publications/national_transportation_statistics/html/table_04_11.html

[3] Forecast from *Employment and Payrolls First Quarter 2008*, Maryland Department of Labor Licensing and Regulation to 2020 based on Cooperative Forecasts in the BRTB's Conformity Determination of Transportation Outlook 2035 and the 2010-2013 Transportation Improvement Program.

Maryland Aviation Administration

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

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

Aircraft emission reductions

- Based on the 2020 forecast, annual 2020 CO_2 emissions from aircraft in 2020 are equal to 142,766 metric tons (MT) per year.
- Taxi/idle/delay accounts for 4 percent of total CO2 emissions from aircraft operations, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- All measures result in 10 percent reduction in air taxi or aircraft turnaround idling/delay

Surface Transportation

[Alternative fuels - MAA vehicles]

- Based on the 2020 forecast, annual 2020 CO_2 emissions from surface transportation are equal to 84,367 mt/yr.
- 40% of MAA vehicles use alternative fuels
- MAA vehicles accounts for 12 percent of total CO_2 emissions from surface transportation, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- 70% of MAA vehicles using alternative fuels are gasoline-powered, and 30% are diesel-powered.
- Gasoline vehicles will use E85, resulting in a 15 percent CO_2 emissions reduction, based on *Alternative Fuels: E85 and Flex Fuel Vehicles. EPA420-F-06-047* (October, 2006).
- Diesel vehicles will use B20, resulting in a 10 percent CO_2 emissions reduction, based on *Alternative Fuels: E85 and Flex Fuel Vehicles. EPA420-F-06-047* (October, 2006).

[Buses & vans congestion reduction]

- Buses & vans account for 1 percent of total CO_2 emissions from surface transportation, based on methodology from the *Port of Seattle Seattle-Tacoma International Airport Greenhouse Gas Emissions Inventory - 2006* (October, 2007).
- 5 percent of CO2 emissions reductions are attributable to reduced congestion

[Vehicle Idle/Delay/VMT Reduction at Parking]

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

Ground Service Equipment (GSE)/ Auxiliary Power Units (APUs)

- All strategies under this group will result in 10% of GSE/APU usage.

Electrical Usage

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

Maryland Port Administration

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

devices, vehicle replacements, and engine repowers will result in GHG emissions reductions.

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

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

Metropolitan Washington Council of Governments

In order to determine the emission reductions associated with the TERMs for the Washington DC Region, project-specific data, obtained from TIPs, LRPs, and conformity documentation, was used to determine a reduction in VMT or fuel consumption.

Table D.1 presents the assumptions required to translate 2008 reductions as estimated by MWCOG for the entire Washington DC region, into Maryland specific impacts, annually in 2020.

Table D.3 MWCOG TERM Analysis Assumptions

Project Type	Description	Assumptions / Methodology (1) (2)
Clean Technology	Bose Automobile Anti-Air Pollutant and Energy Conservation System	MWCOG TERMs analysis, annualization factor = 312 days

Clean Technology	Truck Idling (Truck Stops and Auxiliary Power Unit)	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Clean Technology	100 CNG Buses in place of old Diesel Buses (2010)	Avg. bus VMT = 40k miles per year, avg speed = 15mph, CNG bus consumes 9% less fuel compared to diesel, emission factors from MOVES by model year
Clean Technology	100 Hybrid Buses in place of old Diesel Buses (2010)	Avg. bus VMT = 40k miles per year, avg speed = 15mph, hybrid bus consumes 36% less fuel compared to diesel, Hybrid and Alternative Fueled Vehicles (http://www.kingcounty.gov/operations/procurement/Services/Environmental_Purchasing.aspx)
Clean Technology	Purchase 185 CNG Buses to Accommodate Ridership Growth	Assume 1/4 of VMT reduction in Maryland per MWCOGs TERM analysis, use Mobile6 idle and running emission factors for buses (avg. speed = 15mph, non-route idling = 10.5 minutes per start, % of time in idle = 32%)
Commute Alternatives/ Incentives	Commuter Connections TERMS (Operations Center, GRH, Marketing, etc…)	7.5 percent annual growth rate in VMT impacted, per 2005 Commuter Connections report
Commute Alternatives/ Incentives	Commuter Connections (Ridesharing)	7.5 percent annual growth rate in VMT impacted, per 2005 Commuter Connections report
Commute Alternatives/ Incentives	Employer Outreach for Public Sector Agencies	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Commute Alternatives/ Incentives	Expanded Employer Outreach for Private Sector Employers	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Commute Alternatives/ Incentives	Expansion of Car Sharing Program	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Commute Alternatives/ Incentives	Implement 10 Neighborhood Circulator Bus Service to Metrorail	Assume 1/3 of benefit in Maryland
Commute Alternatives/ Incentives	MD/DC Vanpool Incentive Program	25 percent in Maryland per MWCOG TERMs analysis
Commute Alternatives/ Incentives	Voluntary Employer Parking Cash-Out Subsidy	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Public Transit Improvement	Bus Information Displays with Maps at Bus Stops	Assume 1/3 of benefit in Maryland
Public Transit Improvement	Construction of 1000 Additional Parking at WMATA Metrorail Stations	Assume 1/3 of benefit in Maryland
Public Transit Improvement	Enhanced Commuter Services on Major Corridors (Reverse Commute)	Assume 1/3 of benefit in Maryland
Public Transit Improvement	Free Bus Service Off-Peak (10:00 AM –2:00 PM Mid-Day and	Assume 1/3 of benefit in Maryland

	Weekends)	
Public Transit Improvement	Free Bus-to-Rail/Rail-to Bus Transfer (Similar to NYC Pricing Structure)	Assume 1/3 of benefit in Maryland
Public Transit Improvement	Parking Impact Fees	Apply 47.9 percent MWCOG region VMT in Maryland (per travel demand model, 2000 model calibration report)
Public Transit Improvement	Real Time Bus Schedule Information	Assume 1/3 of benefit in Maryland
Traffic Control	Speed Limit Adherence	Use GHG emission factor (g/mile) differences from Mobile6 modeling for Maryland between 65, 60 and 55 mph

Notes:

(1) Unless noted otherwise, to obtain 2020 estimate, annual VMT growth rate (1.4 percent) is applied to 2008/2010 MWCOG estimates.

(2) Annualization factor for commute alternatives/incentives and transit TERMs is 250 days.

Table D.4 provides the individual project listing of all TERMs considered to be GHG beneficial projects. Many projects identified as TERMs by BMC and MWCOG are for conformity purposes only (ie NOx, VOC or PM) emissions, and thus have minimal or no impact on fuel consumption or GHG emissions.

Table D.4 TERM GHG Reduction Estimates (2010 and 2020)

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Clean Technology	Office of the Secretary	BRTB: Outlook 2035 & TIP Conformity Report	IdleAire Advanced Truckstop Electrification System	This project involves the installation of up to 190 Advanced Truckstop Electrification (ATE) units at truck stops in Jessup and Baltimore City. The ATE units provide individual electric service to trucks utilizing parking spaces.	0.0025	0.0031	TLU-10
Clean Technology	WMATA	MWCOG TERMs Analysis	Purchase of 185 Buses to Accommodate Ridership Growth	WMATA will purchase 185 new CNG buses in the District of Columbia and deploy them on 36 crowded routes resulting in increased frequency.	0.0856	0.0967	TLU-3
Clean Technology		MWCOG TERMs Analysis	Bose Automobile Anti-Air Pollutant and Energy Conservation System	The Bose Automobile Anti- Air Pollutant and Energy Conservation System is a mechanical, gas turbine operated system with no platinum catalysts involved as in catalytic converter systems.	0.0106	0.0120	TLU-10
Clean Technology		MWCOG TERMs Analysis	Truck Idling (Truck Stops and Auxiliary Power Units)	This is a voluntary program designed to install pollution-reduction technology on existing diesel vehicles and equipment. Under this program it is proposed to use a small diesel auxiliary power unit (APU)	0.0108	0.0108	TLU-10
Clean Technology	WMATA	MWCOG TERMs Analysis	100 CNG Buses in place of Old Diesel Buses	The 100 oldest remaining buses in the fleet will be replaced in 2010 with CNG buses.	0.0012	0.0013	TLU-3
Clean Technology	WMATA	MWCOG TERMs Analysis	100 Hybrid Buses in place of Old Diesel Buses	The 100 old diesel buses in the fleet will be replaced in 2010 with Hybrid Buses	0.0046	0.0053	TLU-3
Commute	MTA	MWCOG	Ridesharing	To promote and encourage the establishment of	0.0076	0.0087	TLU-9

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Alternatives / Incentives		2010-15 TIP	Statewide	carpools and vanpools. The ridesharing project covers the activities of the ridesharing unit of the Statewide Transportation Program with coordinators in Frederick, Prince George's and Montgomery Counties.			
Commute Alternatives / Incentives	SHA	MWCOG 2010-15 TIP	Transportation Emissions Reduction Measures	Mission: to reduce the number of VMT, vehicle trips, and emissions. Provides funding to the TPB's Commuter Connection's program for the following projects: a. Commuter Operations Center b. Guaranteed Ride Home c. Marketing d. Monitoring and Evaluation	0.1069	0.1231	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Implement Neighborhood Circulator Buses	The circulator bus service would operate over an expanded period from 5:30 am to 10:00 am and from 3:00 pm to 8:00 pm on weekdays.	0.0025	0.0028	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Employer Outreach for Public Sector Agencies	Marketing and implementing employer based TDM programs	0.0061	0.0069	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Voluntary Employer Parking Cash-Out Subsidy	A program that gives equal compensation "cash-out" to employees who choose not to use free parking provided by employers and use alternative modes of travel instead.	0.0092	0.0105	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Expanded Employer Outreach for Private Sector Employers	Marketing and implementing employer based TDM programs	0.0007	0.0008	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Improve Pedestrian Facilities Near Rail Station	Assumes improvements to sidewlaks, curb ramps, crosswalks and lighting in order to improve pedestrian access to 11 MARC stations and 12 Metrorail station in Montgomery County.	0.0024	0.0027	TLU-3

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Transit Stores in Maryland	Establish 10 transit stores in MD.	0.0070	0.0079	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	6 Kiosks in Maryland	Establish 6 Transportation Information Kiosks in Maryland similar to those being placed in Virginia and DC	0.0000	0.00004	TLU-9
Commute Alternatives / Incentives	ARTMA	BRTB: Outlook 2035 & TIP Conformity Report	Fare-less Cab	When a company participates in Fare-less Cab, an employee who participates in the program can get a free cab ride home in the event of illness (personal or family) or unscheduled overtime.		0.00003	TLU-9
Commute Alternatives / Incentives	Balt.City	BRTB: Outlook 2035 & TIP Conformity Report	Live Near Your Work	Provide matching grant money to employees moving near their work		0.0018	TLU-9
Commute Alternatives / Incentives	Howard County	BRTB: Outlook 2035 & TIP Conformity Report	Park & Ride at MD 32/MD 108	Funds for land acquisition for Park & Ride MD 32/MD 108 is included in this project. New roadway construction in Howard County - Sharing Costs with SHA.	0.0001	0.0002	TLU-9
Commute Alternatives / Incentives	JHU Sustainability Initiative	BRTB: Outlook 2035 & TIP Conformity Report	Car Sharing Program - JHU Sustainability Initiative	Johns Hopkins University Sustainability Initiative has partnered with FlexCar to offer car-sharing service to JHU students and people in the surrounding neighborhoods. Car-sharing is a service in which members can get online and rent a car by the hour.	0.0000	0.0008	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	I-95 at MD 543 Park-n-ride lot	128 new spaces	0.00005	0.00006	TLU-3
Commute	MDOT	BRTB:	US 1 at MD 23	60 new spaces	0.00002	0.00003	TLU-3

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Alternatives / Incentives		Outlook 2035 & TIP Conformity Report	Park-n-Ride Lot				
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC BWI Rail Station Parking Garage	1790 Spaces	0.00188	0.00214	TLU-3
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC Halethorpe Station Parking Expansion	Expand surface parking and investigate future parking at the Halethorpe MARC Station. Parking spaces will be added. The scope of the proposed work also includes high level platforms, new shelters, improved accessibility for persons with disabilities,		0.0001	TLU-3
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Carroll County)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0003	0.0004	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Baltimore City)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0008	0.0010	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Harford County)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0010	0.0011	TLU-9

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Howard County)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0018	0.0021	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Baltimore County)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0020	0.0023	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Baltimore Region Rideshare Program - 2006 (Anne Arundel County)	Provides funding support to local rideshare coordinators to strengthen ridematching and ridesharing coordination services to both commuters and employers	0.0034	0.0038	TLU-9
Commute Alternatives / Incentives	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Telework Partnership with Employers	Bi-regional program to assist employers to establish home-based telecommuting programs for their employees		0.0141	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Parking Impact Fees	This measure would consist of a parking impact fee administered by local governments throughout the region. The fees would allow governments to recoup some of the costs associated with maintaining the roadway infrastructure and mitigating the adverse effects of added congestion.	0.0945	0.1072	TLU-9
Commute Alternatives / Incentives		MWCOG TERMs Analysis	MD/DC Vanpool Incentive	This measure is a package of programs and incentives designed to increase the number of vanpools in the region. Expansion of existing	0.0029	0.0033	TLU-9

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
			Program	Virginia program.			
Commute Alternatives / Incentives		MWCOG TERMs Analysis	Expansion of Car Sharing Program	Funds incentives for 1000 new car sharing customers. Car sharing customers typically increase their transit ridership and decrease driving.	0.0002	0.0003	TLU-9
ITS	MDOT	2009-2014 CTP	Signal Systemization Total	Compiled benefit of all signal systemization projects identified in BMC 2010-2013 TIP.	0.0082	0.0095	TLU-10
ITS	SHA	MWCOG 2010-15 TIP	Metropolitan Area Transportation Operations Coordination (MATOC)*	The MATOC program coordinates and supports regional sharing of transportation systems' conditions and info management during regional incidents through integration of systems' technologies, improved procedures and planning, and improved accuracy and time.	0.0675	0.0777	TLU-10
ITS	SHA	2009-2014 CTP	CHART	Statewide CHART program	0.0535	0.0616	TLU-10
Outreach	SHA	BRTB Outlook 2035 & TIP Conformity Report, MWCOG 2009 CLRP	Clean Air Partners	A public/private consortium that carries out a public education campaign in the Baltimore and Washington D.C. regions, to encourage individuals to take actions to reduce air emissions and protect their health from air pollution. The campaign involves an		0.0065	
Public Transit Amenities				Aggregate benefits of transit amenity projects. Includes: Traveler Information/Fare Programs, pedestrian access improvements	0.00000	0.0012	TLU-3, TLU-8
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Local Bus Replacement	Purchase 4 new vehicles		0.0001	TLU-3

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 100 buses in Contract Year - 1		0.0016	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 125 buses in Contract Year - 2		0.0020	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Bus Replacements	Purchase 107 buses in Contract Year - 3: 94 -40 ft. Low-floor diesel buses; 3 - 30 ft. Low-floor diesel buses; 10- 40ft. Hybrid Electric Buses (included in a separate entry)		0.0017	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	MARC New Bi-level Coach Purchase	Purchase and use 50 bi-level coaches		0.0141	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	Hampden Shuttle	Neighborhood shuttle in Hampden, including connection to Woodberry Light Rail Station (Bus Route #98) and MTA bus routes #22 and #27		0.0000	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP Conformity Report	College Pass Program	Reduced transit pass for area college students		0.0060	TLU-3
Public Transit Imp.	MDOT	BRTB: Outlook 2035 & TIP	State Worker Free Transit Program	Provide free service to state employees for MTA bus, light rail, some commuter buses, and Metro subway systems.		0.0053	TLU-10

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
		Conformity Report					
Public Transit Imp.	WMATA	MWCOG TERMs Analysis	Bus Information Displays with Maps at Bus Stops	Provide more information at 2,000 Metrobus locations (assume 1/3 of benefit in Maryland).	0.0012	0.0014	TLU-3
Public Transit Imp.	WMATA	MWCOG 2010-15 TIP	Glenmont Metro Parking Garage Expansion	Provides for the design and construction of 1200 additional garaged parking spaces at the Glenmont Metrorail Station on the west side of Georgia Ave. The project will be designed and constructed by WMATA.	0.0026	0.0029	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Real Time Bus Schedule Information	Provide real time bus schedule information to the transit riders through internet and at bus shelter display units. Satellite technology would track buses and customers would determine real-time location and arrival time of a specific bus.	0.0010	0.0011	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Free Bus-to-Rail/Rail-to-Bus Transfer (Similar to NYC Pricing Structure)	This program would institute a free bus to rail transfer similar to the reduced fare rail to bus transfer.	0.0028	0.0031	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Free Bus Service Off-Peak (10:00 AM - 2:00 PM Mid-Day and Weekends)	Free bus service (10:00AM-2:00PM mi-day, weekends): Free service during the mid day and all day on weekends.	0.0023	0.0026	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Enhanced Commuter Services on Major	Bus service on corridors with HOV facilities and bus lanes such as US 50, I-270, and US 29. Commuters would be picked up at Metrorail Park & Ride facilities close to Metro stations and	0.0054	0.0061	TLU-3

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
			Corridors in Maryland (HOV Facilities)	transported to major work centers			
Public Transit Imp.		MWCOG TERMs Analysis	Enhanced Commuter Services on Major Corridors (Reverse Commute)	Proposes bus service to Potomac Mills and Arundel Mills shopping centers from Metrorail stations. The service would benefit reverse commuters whose work place is in Prince William and Anne Arundel Counties.	0.0015	0.0017	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Improve Pedestrian Facilities Near Rail Stations	Assumes improvements to sidewalks curb ramps, crosswalks, and lighting in order to improve pedestrian access to 11 MARC stations and 12 Metrorail stations in Montgomery County.	0.0023	0.0026	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Metrorail Feeder Bus Service	Improve Metrorail feeder bus service at two underutilized park and ride lots and implement a fare buydown program.	0.0006	0.0007	TLU-3
Public Transit Imp.		MWCOG TERMs Analysis	Construction of 1000 Additional Parking at WMATA Metrorail Stations	A total of 1000 parking spaces will be added at different Metrorail Stations	0.0007	0.0008	TLU-3
Traffic Control		MWCOG TERMs Analysis	Speed Limit Adherence (accelerated)	Increase speed limit adherence on portions of the freeway where speeding is a problem so that 70 percent of vehicles that are traveling above the speed limit will travel at or below the posted speed limit - assign five police officers for every 20 miles of freeway	0.0198	0.0426	TLU-10

Project Type	Agency	Source	Project	Description	2010 GHG (mmt CO2-e)	2020 GHG (mmt CO2-e)	TLU
Traffic Control	Balt. City	BRTB: Outlook 2035 & TIP Conformity Report	Traffic Signal LED Upgrades	Traditional traffic signal heads are replaced with LED signal heads.		0.0260	TLU-10
TOTAL					**0.52**	**0.71**	

TERM COSTS

Table D.5 TERM Project Costs (2009 – 2020)

Project Type	BMC TERMs (millions)	MWCOG TERMs (millions)	CTP (Statewide) TERMs (millions)	TOTAL (millions)
Clean Technology	$3.17	$4.18	-	$7.35
Commute Alternatives/Incentives	$57.74	$89.61	-	$147.35
ITS - CHART/MATOC, Signal Systems	$12.15	$1.60	$78.20	$91.95
Outreach/ Education Programs	-	-	$2.75	$2.75
Public Transit Amenities Improvement	$0.50	$10.55	$10.06	$21.11
Public Transit Improvement	$156.81	$92.39	$110.00	$359.19
Traffic Control	$3.90	$24.45	-	$28.35
TOTAL	$234.27	$222.79	$201.01	$658.04

Source: BMC 2010-2013 TIP & Transportation Outlook 2035, MWCOG 2010-2015 TIP and 2030 CLRP, MDOT 2009-2014 CTP

Note that the costs associated with the three bus purchase TERMs in the MWCOG region are not included within Table D.5 (see project listing in Table D.3). Any remaining costs not yet spent are included within Table C.5 under the Metro Matters Railcars and Buses line item as identified in the 2009-2014 CTP. The total cost for these buses are estimated at $174.15 million in the MWCOG TERMs analysis. A large share of these buses have already been purchased and are currently in service.

Total costs estimated by MAA to deploy BWI Marshall projects as identified in the *BWI, Thurgood Marshall Airport Greenhouse Gas Baseline Emissions Inventory* by 2020, is $527.65 million. These strategies are listed below, however are not included in the total TERM project cost estimate.

- Dedicated Commercial Vehicle Lanes (Pier A Curbside Expansion, Terminal Curbside Expansion and Skywalks): $100.2 million
- Parking Facilities and Smart Park: $163.45 million
- Ground Service Equipment and Auxiliary Power Units: $256.26 million
- Electrical Usage (Automated Energy Mgmt. System, Energy Performance Tracking, HVAC Conversion Program, LEED Standards): $5.94 million

Table D.6 Individual TERM Project Costs (2009 – 2020)

Project Type	Source	Project	Cost (millions)
Clean Technology	BMC 2010-2013 TIP / 2035 LRP	IdleAire Advanced Truckstop Electrification System	$3.17
Clean Technology	MWCOG 2010-2015 TIP, 2030 CLRP	Bose Automobile Anti-Air Pollutant and Energy Conservation System	$0.47
Clean Technology	MWCOG 2010-2015 TIP, 2030 CLRP	Truck Idling (Truck Stops and Auxiliary Power Units)	$3.71
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Ridesharing Statewide	$3.89
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Transportation Emissions Reduction Measures	$23.50
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Implement Neighborhood Circulator Buses	$1.13
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Employer Outreach for Public Sector Agencies	$0.82
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Voluntary Employer Parking Cash-Out Subsidy	$0.20
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Expanded Employer Outreach for Private Sector Employers	$0.85
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Improve Pedestrian Facilities Near Rail Stations	$14.20
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Transit Stores in Maryland	$0.44
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	6 Kiosks in Maryland	$0.44
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	Fare-less Cab	$0.09

Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	Live Near Your Work	$1.13
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	Park & Ride at MD 32/MD 108	$5.82
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	I-95 at MD 543 Park-n-ride lot	$3.20
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	US 1 at MD 23 Park-n-Ride Lot	$1.50
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	MARC BWI Rail Station Parking Garage	$44.75
Commute Alternatives/ Incentives	BMC 2010-2013 TIP / 2035 LRP	Baltimore Region Rideshare Program & Telework Partnership with Employers	$1.24
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Parking Impact Fees	$41.78
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	MD/DC Vanpool Incentive Program	$1.84
Commute Alternatives/ Incentives	MWCOG 2010-2015 TIP, 2030 CLRP	Expansion of Car Sharing Program	$0.52
ITS	BMC 2010-2013 TIP / 2035 LRP	Signal Systemization Total	$12.15
ITS	MWCOG 2010-2015 TIP, 2030 CLRP	Metropolitan Area Transportation Operations Coordination (MATOC)*	$1.60
ITS	2009-2014 CTP	CHART	$78.20
Outreach	BMC 2010-2013 TIP / 2035 LRP	Clean Air Partners	$2.75
Public Transit Amenities	2009-2014 CTP	Smart Card Program	$10.06
Public Transit Amenities	MWCOG 2010-2015 TIP, 2030 CLRP	Bus Transit Annunciation System	$2.90
Public Transit Amenities	MWCOG 2010-2015 TIP, 2030 CLRP	Bike Stations at Rail Stations	$0.65

Public Transit Amenities	MWCOG 2010-2015 TIP, 2030 CLRP	Bus Information Displays	$0.35
Public Transit Amenities	MWCOG 2010-2015 TIP, 2030 CLRP	Real Time Bus Schedule Information	$6.65
Public Transit Amenities	BMC 2010-2013 TIP / 2035 LRP	Charles Street Improvements	$0.50
Public Transit Improvement	BMC 2010-2013 TIP / 2035 LRP	Local Bus Replacement	$2.20
Public Transit Improvement	BMC 2010-2013 TIP / 2035 LRP	Hybrid Bus Replacements (100 buses)	$52.50
Public Transit Improvement	BMC 2010-2013 TIP / 2035 LRP	Hybrid Bus Replacements (100 buses)	$65.63
Public Transit Improvement	BMC 2010-2013 TIP / 2035 LRP	Bus Replacements (10 hybrid, 97 diesel)	$36.29
Public Transit Improvement	2009-2014 CTP	MARC New Bi-level Coach Purchase	$110.00
Public Transit Improvement	BMC 2010-2013 TIP / 2035 LRP	College Pass Program	$0.19
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Glenmont Metro Parking Garage Expansion	$1.00
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Free Bus-to-Rail/Rail-to-Bus Transfer (Similar to NYC Pricing Structure)	$36.82
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Free Bus Service Off-Peak (10:00 AM - 2:00 PM Mid-Day and Weekends)	$21.82
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Enhanced Commuter Services on Major Corridors in Maryland (HOV Facilities)	$2.66
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Enhanced Commuter Services on Major Corridors (Reverse Commute)	$2.52
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Metrorail Feeder Bus Service	$1.07
Public Transit Improvement	MWCOG 2010-2015 TIP, 2030 CLRP	Construction of 1000 Additional Parking at WMATA Stations	$26.50
Traffic Control	MWCOG 2010-2015 TIP, 2030 CLRP	Speed Limit Adherence (accelerated)	$24.45
Traffic Control	BMC 2010-2013 TIP / 2035 LRP	Traffic Signal LED Upgrades	$3.90
TOTAL			**$658.04**

E. Coordinating Committee and TLU Working Group Members

MDOT Climate Action Plan Implementation Coordinating Committee Member List

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MDOT	Don Halligan (Chair)	Director, Office of Planning and Capital Programming	865-1275	DHalligan@MDOT.state.md.us
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MDOT Climate Action Plan Implementation
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