

Reasonably Available Control Measure (RACM) Analysis for the Baltimore Region

SIP Revision 01-08
(Proposed)

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Prepared for:

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in coordination with the
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Executive Summary

The purpose of this document is to review potential and adopted control strategies and evaluate whether the Baltimore nonattainment area will comply with the federal ozone standard as quickly as possible. Section 172(c)(1) of the Clean Air Act requires State Implementation Plans (SIPs) to contain reasonably available control measures (RACM) as necessary to provide for attainment as expeditiously as possible. In order for a state's attainment demonstration to be approved by the EPA, the State must address whether additional control measures exist that are reasonably available and that may advance the attainment date. The Maryland Department of the Environment (MDE), as the lead air quality agency for the State of Maryland, conducted this RACM evaluation in coordination with the Maryland Department of Transportation and the Baltimore Regional Transportation Board (BRTB, the designated Metropolitan Planning Organization for the Baltimore region), and in consultation with EPA.

In December 1999, the U.S. Environmental Protection Agency (EPA) proposed approval of the *Phase II Attainment Plan for the Baltimore Region and Cecil County*, conditioned on several actions by the State. Under the terms of a recent consent decree, EPA must propose final approval of Baltimore's attainment demonstration SIP by October 15, 2001. If EPA has not fully approved the attainment demonstration SIP, EPA is obligated to promulgate an attainment demonstration Federal Implementation Plan (FIP) by June 14, 2002. Failure to address the RACM requirement of the CAA could result in disapproval of the attainment demonstration SIP. (EPA Policy Memo, 12/14/00).

This document presents a summary of analyses conducted to determine whether the SIP includes all reasonable control measures. Measures were evaluated against the following criteria provided in EPA guidance to determine whether the measures were RACM and should be included in the SIP. EPA guidance provides a narrow definition of RACM. The guidance states that measures which can be implemented and produce sufficient benefits to advance the attainment date are RACM. The guidance states that cost can be a factor in determining whether a measure is reasonable. EPA guidance notes that measures that are not enforceable are not RACM.

Based on guidance from the EPA, the analysis for each measure considers feasibility, cost effectiveness, and whether implementation of the measure alone or in combination with other measures would allow the Baltimore Nonattainment Area to attain the federal ozone standard in advance of the mandated 2005 timeframe. This document is not intended to present a complete cost/ benefit analysis of the total benefits of various measures (i.e., quality-of-life, utility, etc.). Feasibility considerations included a review of both the planning process and implementation process to evaluate whether additional legislation, regulation, ordinances or contractual modifications were needed and could be accomplished in a timeframe that allowed effective implementation of the measure prior to the attainment date. Feasibility also considers whether a measure can be adequately enforced. Cost effectiveness considerations compared the cost of potential measures against the cost of measures in the SIP on a cost per ton basis. Cost was also judged as to whether it was affordable for the region and whether the cost adversely affects a

particular social group. The ability of a measure to advance the attainment date was judged based on the significance of the reduction compared to the total reductions needed for attainment and the remaining emissions and whether the measures can be implemented and produce reductions by the 2004 ozone season.

Ultimately, MDE, MDOT, and BRTB jointly concluded that none of the 100 plus strategies would be considered RACM, based on EPA RACM guidance. The fundamental reason for the conclusion is that these measures, individually or collectively, would not allow the region to advance attainment. Many strategies were eliminated as RACM based on cost, implementation issues, or unreliability of emissions reductions achieved in a four year period. Each report section describes the measures, the issues, and the reason for the rejection of the strategy to be considered RACM. The RACM analysis and conclusion for the Baltimore region are based on the definition of RACM established through EPA guidance

The purpose of the SIP revision is to satisfy the requirement of the CAA Section 172 (c)(1). The MDE, MDOT, and the BRTB realize the long-term value of many of the strategies examined in this document to provide air and water quality benefits, congestion management benefits and livable community benefits. The decision that these control measures are not RACM does not imply that these measures are not under consideration for inclusion in the SIP. The table below lists a number of candidate measures currently under study as potential SIP measures.

Potential Measures Currently being Considered for SIP Inclusion
Smart Growth Land Use Projects (Digital Harbor, Owings Mills, Parole)
Ozone Action Days
Commuter Tax Credit Program
Commute Smart Program (<i>a grouping of measures such as: Clean Vehicle Technology, Alternative Fuels, and Intelligent Transportation Systems</i>)

1.0 Introduction and Methodology

A. Introduction:

The purpose of this document is to review potential and adopted control strategies and evaluate whether the Baltimore nonattainment area will comply with the federal ozone standard as quickly as possible. Section 172(c)(1) of the Clean Air Act requires State Implementation Plans (SIPs) to contain reasonably available control measures (RACM) as necessary to provide for attainment as expeditiously as possible. In order for a state's attainment demonstration to be approved by the EPA, the State must address whether additional control measures exist that are reasonably available and that may advance the attainment date. The Maryland Department of the Environment (MDE), as the lead air quality agency for the State of Maryland, conducted this RACM evaluation in coordination with the Maryland Department of Transportation and the Baltimore Regional Transportation Board (BRTB, the designated Metropolitan Planning Organization for the Baltimore region), and in consultation with EPA.

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Commute Smart Program (<i>a grouping of measures such as: Clean Vehicle Technology, Alternative Fuels, and Intelligent Transportation Systems</i>)

B. Methodology (Joint RACM Review Process):

The Maryland Department of the Environment (MDE), as the lead air quality agency for the State of Maryland, conducted this RACM evaluation in coordination with the Maryland Department of Transportation and the Baltimore Regional Transportation Board (BRTB, the designated Metropolitan Planning Organization for the Baltimore region), and in consultation with EPA.

The analysis was conducted in coordination with the other air quality activities occurring in the region, such as the work of the BRTB’s Emission Mitigation Strategies Subcommittee, the preparation of “shortfall measures” for the region by MDE, and the

interagency investigation into the applicability of new EPA guidance linking land use, transportation, and air quality by multiple state agencies.

During the last decade, the MDE has compiled exhaustive lists of potential control measures with the assistance of both the BRTB and MWAQC (Metropolitan Washington Air Quality Committee). The MDE has also conducted extensive research into measures used in other states as air quality control strategies. Time and resources limit the selection of strategies for analysis. The foundation of this RACM evaluation includes the final strategies selected for the region through a two-year, public, interagency process in 1994. A second, similar process is currently underway in the region. Selected strategies presented in 1994 were reassessed for this analysis in case a change in conditions warranted an update.

The categories of strategies analyzed for the Baltimore region include the following:

- All Clean Air Act Section 108(f) measures (Transportation Control Measures)
- All comments received by the BRTB as suggested strategies since 1999, and those received by MDE since 1997
- All strategies selected for review through an extensive two-year process in 1994
- All “emission friendly” activities in the Baltimore region as listed in a summary report submitted to the US EPA in September 2000 (*Transportation & Air Quality Emission Reduction Activities in the Baltimore Region*, September 2000)

In considering the selected strategies, MDE addressed a number of issues such as cost, political feasibility, logistics for implementation, local issues/processes, and quantity of emissions reduced.

C. Methodology (Cost Comparisons):

When making decisions on the selection of any emission control measure, cost is a consideration. The cost of a new measure may be borne by the regulated industry being, or the cost may be placed on the implementing agency tasked with ensuring proper and timely implementation. When reviewing the cost of an emission control measure, the most common analysis uses the cost per ton of a measure. Typically, control measures based on technological innovations have lower costs than measures that require behavioral changes. Behavioral changes have relatively low emission benefits compared with their implementation costs.

For the purposes of this analysis for RACM, a program is considered to have a high cost if the cost of the measure exceeds \$75,000 per ton. In comparison, MDE is currently in the process of reviewing several innovative emission reduction measures pertaining to area sources. The chart below lists the approximate cost per ton of volatile organic compounds (VOC), with the highest cost identified in the \$5,000 per ton range for these area source measures.

Technological Control Measure	Cost per Ton of VOC Reduced
Portable Fuel Container Changes	\$450
Consumer Product Changes (CA Standards)	\$800
Reformulated Paints	\$5,000

Demand Management Strategies	Cost per Ton of VOC Reduced
MTA Bus Replacement	\$1,650,000,000
Control Student Parking at High Schools	\$1,744,186

In an effort to average the costs and benefits from all the measures reviewed in this analysis, the costs of the projects were added and divided by the total number of VOC benefits to see how much the average measure would cost per ton. The basic analysis had several drawbacks. Many of the measures reviewed did not include an approximate cost. In addition, the costs of some measures were estimated in 1994 dollars while others were estimated in 2001 dollars.

The following chart maintains separate estimates for projects with cost projections in 1994 dollars and those in 2001 dollars. The costs for 1994 and 2001 were added separately, and the potential estimated emission benefits were summed separately. The cost per ton of VOC reduced was then calculated as two averages, one for 1994 and one for 2001.

The calculations below, in no way identify the true potential costs or benefits from any of these program. There are numerous issues involved in calculation a cost per ton average and the chart below does not address all of the potential issues (due to time constraints on the RACM analysis).

Strategy	1994	1994	1994	2001	2001	2001
#	Cost (\$)	VOC (tpd)	NOx (tpd)	Cost (\$)	VOC (tpd)	NOx(tpd)
1	NA	NA	NA	58,000,000	0.093	0.224
4	NA	NA	NA	2,000,000	NA	NA
5	3,750,000	1.185	0.705	NA	NA	NA
8	NA	NA	NA	23,000,000	0	0
11	9,000,000	1.76	2.78	NA	NA	NA
12	1,100,000	0.263	0.406	NA	NA	NA
13	12,000,000	0.07	0.109	NA	NA	NA
19	3,600,000	0.259	0.398	NA	NA	NA
20	941,000	0.061	0.103	NA	NA	NA
23	8,000,000	0.082	-0.16	NA	NA	NA
27	5,000,000	0.336	0.473	NA	NA	NA
42	225,000	0.129	0.168	NA	NA	NA
43	4,500,000	0.17	0.242	NA	NA	NA
60	5,000,000	0.2	0.53	NA	NA	NA
65	15,000,000	0.015	0.046	NA	NA	NA
67	NA	NA	NA	400,000	0.025	0.085
68	NA	NA	NA	132,000,000	0.08	0.92
81	NA	NA	NA	70,000,000	NA	NA
82	NA	NA	NA	7,500	NA	NA
83	NA	NA	NA	2,440,000	NA	NA
84	NA	NA	NA	1,200,000	NA	NA
85	NA	NA	NA	73,500	NA	NA
B/Ped Total	NA	NA	NA	NA	0.969	0.111
104	12,000,000	0.012	0.05	NA	NA	NA
TOTALS	80,116,000	4.542	5.85	289,121,000	1.167	1.34
		VOC	NOx		VOC	NOx
Per Ton		17,638,926	13,695,043		247,747,215	215,761,940
Totals						

2.0 Overview

A. Relationship of RACM to other State Implementation Plans

The Baltimore Nonattainment Area consists of five jurisdictions, Anne Arundel County, Baltimore County, Carroll County, Howard and Harford Counties, and Baltimore City. Many of these counties have been nonattainment for ozone for over two decades. During the last decade, many former control policies have been reexamined and research into the ozone problem has redirected and refined many control programs. Three long term control plans, one of which was the attainment plan, and numerous individual control SIPs were filed. A brief history of these major plans follows in section B.

Under this RACM process, all of the SIPs were reexamined to inventory the control programs in place and were reviewed against current emission inventories to look for additional categories that might provide significant reductions.

B. History of Baltimore under the Clean Air Act Amendments:

Under the 1990 Clean Air Act Amendments, the Baltimore region was classified as a severe nonattainment area with respect to the National Ambient Air Quality Standard for ozone. By November 1994, the Clean Air Act required that severe ozone nonattainment areas submit an attainment plan that included a photochemical modeling demonstration that the area would comply with the federal ozone standard by 2005. In a memorandum dated March 2, 1995, Mary Nichols, Assistant Administrator of the U. S. Environmental Protection Agency (EPA), provided an extended schedule for submitting attainment demonstrations in two phases for serious and severe ozone nonattainment areas. The extended schedule was contingent upon participation in the Ozone Transport Assessment Group and adoption of regional control measures such as the National Low Emission Vehicle (NLEV) Program and regional nitrogen oxides (NOx) reductions from utilities and other large NOx sources.

On April 28, 1998 Maryland submitted an attainment plan for the Baltimore Nonattainment Area and Cecil County entitled *Phase II Attainment Plan for the Baltimore Region and Cecil County*. This plan included local and regional modeling and weight of evidence demonstrations that these areas would be likely to achieve compliance with the federal ozone standard if pollution transported from areas outside these nonattainment areas was reduced. Maryland participated in the Ozone Transport Assessment Group (OTAG) process to identify a suite of regional strategies that would reduce transport across the eastern half of the United States. These regional measures, when combined with federal, state and local measures already included in the Phase II Attainment Plan were likely to result in achieving compliance with the ozone standard in 2005.

On November 7, 1997, EPA proposed federal regulations called *Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone* (NOx SIP Call). The proposed regulations were based on the OTAG recommendations, which required 22 states to cut emissions to reduce transport. On August 17, 1998, Maryland submitted a supplement to the Phase II Attainment Plan which included additional modeling of these regional strategies performed by EPA as part of the NOx SIP Call.

Recently, Maryland has made several changes to the mobile budget portion of the Phase II SIP in response to the introduction of new mobile source control measures (Tier II, NLEV). In addition, Maryland has continued to provide innovative ideas for potential inclusion in the SIP to both the EPA and local stakeholders. In response to commitments made by Maryland to the EPA pertaining to the conditional approval of the Phase II SIP, Maryland intends to complete a mid-course review, analysis, submit measures to make up an emission reduction shortfall that EPA identified, and develop new motor vehicle emission budgets using the new mobile model, MOBILE6. Maryland expects full approval of the Phase II SIP in October of 2001.

3.0 RACM Measure Analysis

The following listing contains a total of over 100 measures that were reviewed by the joint agency workgroup as potential RACM measures. Where estimates of emissions reductions were completed as part of an extensive review in 1994, calculations can be found in corresponding reports in Appendix B.

A. Alternative Fuel Vehicles and Advanced Technology

A.1 Downtown CNG Shuttle Fleet

Definition:

Promote the installation of a downtown bus shuttle fleet comprised of CNG buses that would be used daily to move employees and tourists. The advantage of this fleet is the use of CNG which burns cleaner than diesel fuel.

Issues:

- Operator resistance (requires education on the benefits, maintenance, etc. of these vehicles). Current doubts include reliability, range of operation without refueling and safety issues, common concerns for the introduction of any AFV system.)
- Complexities in implementation do not allow the program to be implemented in time for emissions reductions to advance the attainment date.
- Appropriate CNG fueling infrastructure is not in place at this time.
- Small size of fleet does not produce extensive emissions benefits.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

A.2 Downtown Electric Buses for Tourists

Definition:

Promote and implement a downtown electric bus fleet for use by tourists for transport to tourist attractions.

Issues:

- Implementation would likely occur after 2005 due to local issues such as budgeting and the city planning process. The expected costs of the program are relatively high.

- Would require establishment of an office to manage the buses and schedule.
- The estimated credits would not be large enough to advance the attainment date.
- There is a technical feasibility concern pertaining to cold weather reliability and the potential limited range of operation the fleet.

Estimate of Emissions Benefits:

Assuming a 300 day-per-year usage and a 40,000 mile-per-year total the estimated potential emission savings for one bus would be 0.00063 tpd of VOC and 0.0023 tpd of NOx. Assuming a fleet of 10, the total estimated emissions reductions would be .0063 VOC and .023 NOx.

Equation:

$$(\text{emission grams/mile}) \times (\text{miles driven/year}) / (907,185 \text{ grams/ton}) = \text{tons/year}$$

$$(\text{tons/year}) / (\text{days of operation/year}) = \text{tons/day}$$

Where 907,185 grams = 1 ton

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

A.3 I/M for Diesel Vehicles

Definition:

Design and implement an Inspection and Maintenance (I/M) program that will be used for diesel vehicles.

Issues:

- Predicted technical limitations of site testing of vehicles may not be solved by 2005 and this timeframe does not assist with attainment.
- There is a concern related to testing technique as diesel engines are sometimes tested out of the vehicle for certification purposes. Currently the testing equipment is not available for on site diesel testing.
- The Federal Government has not established a mandatory testing methodology or a results-based standard.
- The costs of the program could be prohibitive to implement.
- MDE currently has in place an opacity-based, roadside, heavy-duty truck/bus testing program that addresses large-scale diesel emissions problems.
- Diesel testing primarily addresses the release of particulate matter (PM), not hydrocarbons. The Baltimore region currently meets the national standards for PM.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment. Air quality benefits for this type of program do not fundamentally address hydrocarbons or nitrogen dioxides, the precursors to ozone pollution.

A.4 CARB Diesel Fuel (On-Road Fuel Only)

Definition:

Implement CARB (California) diesel fuel standards that are cleaner than current diesel fuel standards in Maryland.

Issues:

- This program requires retrofitting the existing fleet of buses in order to achieve an emissions benefit.
- The new emissions technology that is needed to get actual benefits has not been proven to date and will not be likely available in the short term (1-2 years).
- The availability of this fuel is limited at present because modifications are needed at refineries to produce their fuel. Under federal rules similar fuels are not required until 2007. Fuel shortage problems could result if demand is greater than the available supply for the region (seasonality of supply and inter-state use).
- It is difficult to isolate Maryland in the regional market for this type of fuel. Maryland has no refineries and must purchase fuel from other states.
- High costs of fuel may lead to increases in emissions and fuel sales in neighboring states.
- Program would require new diesel fuel rules and regulations to be passed and would meet opposition by local fuel distributors and wholesalers.
- Strong opposition to rule changes may extend beyond the 2005 attainment date and this program would not advance attainment.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

A.5 Advanced Technology Vehicle Program

Definition:

MDOT currently operates a program of flexible funding incentives for fleets willing to deploy clean vehicles in the Washington and Baltimore regions. Currently \$2 million (for both the Washington and Baltimore regions) is committed for this program over the next two years (to 2002).

Issues:

- This program does not include funding for enhancement of the fueling infrastructure.
- The expected benefits from the program are not high enough to advance the attainment date.
- Funding is only committed for the next two years and depending on the success of the program – funding may be halted. This level of funding variability makes it very difficult to commit to the program in a SIP.
- The success of the program is partially dependent on private sector participation. Business sector resistance has been seen in the Baltimore region.

Estimate of Emissions Benefits:

The estimated emissions reductions for the existing program are 0.025 tpd of VOC and 0.085 tpd of NOx. The current funding commitment for the Baltimore region is \$200,000 each year for FY2001 and FY2002. An accelerated program with \$500,000 per year is estimated to reduce 0.065 tons/day VOC and 0.215 tons/day NOx.

Calculations:

The Baltimore area goal is determined by the ratio of funding as follows:

$$\begin{aligned}
 & \$200,000 / \$825,000 \times 0.068 \text{ tons per day} \\
 & = \mathbf{0.017 \text{ tons per day}} \\
 & = \mathbf{NOx \text{ emission reduction goal for 1 year for Baltimore area}}
 \end{aligned}$$

For VOC emission reduction calculations, an emissions benefit of 2.35 gram per mile was assumed, using the same logic as above. Total reductions are estimated as follows:

$$\begin{aligned}
 & 42 \text{ taxis} \times 2.35 \text{ gm/mile} \times 59,000 / (907,185 \text{ gm/ton} \times 300 \text{ days}) \\
 & = \mathbf{0.021 \text{ tons per day}} \\
 & = \mathbf{VOC \text{ emission reduction goal for 1 year for D.C. area}}
 \end{aligned}$$

The Baltimore area goal is determined by the ratio of funding as follows:

$$\begin{aligned}
 & \$200,000 / \$825,000 \times 0.021 \text{ tons per day} \\
 & = \mathbf{0.005 \text{ tons per day}} \\
 & = \mathbf{VOC \text{ emission reduction goal for 1 year for Baltimore area}}
 \end{aligned}$$

Thus, projected annual ATV Program emission reductions for the Baltimore region between 2001 and 2005 for NOx and VOC, assuming continued funding at the current rate, are as follows:

Baltimore Region ATV Program Emission Reduction Goals (Tons per Day)

Pollutant	2001	2002	2003	2004	2005
NOx	0.017	0.034	0.051	0.068	0.085
VOC	0.005	0.010	0.015	0.020	0.025

RACM Determination:

Estimated emissions reductions, for the current program or an expanded program, will not advance the attainment date.

A.6 Accelerated Phase Out of Diesel Buses

Definition:

Phase out the current older diesel buses and replace them with newer, cleaner diesels at a rate faster than the expected 12-year schedule. There are currently 800 buses in the fleet. The measure calls for the replacement of 200 per year at \$250,000 each for a total yearly cost of \$50,000,000.

Issues:

- The measure is extremely costly when replacing 25% (based on the complete phase out of diesel buses by 2005) or more of the fleet in one year.
- Normal buses last for an average of 12 years and removing them from the fleet prior to the end of their useful life is not cost efficient and is prohibited by federal funding restrictions as it perpetrates an unrealistic replacement schedule.
- Funding has been allocated for replacements based on a useful life of 12 years; funding shifts would be needed.
- Currently, this replacement schedule is not in the Transportation Improvement Plan (TIP) and the Baltimore Regional Transportation Plan (BRTP) and due to cost and cost effectiveness considerations. Delayed implementation or non-implementation would not advance the attainment date.
- Many new technologies are under development that may produce even lower emissions. Accelerated replacement of the entire fleet would preclude the purchase of buses with cleaner technologies.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

A.7 Accelerated Phase Out of Diesel Buses to CNG

Definition:

Phase out the current older diesel buses and replace them at a rate faster than the expected 12-year schedule, or replace diesel buses with CNG buses. There are currently 800 buses in the fleet; 80 are programmed to be replaced per year through 2005 (400 total).

Issues:

- This measure requires large infrastructure changes for the CNG refueling stations, including a time lag for a permitting process, staff training, construction, etc.
- The measure is extremely costly when replacing 25% (based on the complete phase out of diesel buses by 2005) or more of the fleet in one year.
- Funding has been allocated for replacements based on a useful life of 12 years; funding shifts would be needed.
- Currently, this replacement schedule is not in the Transportation Improvement Plan (TIP) and the Baltimore Regional Transportation Plan (BRTP) and due to cost and cost effectiveness considerations. Delayed implementation or non-implementation would not advance the attainment date.
- Currently, diesel buses last for an average of 12 years and removing them from the fleet prior to the end of their useful life is not cost efficient and is prohibited by federal funding restrictions as it perpetrates an unrealistic replacement schedule.
- CNG buses have particulate matter (PM) benefits that are not addressed in the emissions estimates/cost effectiveness analysis.

Estimate of Emissions Benefits:

Current estimates show an emissions benefit of 0.187 tpd of VOC and 0.447 tpd of NOx. Approximate cost is \$156 million for 400 buses, to replace older diesel buses through 2005.

Calculations:

New buses average 34000 miles per year and operate 330 days per year.
 Total mileage for 80 new buses = 2720000

Bus emission factors in grams per mile for the bus year are:

	1988 factors	1998 factors for new diesel buses	1998 factors for CNG buses	Savings for new diesel buses	Savings for CNG buses
VOC	4.66	4.26	0.13	0.4	4.53
NOx	36.24	15.87	6.02	20.37	30.22

CNG Replacement Buses (80)

VOC emissions savings x annual bus miles = 12321600
 NOx emissions savings x annual bus miles = 82198400
 Convert to kg/day (grams saved/1000/330 days)
 VOC kg of emissions savings per day = 37.33818182

NOx kg of emissions savings per day = 249.0860606
 Convert to tons/day (grams/1000/908/330)
 Total benefits of 80 CNG replacement buses =
 VOC tons of emissions savings per day = 0.041121346
 NOx tons of emissions savings per day = 0.274323855

Total benefits of 400 CNG replacement buses (2005) =
 VOC tons of emissions savings per day = 0.206
 NOx tons of emissions savings per day = 1.372

Approximate Cost for CNG buses

	Cost for diesel buses (millions)	Incremental Cost (millions) (range \$25-60,000)	Total Cost (millions)
80 Buses:	26.4	3.2	29.6
Refueling infrastructure (\$3 million serves 250 buses)			6.0
Modifications (range \$0.5-2 million per refueling station required for refueling infrastructure)			2.0
			156.0

Cost for CNG bus replacements is an approximate estimate. Does not include other costs associated with AFV fleet implementation such as training. Assumes 400 buses would require two refueling stations, \$3 million per station with \$1 million for modifications, and \$40,000 per bus incremental cost.

New Diesel Engine Replacement Buses

VOC emissions savings x annual bus miles = 1088000
 NOx emissions savings x annual bus miles = 55406400
 Convert to kg/day (grams saved/1000/330 days)
 VOC kg of emissions savings per day = 3.296969697
 NOx kg of emissions savings per day = 167.8981818
 Convert to tons/day (grams/1000/908/330)
 Total benefits of 80 diesel replacement buses =
 VOC tons of emissions savings per day = 0.003631024
 NOx tons of emissions savings per day = 0.184909892

Total benefits of 400 new diesel replacement buses (2005) =
 VOC tons of emissions savings per day = 0.018
 NOx tons of emissions savings per day = 0.925

Difference between 400 CNG replacement buses and 400 new diesel replacement buses =
 VOC tons of emissions savings per day = 0.187
 NOx tons of emissions savings per day = 0.447

Difference in cost between 400 new diesel and CNG replacement buses = 156-132= \$24 million

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment. Based on the above estimates the emission benefits from this program would not advance the attainment date.

B. Bicycle and Pedestrian Improvements

Note: Due to the nature of quantification methods for bicycle and pedestrian programs, all of the programs in this section are quantified together. A description of the methodology and results is given at the end of the section.

B.1 Expanded Bike/ Pedestrian Facilities

Definition:

Accelerate completion of proposed bicycle, pedestrian, and greenway projects in the region by 2005. The projects for this strategy are all planned bike/ped/greenway projects in the draft updated 2001 Baltimore Regional Transportation Plan.

Issues:

- Timeframe (4 years until the attainment date) does not allow sufficient time for travel behavior changes that would permit maximum increase in bike trips to take advantage of expanded bike/pedestrian resources.
- Many bike projects are tied to highway improvement completion and cannot be advanced without advancing the attainment date.
- Local governments are expected to have increased hardship in implementing this accelerated schedule, particularly in reallocating financial resources.
- Implementation issues include difficulty in acquiring necessary rights-of-way, in garnering public support for projects at the local level, and in allocating resources such as manpower, equipment, and planning staff.

Estimate of Emissions Benefits:

Due to the quantification methodology, the emissions benefits for this strategy are included with other bike/pedestrian strategies listed in this section through an aggregate benefits calculation. A complete description of the methodology is found at the end of the section. The estimated cost is \$70 million for planned bike/pedestrian facilities alone.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

B.2 Bike to Work Day

Definition:

Conduct a one-day event where citizens bike to work. Event includes preceding outreach activities, education on the option to bike to work, and assistance in trying this clean commuting option. This event occurs annually in the Baltimore region through a joint effort between the MPO, MDE, MDOT, and the Maryland Department of Planning (MDP). Participation and media coverage have increased each year.

Issues:

- While funding can affect the size of the event, there are generally no limiting implementation issues in the Baltimore region.

Estimate of Emissions Benefits:

Due to the nature of this event, and its one-day focus, it is not possible to quantify the effects of this strategy as an isolated means to increase bike trips in the region. However, it is assumed that outreach activities such as this one contribute to the overall increase in bike trips and converted SOV trips in the estimated aggregate benefits for this section. Estimated cost for this event is \$7,500; any funding, staff time, materials, and prizes are donated or leveraged from the public and private sectors.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions of an amount expected to advance the attainment date. This measure is included in a “packaged” bike/ped strategy, listed at the end of this section.

B.3 Retrofit Bicycle Program

Definition:

Enhance bicycle transportation access on or near state roads. Program is sponsored by the Maryland Department of Transportation, State Highway Administration. Projects include bicycle-friendly enhancements, such as fixing potholes, manholes, trimming shrubbery, upgrading shoulders, striping, adding signs, etc (usually under \$50,000/project). Current funding is \$1 million per year FY2001-2003 (\$3 million total) statewide.

Issues:

- Project are selected according to demand/requests, which can be made by all parties including local jurisdiction, citizen, organization, etc.
- Helps to enhance bikability of established communities.
- Larger projects, particularly adding new shoulders, may involve a permitting process and/or including water quality analyses based on impervious surfaces. Right-of-way issues may also be involved. Therefore, these types of larger bike improvements are usually tied to road improvements projects.

Estimate of Emissions Benefits:

Due to the annual variability of projects and general nature of this program, it is difficult to estimate benefits derived from this program alone. However, it is assumed that programs such as this one enhance the bicycle network in the region and therefore promote overall bike trips. Benefits of this program are included in the aggregate estimate for the region (see end of section). Approximate cost for this program is \$1 million annually statewide.

RACM Determination:

As an isolated measure, does not produce emissions reductions of an amount expected to advance the attainment date. This measure is included in a “packaged” bike/ped strategy, listed at the end of this section.

B.4 Annapolis Transit Bike Racks and Shelters

Definition:

Installation of bike racks on Annapolis Transit buses (completed), installation of bike racks throughout the city (4 programmed), improvement of bus stop amenities (programmed-2002), creation of “A-STEP map” of alternative transportation options (bike, walk, and bus) in the Annapolis area (complete), acquisition of computerized bike racks and bicycles to be used by transit riders (programmed-2002).

Issues:

- Activities are complete or programmed in the Annapolis area; therefore, there are fewer issues for this strategy.
- Implementation issues include technology obstacles (application of European technology for SmartBike), and technical obstacles (i.e., required bus modifications for safety). These types of issues led to delays in implementation.
- Ground installation of bike racks has been fairly inexpensive with implementation issues related to maintenance and liability on private property (malls, etc.).
- The A-STEP map has received good support and demand.

Estimate of Emissions Benefits:

Annapolis Transit has approximately 15 buses with an approximate ridership of 1 million per year (including transfers). The projects included in this strategy are aimed to increase both transit ridership and bike trips (reducing cold starts). This type of strategy has limited applicability, therefore it is difficult to estimate emission reductions on a regional scale. However, it is assumed that activities such as these enhance the bikeability in Annapolis and increase transit ridership. Therefore, benefits from activities such as these are included in the aggregate estimate for the region (see end of section). Approximate cost for this strategy to date is \$73,500.

RACM Determination:

This measure is included in a “packaged” bike/pedestrian strategy, listed at the end of this section. The emission reductions expected from the bike/ pedestrian package are not sufficient to advance attainment.

B.5 Local Bike/ Pedestrian Program

Definition:

Throughout the Baltimore region, local jurisdictions undertake enhancement projects that improve the region's network for bicycle and pedestrian transportation alternatives. These projects are often small in scope (several hundred yards), but nonetheless culminate in an improved non-motorized system. These projects may also enhance access between employment centers, school, retail, residential areas, transit stations, and/or recreational facilities.

Issues:

- Due to resource limitations, the number of projects are limited on an annual basis.
- Projects are usually completed based on safety priority and demand on the local level.
- Installation or construction of such projects without demand can lead to contention by the affected community.

Estimate of Emissions Benefits:

The scale of non-motorized travel behavior generated from these types of projects cannot be modeled in the traditional transportation planning modeling process. In addition, research does not yield a specific methodology for capturing this type of transportation improvement. However, it is assumed that these projects do enhance the regional transportation system of bicycle and pedestrian (and transit) travel, thereby reducing auto trips. These benefits are captured in the aggregate calculation of benefits (see end of section). Due to the number and variability of these projects, it is not possible to capture an estimated cost at this time.

RACM Determination:

As an isolated measure, this measure does not produce emissions reductions of an amount expected to advance the attainment date. This measure is included in a "packaged" bike/pedestrian strategy, listed at the end of this section.

B.6 Accelerated Bike/ Pedestrian Access to Transit

Definition:

Promote and implement all bike/ pedestrian access to transit plans on an expedited schedule.

Issues:

- Would require changes in local plans and funding arrangements
- Potential emission benefits would be limited as typical bike/ pedestrian projects do not offer large-scale emission benefits of the type that could potentially advance attainment.
- Program would be more costly to implement because compressed implementation schedule would restrict developer provided bicycle/pedestrian improvements.

- The Maryland Transit Administration (MTA) is moving forward with an investigation into options related to this type of program. Implementation issues associated with this type of activity may delay implementation or accelerated implementation so that the projects do not advance attainment.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) may hinder the ability to implement this strategy in time to advance attainment. The expected emissions reductions are not large enough to advance attainment.

B.7 MTA Bicycle Racks on Buses and Commuter Rail (MARC)

Definition:

Install bicycle racks on MTA buses (Baltimore City) and MARC commuter rail trains.

Issues:

Buses

- MTA has completed a 6-month feasibility study to test application of racks on buses.
- Implementation issues include fit and selection of equipment and operation/distribution of buses.
- There could also be a delay in headway (timing of stop at station) caused by people putting bikes on racks.
- MTA is working to conduct a pilot program to install racks on one division of buses (of 4 divisions total). If feasible, the Northwestern Division which serves Metro lines will be equipped for a total of approximately 200 buses.
- The final conclusion on implementability for all MTA buses will be determined pending the outcome of the pilot.

Commuter Rail

- MTA conducted a 6-month study to investigate the feasibility of installing bicycle equipment on MARC commuter trains.
- The primary implementation issue is the requirement to meet Federal Rail Administration safety requirements. This requirement demands specific measures to secure bicycles.
- MTA plans to conduct a pilot program, installing bicycle equipment on 52 trains spread across lines to ensure one bicycle-friendly train for each scheduled train. The pilot requires a bid process to design appropriate equipment to meet safety requirements and to install such equipment (may require structure modifications to the trains).

- Final conclusion on the implementability of the installation of bicycle equipment on MARC trains will be determined pending the outcome of the pilot.

Estimate of Emissions Benefits:

Approximate cost of installation of bicycle racks on all MTA buses is \$2 million*. Due to requirements for new design specifications for bicycle equipment on MARC commuter rail, it is not possible to derive a cost estimate at this time.

RACM Determination:

As an isolated strategy, this measure is not expected to produce emissions reductions of an amount sufficient to advance the attainment date. This measure is included in a “packaged” bicycle/pedestrian strategy, listed at the end of this section.

* Cost is a general, approximate cost, based most closely on order of magnitude. Specific estimates are not available and will depend on cost/ability to remove obstacles to implementation.

**Bicycle & Pedestrian Summary Package
Includes all above-listed measures**

Assumptions for 2005 Bicycle RACM Analysis

1. The major groups of bicycle riders used in this analysis are bicycle commuters and college student bicycle riders. Baseline date for bicycle commuters is the 1990 Census, Geographic Mobility, Commuting and Veteran Status: 1990, Table 143. Baseline data for college student bicycle riders is Regional College Enrollment information use in 1994 BMC TCM.
2. The projection of 2005 bicycle commuters is based on BMC Round 5-C population and employment projection. The projection of 2005 college student bicycle riders is based on Maryland Department of Planning, Report 2: Age, Race & Sex 1990-2020, 1998. The later report show that college age population groups steadily increase until 2010.
3. An average bicycle trip length for employees and college students is assumed to be 1.8 miles. (Source: National Personal Transportation Survey)
4. Based on an aggregate behavior approach, the increase in 2005 bicycle use is assumed to be proportional to the proposed increase in planned regional bicycleway facilities shown in the proposed Baltimore Regional Bicycle, Pedestrian, and Greenway Transportation Plan. In the longer term of 2015, a fully proportional relationship is regarded as realistic. However, in the shorter term that would result from a 2005 accelerated completion schedule, there is less time for travel behavior to adapt to the presence of major new bicycle facilities. Therefore, it is assumed that the 2005 increase in bicycle usage would be partially proportional (75%) to the magnitude of increase in bicycleway facilities in 2005.
5. The estimate of the potential additional emissions reductions from midday bicycle trips, plus other proposed bicycle enhancements, assumes that the combined effect would add approximately 50% to peak period emissions reductions. The

assumption recognizes that while the number of midday trips are larger in number that the length of these trips are much shorter than peak period commute trips.

1990 Bicycle Commuter = 1,828 employees (Source: 1990 Census, Geographic Mobility, Commuting, and Veteran Status, Table 143)

2005 Bicycle Commuter Multiplier = 1,511,335 employment in 2005 / 1,345,300 employment in 1990 = 1.1234

2005 Bicycle Commuters = 1,828 x 1.1234 = 2,054 employees

Projection of Regional College Students to 2005 (Source: 1994 BMC TCM M-54)

1994 Full Time Students = 115,895 total students – 75,808 day students = 40,087 students

1994 Day Students (Commuting Students) = 75,808 students

1994 Full Time Students Who Walk to School = 40,087 x 0.50 = 20,044 students

1994 Day Students Who Walk to School = 75,800 x 0.25 = 18,950 students

1994 Full Time Students Who Bicycle to School = 40,087 x 0.05 = 3,790 students

1994 Students Who Bicycle to School = 4,009 + 3,790 = 7,799 students

2015 Students Who Bicycle to School = 7,799 x 1.1203 multiplier = 8,737 students

2005 Students Who Bicycle to School = 8,737 students x (730,192 college age population in 2005/800,351 college age population in 2015) = 8,737 x 0.9123 = 7,971 students biking to school in 2005

2005 estimated bicycle users (assuming no regional bicycleway improvements by 2005) = 2,054 employees + 7,971 student bicyclers = 10,025 bicycle users

2005 increase in bicycleways in region = 315.06 miles proposed bicycleways/116.34 miles existing bicycleways = 2.71 multiplier by 2005

2005 estimated bicycle users (assuming full implementation of all proposed regional bicycleways by 2005) = 10,025 bicycle users x 2.71 bicycleway system expansion factor x 0.75 discount factor for early 2005 completion = 20,376 bicyclers

2005 net increase in bicycle users with all bicycleway improvements = 20,376 – 10,351 bicycle users

Year 2005 Emission Reduction Analysis

2005 VT reduction = 10,351 bicyclers x 2 VT/day = 20,702 VT/day

2005 VMT reduction = 10,351 bicyclers x 2 VT/day x 1.80 miles/trip = 37,264 VMT/day

37,264 VMT x 1.323 gr/mile = 49,300 NOx gr/day = 0.0149 t/day

37,264 VMT x 0.363 gr/mile = 13,527 VOC gr/day = 0.0149 t/day

20,702 VT x 2.180 gr/trip = 45,130 VOC gr/day = 0.0497 t/day

20,702 VT x 0.865 gr/trip = 17,907 NOx gr/day = 0.0197 t/day

2005 VOC reduction = 0.0149 + 0.0497 = 0.0646 t/day

2005 NOx reduction = 0.0543 + 0.0197 = 0.0740 t/day

2005 VOC reduction (including midday bicycle trips + bicycle enhancements) = 0.0646 x 1.50 = **0.0969 t/day**

2005 NOx reduction (including midday bicycle trips + bicycle enhancements) = 0.0740 x 1.50 = **0.1111 t/day**

Aggregated Bicycle Methodologies Reviewed

- Alta Transportation Consulting Bicycle Demand and Benefit Model, April 2000
- San Luis Obispo County Air Pollution Control District – Bicycle Transportation Control Measure Methodology
- FHWA Guidebook on Methods to Estimate Non-Motorized Travel, July 1999
- MWCOC Bicycle TERMS Methodology
- WILMPACO Emission Reduction Strategies
- U.S. EPA Transportation Measure Quantification Efforts Index: Methodology Matrix

RACM Determination:

Estimated emissions reductions from package of all projects is not sufficient to advance the attainment date. Implementation issues (as listed in all of the measures above) hinder the ability to implement this strategy in time to advance attainment. In addition, emissions estimates from any selection of strategies is unlikely to advance that attainment date.

C. Voluntary Vehicle Removal Programs

C.1 Cash for Clunkers Program (Pre-1975)

Description:

Establish program to purchase pre-1975 vehicles that have minimal/ no emissions controls. A demonstration program was conducted in 1994 by Crown Central Petroleum Corp., CLEAR (Crown Lower Emissions through Automotive Recycling)

Issues:

- Emissions benefits are transient. Under EPA guidance, credits from retiring older vehicles have a limited life because the vehicles are often replaced by vehicles only slightly newer and emission models assume older vehicles are replaced as part of fleet turnover.
- Competition with numerous vehicle acquisition programs operated by charitable organizations in the Baltimore region that offer tax deductions.
- The supply of available older vehicles is shrinking due to natural attrition and competing acquisition programs.

Estimate of Emissions Benefits:

1994 estimates show an emissions benefit of 1.185 tons/day of VOC and 0.705 tons/day of NO_x for removal of pre-1990 vehicles. Approximate associated cost is \$3,750,000, for 5,000 vehicles. Calculations were not updated in 2001 because the reductions are not permanent.

RACM Determination:

Measure is unreliable for use in meeting/advancing attainment.

D. Land Use/ Development Changes

D.1 Retrofit Sidewalk Program

Definition:

MDOT has established the Retrofit Sidewalk Program, administered by the State Highway Administration (SHA), to provide funding for the construction of new and the reconstruction of existing sidewalks and pathways. This program supports legislation aimed at promoting bicycle and pedestrian access and supports MDOT's increased emphasis on walking and bicycling as viable and safe modes of transportation. The incorporation of sidewalks and other pedestrian amenities can facilitate and encourage safe and convenient pedestrian travel within communities and among different land uses. They can provide safe and reasonable access to public transportation and other alternative modes of transportation, thereby enhancing the regional network for multi-modal transportation.

This program, funded at a maximum of \$2 million annually, is aimed at providing or improving safe pedestrian access along state routes in existing communities, especially in the vicinity of schools. SHA works in partnership with counties and local communities to identify and prioritize proposed sidewalk locations. The guidelines used in the selection of projects include the following:

- Sidewalks must be along a State Highway
- The project should demonstrate safety benefits to pedestrians.
- It should provide or improve mobility for the general and disabled populace.
- Priority is given to projects that demonstrate that the addition of sidewalks will benefit revitalization by providing access to business, commercial and/or recreational areas that does not currently exist. Projects that are within Smart Growth Areas designated by local governments according to State criteria can be funded totally through this program. Projects not within these designated areas are only funded for 50% of the cost.
- The local jurisdiction should show evidence that they are in support of pedestrian facilities.
- It should be evident there is either existing or projected pedestrian traffic.
- The project should have the support of the adjacent local community that will be the potential users of the community.

In the first three years of the Retrofit Sidewalk Program, 170 communities have benefited, representing a commitment of \$4.1 million or 98% of available funding. For fiscal year 1999, an additional \$2 million was committed.

Issues:

- This program requires local county involvement in both budgeting (assist financing the improvements) and planning.

- The requirements for funding are stringent and apply to only certain areas, making funding access limited.
- While the funding is currently available, the program is not guaranteed to extend to 2005.
- Project benefits are small when calculating the emission reductions from sidewalk program because the connectivity of the projects is not assured.

Estimate of Emissions Benefits:

An estimate of emissions benefits was not calculated for this strategy because no data is available to estimate the number of trips reduced without transit support. Available in many communities, the measure produces limited trip reduction. However, it is assumed that programs such as this one promote walkability and enhance the region’s transportation network, particularly for non-motorized travel. Estimated cost in the Baltimore region is \$2.44 million (40% of statewide total). Together with planned transit enhancements, this program may produce quantifiable emission benefits, but the timeframe necessary to fully implement the program will not produce sufficient benefits to advance attainment.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions of a quantifiable amount and/or of an amount expected to advance the attainment date.

D.2 Modified Land Use Development Changes

Definition:

Alter the planning process to include modified land development patterns that may assist with sprawl and reduce vehicle miles traveled. Options include enhancing mixed-use development, infill development, and transit oriented development.

Issues:

- These types of decisions are local in nature and require that local planning departments change their policies and procedures.
- Large-scale changes in the local planning process typically take great efforts and several years of time (please see the summary of the typical MD planning process in Appendix D of this report).
- The timeframes needed for changing the local ordinances and then for development of any particular project probably exceeds the 2005 attainment date for the region.
- In addition, several Smart Growth projects that use these principals are under consideration for inclusion in the SIP.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated. Emission benefits would be extremely small in the early years of implementation.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

D.3 Infill/ TOD Development

Definition:

Alter the planning process to include more infill/ transit oriented development (TOD) that may assist with sprawl and reduce vehicle miles traveled.

Issues:

- These types of decisions are local in nature and may require that local planning departments change their adopted ordinances.
- Large-scale changes in the local planning process typically take great efforts and several years of time (please see the summary of the typical MD planning process in Appendix D of this report).
- Projects often face local opposition, especially if addition of transit is involved.
- The timeframes needed for significant change and adopting codes that foster infill/ TOD development exceed the 2005 attainment date for the region.
- In addition, several Smart Growth projects that use these principals are under consideration for inclusion in the SIP.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated. Emission benefits would be extremely small in the early years of implementation.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

D.4 Incentives for Mixed Use at Transit Centers

Definition:

Alter the planning process to include incentives for mixed-use development at transit centers that may assist with sprawl and reduce vehicle miles traveled. This program would provide amenities such as day care centers for children and convenience stores. This measure would make it attractive to use transit by eliminating the need to use automobiles to access day care and shopping.

Issues:

- Several financial incentive programs are in place with similar goals to this measure. These programs, operated by the MTA, are described in sections D.12.

- These types of decisions are local in nature and may require that local planning departments change their adopted ordinances.
- Large-scale changes in the local planning process typically take great efforts and several years of time (please see the summary of the typical MD planning process in Appendix D of this report).
- Projects often face local opposition, especially if addition of transit is involved.
- The timeframes needed for significant change and adopting codes that foster this type of development exceed the 2005 attainment date for the region.
- In addition, several Smart Growth projects that use these principals are under consideration for inclusion in the SIP.

Estimate of Emissions Benefits:

An estimate for the Washington region, completed in 1994 using several realistic assumptions (6 day care centers) showed an emissions benefit of 0.014 tpd of VOC. Emission benefits in this order of magnitude would not advance the attainment date for the Baltimore region.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in timeframe to advance attainment.

D.5 Convenience Commercial Centers in Residential Areas

Definition:

Changes to zoning ordinances to allow neighborhood-serving retail establishments in residential areas. This measure would induce short trips via walking and biking.

Issues:

- Zoning Changes – small if requested for variance (one year or so). Large scale changes could require full planning process and legislative backing (2-3 years)
- Potential changes in building codes (to allow for mix use buildings in residential areas)
- May require full public process (development management group), which may foster public dissent
- Some local zoning ordinances related to this measure already exist; therefore convenience centers may already exist within bike/walk distance. Benefits of these programs are captured in the baseline.

Estimate of Emissions Benefits:

Calculations:

Assume an average of 887 (range 396-932) vehicle trip ends per day for every 1,000 ft² gross floor area commercial center (ITE Trip Generation Manual, 4th edition)

Assume 2000 ft² convenience commercial centers = 1774 vehicle trip ends = 3500 total vehicle trips

Assume maximum walk distance = 0.75 mile, maximum bike distance = 3 miles

Assume catchments (service area) for center is 5 miles = 1130 acres/ 0.75 mile radius, 18096 acres/ 3 miles, 50239 acres/ 5 miles

3500 total vehicle trips to center = 0.011611 trips per unit to center within 5 mile radius

Assume 6 units/acre = 79 total vehicle trips to center within 0.75 walk distance, 1260 total vehicle trips within 3 miles, 3500 total vehicle trips within 5 miles

Assume 10% conversion of vehicle trips from SOV to bike or walk = 8 walk trips, 126 bike trips

8 walk trips * 0.75 = VMT reduced

126 bike trips * 3 = VMT reduced

Cold Start Emissions

Walk Trips	8	
NOx	7.296	Grams (Trips X .912gms)
VOC	13.87	Grams Trips X 1.734gms
Bike Trips	126	
NOx	114.912	Grams Trips X .912gms
VOC	218.484	Grams Trips X 1.734gms

Running Emissions

VMT	384	(8*0.75+126*3)
NOx	376	Grams Trips X .98gms
VOC	133	Grams Trips X .347gms

Hot Soak Emissions

Trips	134	
NOx	0	Grams
VOC	74	Grams Trips X .553gms

Totals

NOx	0.001	tpd	Sum/ 907185
VOC	0.0004843	tpd	Sum/ 907185

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

D.6 Live Near Your Work Program

Definition:

The Maryland Department of Housing and Community Development has implemented the "Live Near Your Work (LNYW)" Program to encourage employees of Maryland's businesses and institutions to buy homes near their workplace. This initiative works to stabilize the neighborhoods surrounding the State's major employers by stimulating home ownership in targeted communities. In addition the program provides resources for LNYW Programs sponsored by public and private institutions, the State is participating in LNYW as a major employer.

The LNYW program provides a minimum \$3000 to homebuyers moving to designated neighborhoods. The local government designates LNYW areas with the Department's concurrence and administers the program within its jurisdiction. Participating employers include businesses, non-profits, colleges or universities, or government agencies. The employers set eligibility requirements, promote the program to their employees and provide matching resources. To qualify, the employee must purchase a home in a designated LNYW area, and live there for at least three years.

Issues:

- This program is in place; but the number of people moving to designated neighborhoods is limited.
- The success of the program is dependant on participation by local jurisdictions, and, employers in the private sector.
- Participation in the program has grown since its inception, including large Maryland employers such as Johns Hopkins.
- Homeowner participation in the program is generally small on a region-wide scale and would likely not provide the benefits that would advance attainment.
- Emissions benefits from changes in travel behavior generated from the program are reduced due to the percentage of individuals who did not decrease the distance from home to work and/or from individuals who were previously renting and simply purchased their home.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated but would be very small based on the number of houses purchased to date.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

D.7 Neighborhood Conservation Program

Definition:

Encourage development and redevelopment of land in locally designated growth areas while encouraging local governments to place greater emphasis on land development near transit stations. This program is already implemented as part of the Smart Growth Transit Program. Most of these projects support pedestrian, bicycle, and transit travel.

Issues:

- Local government decisions and citizen opposition on land use topics may lead to implementation issues and delays.
- Accelerating the program would require large scale membership and support to produce high emission benefits and historically the program has not had large scale support.
- Funding commitment extends until 2004 and the program may not be funded past this date. Thus support for the program could end before the 2005 attainment date.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date

D.8 Smart Growth Transit Programs

Definition:

Encourage development and redevelopment of land in locally designated growth areas while encouraging local governments to place greater emphasis on land development near transit stations. MDOT provides funding in an effort to promote more efficient land uses and increase transit ridership. Funding sources under this umbrella program include: Transit Station Development Incentive Program, Neighborhood Conservation, Access 2000 Bicycle and Pedestrian Improvement Program, and the Adopt-A-Shelter Program.

Issues:

- Local government decisions and citizen opposition on land use topics may lead to implementation issues and delays
- Program is currently implemented and funded but funding is not guaranteed through 2005.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

D.9 Transit Station Smart Growth Initiative

Definition:

Encourage development and redevelopment of land in locally designated growth areas while encouraging local governments to place greater emphasis on land development near transit stations. The program provides funds directly to developers for the construction of transportation related improvements in support of development in the vicinity of a rail transit station. The projects will be proposed and selected by the State of Maryland (MDOT, DHCD, DBED, MDE, MDP).

Issues:

- Local decisions on land use topics may lead to implementation issues and delays.
- Program is currently implemented and funded but funding is not guaranteed through 2005.
- The current cost for this program is \$3.6 million of committed funds.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations above and emission benefits were not calculated.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

D.10 Infill Development – Digital Harbor

Definition:

Conduct a series of infill development projects in the vicinity of Baltimore's Inner Harbor. This initiative, the "Digital Harbor" project includes such infill projects and corresponding land use/Smart Growth policies.

Issues:

- Part of the Smart Growth and Innovative Measures SIP, utilizing new EPA land use/air quality/transportation guidance.
- Requires local actions, funding, and implementation.
- Air quality benefits require extensive quantitative evaluation procedures.
- Currently, an unbalanced housing and employment ratio exists, reducing the emissions benefits possible before 2005.

Estimate of Emissions Benefits:

This project is under consideration as part of the Smart Growth and Innovative Measures SIP. Estimates of the 2005 benefits will not be available until late summer/fall of 2001.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions of an amount expected to advance the attainment date.

D.11 Infill Development – Parole Town Center

Definition:

Smart Growth development in the Parole area of Anne Arundel County.

Issues:

- Part of the Smart Growth and Innovative Measures SIP.
- Requires local actions and local level implementation.
- Requires EPA approval as land use projects have not yet been included in the SIP.
- Currently, this project is in the planning process and development may not begin until a date closer to 2005.

Estimate of Emissions Benefits:

This project is under consideration as part of the Smart Growth and Innovative Measures SIP. Estimates of the 2005 benefits will not be available until later in the summer of 2001. It is unlikely that emission benefits sufficient to assist with attainment would be captured prior to 2005, the existing attainment date.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions of an amount expected to advance the attainment date.

D.12 Infill Development – Owings Mills Center

Definition:

Smart Growth development in the Owings Mills area of Baltimore County.

Issues:

- Part of the Smart Growth and Innovative Measures SIP.
- Requires local actions and local level implementation.
- Requires EPA approval as land use projects have not yet been included in the SIP.
- Currently, the project is in the planning process and development may not begin until a date closer to 2003.

Estimate of Emissions Benefits:

This measure is under consideration as part of the Smart Growth and Innovative Measures SIP. Estimates of the 2005 benefits will not be available until later in the summer of 2001. It is unlikely that emission benefits sufficient to assist with attainment would be captured prior to 2005, the existing attainment date.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions of an amount expected to advance the attainment date.

E. Transit Improvements

E.1 Bus Replacement – MTA Fleet

Definition:

Initiate the replacement of MTA buses from older diesel burning engines to newer diesel buses with cleaner burning engines. The current program calls for replacement of 80 buses per year for the next five years, or 400 buses total.

Issues:

- This program is currently implemented, and implementation issues are minimal.
- The emission reduction credits for this program are not sufficient to advance the attainment date.
- The cost for 80 buses is \$26.4 million, with a total cost of \$132 million.

Estimate of Emissions Benefits:

Estimated emissions benefits for 400 buses are 0.08 tpd of VOC and 0.92 tpd of NOx.

Calculations:

Bus Usage Data

New buses average 34,000 mile per year and operate 330 days per year.

Total mileage for 80 new buses is 2,720,000.

Bus emission factors in grams/mile for the bus year are:

	1988 Factors	1998 Factors	Savings
VOC	4.6600	4.2600	0.4000
NOx	36.2400	15.8700	0.195

Calculation of grams for annual bus miles for 80 buses

VOC emissions savings x annual bus miles = 1,088,000 grams saved

NOx emissions savings x annual bus miles = 55,406,400 grams saved

Convert to kg/day (grams saved/1000/330 days)

VOC kg of emissions savings per day = 3.2970

NOx kg of emissions savings per day = 167.8982

Convert to ton/day (grams/1000/908/330 days)

VOC tons of emissions savings per day = 0.0036

NOx tons of emissions savings per day = 0.1849

Total benefits for 80 buses are:

VOC = 0.0036 tons/day; NOx = 0.1849 tons/day

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.2 Bus Engine Upgrade

Definition:

Perform engine overhauls on the MTA bus fleet including the installation of catalytic converters and using an EPA certified engine rebuild kit. This program does not include any changes in fuel type.

Issues:

- The engine overhaul kits reduce particulate matter in bus exhaust. The kits do not focus on reducing NOx or VOC emissions.
- Funding is not guaranteed.
- The emission reduction credits for this program do not contribute to ozone reduction.

Estimate of Emissions Benefits:

According to a 2000 estimate, there would be no benefits within the 1/1000 of a ton for either NOx or VOC for this program. PM benefits are estimated as 14.94 tons/year. Cost of the program is approximately \$23 million. This level of emissions reductions for NOx and VOC would not advance the attainment date.

Calculations:

MTA rebuilds approximately 150 buses engines per year. The rebuild is scheduled as needed or after 300,000 miles of service. MTA has 809 buses available for service.

The FY98 total vehicle miles were 21,062,550
 $21,062,550 \text{ miles} / 809 \text{ buses} = 26,035 \text{ average miles per bus}$
New Buses Average 34,000 mpy
 $26,035 \times 150 \text{ overhaul engines} = 3,905,250 \text{ overhaul bus miles}$

Southwestern Research and MTA data indicates that each gram per brake horsepower-hour (g/bhp-hr) is equal to 1.5 tons of particulate matter (PM) for each 100,000-bus mile.
 $3,905,250 \text{ bus overhaul miles} / 100,000 \text{ miles} = 39.05 \text{ per } 100,000 \text{ mile segments}$
 $39.05 \times 1.5 \text{ tons} = 58.58 \text{ tons of PM per g/bhp-hr}$

Data provided by the Engelhard Automotive Emission Systems indicates that depending on the age of the bus and engine type, the PM can be reduced at between 0.46 and 0.05 gram per brake horsepower-hour. The average will vary around 0.255 g/bhp-hr of PM.
 $0.255 \text{ g/bhp-hr} \times 58.58 \text{ tons per g/bhp-hr} = 14.94 \text{ tons of PM removed per year}$
This data will vary from engine to engine. A reasonable range of PM removal would be 13 to 17 tons per year for the 150 overhauled buses.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.3 Expansion of Transit Service

Definition:

Expand the current transit system above and beyond the existing programmed enhancements and expansion, prior to 2005. This program would increase the frequency of weekday peak period transit service.

Issues:

- The farebox recovery requirement makes rapid expansion of transit service risky because new routes may not generate sufficient revenue to continue the route.
- Americans with Disabilities Act (ADA) dual paratransit service requirements may substantially limit the scope of such a proposed transit service expansion.
- Extensive transit expansion is already planned in line with the Governor's Initiative on Transit.

Estimate of Emissions Benefits:

1994 estimates show 0.17 tpd of VOC and a decrease in NOx of 0.242 tpd for 2005 from this program. The approximate costs of this program could be in excess of \$4.5 million. Calculations were not updated in 2001 due to the rejection of this strategy for the reasons listed above.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.4 Free Rail Fares Between 10 am and 3 pm

Definition:

Offer free rail services between 10 am and 3 pm on a daily basis.

Issues:

- High program costs would force rate hikes at other times during the day.
- Program would not impact peak travel hours and may (due to potential higher costs) reduce transit ridership at peak times.
- Without changes in current farebox recovery legislation, this program may have only marginal feasibility.

Estimate of Emissions Benefits:

An estimate of benefits for this measure was not calculated based on the inability to implement this measure due to the issues noted above. Based on an analysis done for the Washington region in 1994, the expected VOC emission savings for the Washington region would be 0.06 tons per day.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment. Emission reductions are not sufficient to advance attainment.

E.5 Reduced or Zero Transit Fares/ Discounted Transit Fare Instruments

Definition:

Offer free transit on a daily basis in an effort to enhance transit ridership.

Issues:

- The costs of this program would be high and would require large subsidies.
- The program would require farebox recovery and other legislative changes that would be politically controversial and difficult to achieve.
- The program would not be implemented system-wide by the attainment date.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.6 Free Transit Passes to Students

Definition:

Offer free transit passes to students (high school and college level) that do not currently use public transportation.

Issues:

- Extremely high costs would force rate hikes at other times during the day (where applicable, the fairbox recovery requirement would present a problem)
- Students located in college areas typically have low ridership averages and the majority of schools offer competing shuttle/ free transportation services
- Would require local jurisdiction legislation and financial support.
- The emission reduction credits for this program are limited and would not advance the attainment date.
- Equity considerations would require that free transit passes also be given to existing student transit riders thus further increasing the cost of the program.

Estimate of Emissions Benefits:

An estimate completed for the Washington region in 1994 found a potential emissions credit of 0.037 tpd of VOC. With a region even smaller in size, and with a less extensive transit system it is unlikely that the Baltimore area would calculate emissions credits larger than this within the framework of this type of program.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.7 Half Price Fare on Feeder Bus Service

Definition:

Offer half price fare on feeder bus services that support MARC and other rail transit stations.

Issues:

- High costs would force rate hikes at other times during the day and on other transit services.
- Farebox recovery requirement would not be satisfied
- Program may be difficult to implement because many transit routes serve as feeders to rail transit as well as provide through bus transit service.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.8 Single Price Public Transit Service

Definition:

Offer single price public transit service. An example would be to allow ridership of all transit services for a single daily rate. Currently a daily fare allows transfers between core MTA bus, light rail and Metro.

Issues:

- Extremely high costs would force rate hikes and would be politically controversial
- Program would not satisfy the farebox recovery requirement
- Program would be difficult to implement because of equity and subsidy issues related to long distance suburban bus and commuter bus service.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.10 Increase Frequency of Commuter Rail

Definition:

Increase the frequency of commuter rail service to allow more trains and schedule changes. The TCM would increase the frequency of commuter rail service by 25%, in both directions, during weekday peak periods on the MARC Penn and Camden Lines.

Issues:

- This program could be very high in cost due to the potential scheduling changes, transit purchases, and staff requirements needed to implement a major transit change.
- There are limitations on the existing tracks due to ownership, freight/passenger use, and new tracks and would be very expensive to construct in short timeframe (land acquisition, NEPA process, complex construction staging, etc.)
- Existing and projected long distance passenger and freight movements have limited efforts to increase the frequency of commuter rail service in the Baltimore region.
- Current rail schedules are focused at peak times and offer the most efficient use of the available service lines.
- MTA has purchased bi-level coaches to overcome limitations imposed by CSX and Amtrak.

Estimate of Emissions Benefits:

1994 estimates show a VOC benefit of 0.077 tpd and a decrease in NOx of 0.128 tpd for 2005 from this program. The approximate costs of this concept could be in excess of \$12 million. Calculations were not updated in 2001 due to the rejection of this strategy as a reliable emission reduction strategy for the reasons listed above.

Additional calculations were completed (2001) for a measure consisting of a frequency increase of 10% for commuter rail. Estimated emission results were 0.0121 tons/day VOC and 0.051 tons/day NOx.

Calculations (2001)

10% increase in frequency = 3.6% increase in ridership (Travel Demand Model Validation, elasticity sensitivity)

2005 Base	21, 474
2005 New Riders	22,247
Emissions Factors for 45 mph:	VOC 0.325, NOx 1.367
Average Trip Length MARC trip, One-way trips	21.8
2005 Base Emissions	VOC 0.3351, NOx 1.4096
2005 New Rider Emission	VOC 0.3472, NOx 1.4603
Benefits:	VOC 0.0121, NOx 0.0507

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.11 Transit Priority Treatment (Bus Rapid Transit)

Definition:

This program offers a slightly different way of viewing the bus transit mode as a means of making this mode more attractive. Specifically this type of program enhances transit time via:

- Exclusive right of ways – making a lane used solely for bus transit
- Newer buses that are more reliable
- Attractive rail like buses
- Attractive infrastructure – bus stops and terminals
- Streamlined fare collection
- Fast dwell times

Issues:

- The costs of this program would be high and would require large subsidies.
- The program would require farebox recovery mandates to be met.
- This program works best in areas where a light rail system is not present.
- The program would not likely be implemented by the attainment date.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.12 Transit Transfer Centers with Extensive Suburban Coverage

Definition:

Development and implementation of transit transfer centers in areas that could support extensive suburban coverage to allow for increased ridership of transit from areas distant to the central business district. Weekday peak period bus routes and schedules would be better coordinated to minimize transfer times at these new centers. Bus routes would also be adjusted to provide better coverage of residential and employment areas near these centers.

Issues:

- Local issues and private sector involvement would need to extend past the 2005 timeframe for attainment.
- There is little time for build-out prior to 2005 attainment date.
- This program is local in nature and would require extensive funding and planning at the local level, which would delay immediate implementation.

Estimate of Emissions Benefits:

An estimate of the emissions benefits for this measure was not calculated due to the issues listed above.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.13 Shorter Distance to Buildings from Bus Stops

Definition:

This measure affects both existing and new buildings. Existing buildings would require a re-route of traffic to allow buses in close to the building. For new buildings, setback requirements would have to be altered. MWCOG assumed an increase in transit ridership of 6,000 people due to these changes.

Issues:

Changes in Existing Building Lots:

- The owners pay all the lot retrofit costs with little economic incentive
- Requires a large change in the timing of bus routes as the added time required to drive into smaller off street spaces will add time to each stop and would force changes to the entire schedule.
- In high traffic areas – re-entering road would be a problem and may lead to extensive system delays.
- May require new stops and this may alter the routes and increase overall transit travel times
- Will cause loss of parking spots near existing buildings.
- Will need Zoning Board of Appeals (ZBA) variance – public process takes time

Changes to New Lots:

- Zoning Changes require ZBA Process which takes time (for small changes on case by case basis) for setbacks
- May need legislative backing depending on current County Plan for large scale changes to setbacks
- Entire process could take several years depending on process variations (each county may utilize a slightly different process as well)

Other Issues:

- Changes in bus routes could be expensive and time consuming to implement
- The Baltimore region in general does not have a bus system as extensive as Washington and MWCOG predicted a gain of 6,000 daily riders by reducing walk trip average from three minutes to one.

Estimate of Emissions Benefits:

- Washington area benefits estimated at 0.138 tpd of VOC based on 6,000 new daily riders.
- Assuming ½ the expected COG ridership which would reduce 6,000 trips and cold starts and if the average trip was 3.5 miles then the expected Baltimore region emission benefits would be: 0.135 tpd NOx and 0.06 tpd VOC.

Cold Start Emissions

Trips	6000		
NOx	5472	Grams	Trips X .912gms
VOC	10404	Grams	Trips X 1.734gms

Running Emissions

VMT	21000		
NOx	20580	Grams	Trips X .98gms
VOC	7287	Grams	Trips X .347gms

Hot Soak Emissions

Trips	6000		
NOx	0	Grams	
VOC	3318	Grams	Trips X .553gms

Totals

NOx	0.028	tpd	Sum/ 907185
VOC	0.0231	tpd	Sum/ 907185

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.14 Access to Jobs Program

Definition:

This program identifies gaps in transit service between place of residence and place of work for low wage workers. As in many metropolitan areas, there is a spatial mismatch between urban poor and suburban job opportunities. This program is currently funded and implemented by both MDOT and the Baltimore MPO. Several pilot bus routes have recently been cut due to low ridership. Statewide, 21 diverse organizations have received grants to conduct access to jobs and reverse commute programs.

Issues:

- Benefits are difficult to quantify due to the program variables
- There is an annual funding variability built into the program
- A questionable single occupant vehicle conversion problem remains a large issue
- Recent bus routes in the program have been cut due to low ridership
- The program is expensive and funding has been earmarked for 1999-2001 in excess of 9 million dollars of state funds.
- Without ongoing public and private subsidy commitments, this program may not be sustainable.

Estimate of Emissions Benefits:

An estimate of the emissions benefits for this measure was not calculated due to the to the issues listed above.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

E.15 Local Bus Replacement – Howard County

Definition:

Bus replacement program for local buses operated in the Baltimore region (jurisdiction specific program).

Issues:

- Low estimate of emission reduction benefits will not likely lead to advancement of the attainment date
- County program is not easily tracked and does not apply to the entire region
- Funding is not guaranteed and only comes from MDOT as funding allows

Estimate of Emissions Benefits:

An estimate completed in 2000 showed potential benefits of 0.000 tpd of VOC and 0.012 tpd of NOx.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.16 Local Bus Replacement – Harford County

Definition:

Bus replacement program for local buses operated in the Baltimore region (jurisdiction specific program).

Issues:

- Low estimate of emission reduction benefits will not likely lead to advancement of the attainment date
- County program is not easily tracked and does not apply to the entire region
- Funding is not guaranteed and only comes from MDOT as funding allows

Estimate of Emissions Benefits:

An estimate completed in 2000 showed potential benefits of 0.000 tpd of VOC and 0.003 tpd of NO_x.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date..

E.17 Local Bus Replacement – Annapolis

Definition:

Bus replacement program for local buses operated in the Baltimore region (jurisdiction specific program).

Issues:

- Low estimate of emission reduction benefits will not likely lead to advancement of the attainment date
- County program is not easily tracked and does not apply to the entire region
- Funding is not guaranteed and only comes from MDOT as funding allows

Estimate of Emissions Benefits:

An estimate completed in 2001 showed potential benefits of 0.000 tpd of VOC and 0.003 tpd of NO_x.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.18 The College 33 Pass System

Definition:

Implementation of a college bus fare program that allows students to take advantage of a reduced fare system near some of the 19 participating schools located in the region.

Under this system, a monthly fare pass typically costing \$54 per month is reduced to \$33. In the year 2000, an increase of 236% occurred for these types of passes.

Issues:

- This system is currently in place, and few implementation issues exist at this time.
- Extension of this program depends on voluntary participation with schools, there are 13 schools not currently participating.

Estimate of Emissions Benefits:

The current estimation for 2005 emissions benefits are 0.014 tpd of VOC and 0.032 tpd of NOx.

Calculations:

The program will continue to be offered at 19 of the 32 colleges in the region.

The program will be expanded to additional colleges.

Recent sales are: October 1999 sales of 1,119 passes, April 2000 sales of 2,246, and July 2000 sales of 1,300

Estimated full/part-time students at participating institutions = 150,000

Estimated full/part-time employees at participating institutions = 25,000

Assumptions:

- Participation growth rate at 12.00% per year
- Share that change from auto = 65.00%
- One-way school trip average length = 8 miles
- One-way non-school trip average length = 4 miles
- Average travel speed = 30 mph
- Non-school trip participation = 15.00%
- Vehicle trip eliminated = 65%

	1999	2002	2005
Participants for an average weekday	1000	1405	1974
Participants who change means of Transportation	650	913	1283

Reductions from school trips

1999						
	VOC	0.72898 (gm/mile) X 10,400 miles =	7581.392 gm/day	0.008	tons/day	
	NOx	1.688 (gm/mile) X 10,400 miles =	17555.2 gm/day	0.019	tons/day	
2002						
	VOC	0.52598 (gm/mile) X 14,608 miles =	7683.5158 gm/day	0.008	tons/day	
	NOx	1.434 (gm/mile) X 14,608 miles =	20947.872 gm/day	0.023	tons/day	
2005						

VOC	0.4748 (gm/mile) X 20,528	miles = 9746.6944 gm/day	0.011	tons/day
NOx	1.292 (gm/mile) X 20,528	miles = 26522.176 gm/day	0.029	tons/day

Reductions from non-school trips

1999				
VOC	0.72898 (gm/mile) X 780	miles = 568.6044 gm/day	0.001	tons/day
NOx	1.688 (gm/mile) X 780	miles = 1316.64 gm/day	0.001	tons/day
2002				
VOC	0.52598 (gm/mile) X 1,096	miles = 576.26369 gm/day	0.001	tons/day
NOx	1.434 (gm/mile) X 1,096	miles = 1571.0904 gm/day	0.002	tons/day
2005				
VOC	0.4748 (gm/mile) X 1,540	miles = 731.00208 gm/day	0.001	tons/day
NOx	1.292 (gm/mile) X 1,540	miles = 1989.1632 gm/day	0.002	tons/day

Cold Start Reductions

1999				
VOC	2.90072 (gm/start) X 423	starts = 1227.0046 gm/day	0.001	tons/day
NOx	1.32471 (gm/start) X 423	starts = 560.35233 gm/day	0.001	tons/day
2002				
VOC	1.92783 (gm/start) X 593	starts = 1143.2032 gm/day	0.001	tons/day
NOx	0.95853 (gm/start) X 593	starts = 568.40829 gm/day	0.001	tons/day
2005				
VOC	1.74833 (gm/start) X 834	starts = 1458.1072 gm/day	0.002	tons/day
NOx	0.86519 (gm/start) X 834	starts = 721.56846 gm/day	0.001	tons/day

Hot Soak Reductions

1999				
VOC	0.86531 (gm/start) X 423	starts = 366.02613 gm/day	0.000	tons/day
NOx	NA (gm/start) X 423	starts = gm/day		tons/day
2002				
VOC	0.52408 (gm/start) X 593	starts = 310.77944 gm/day	0.000	tons/day
NOx	NA (gm/start) X 593	starts = gm/day		tons/day
2005				
VOC	0.43231 (gm/start) X 834	starts = 360.54654 gm/day	0.000	tons/day
NOx	NA (gm/start) X 834	starts = gm/day		tons/day

Total Reductions

1999	
VOC	0.011 tons/day
NOx	0.021 tons/day
2002	
VOC	0.011 tons/day
NOx	0.025 tons/day
2005	
VOC	0.014 tons/day
NOx	0.032 tons/day

RACM Determination:

Emissions reductions will not advance the attainment date.

E.19 Light Rail Double Tracking and Additional Vehicles

Definition:

Provide a second track for light rail lines and add vehicles to the line in an effort to shorten track times and add convenience which will add to transit ridership. Double tracking is currently on target for completion in 2006. Funds are being used to purchase 18 additional trains by 2002. This project, funded by TEA-21 (Federal Funds), will add 9.4 miles of second tracks, but will not expand the existing route mileage or the number of stations.

Issues:

- This project is already programmed and is being implemented in the Baltimore region.
- The project will not expand the routes nor add any new stations, it will simply increase the reliability of existing service levels
- This project is accounted for in the planning baseline
- Downtown line sections limit significant increases in frequency of service.

Estimate of Emissions Benefits:

This project is already found in the transportation-planning baseline. In addition, the project will not be completed until the year of attainment and will not expand the current service lines.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date. In addition, implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment

E.20 Bus Terminal at Penn Station

Definition:

Construction of a new bus terminal at Penn Station. This facility will function as an intermodal center with access to bus, train, local bus, and light rail lines, integrated with retail/office/hotel complex. The project will be completed in mid-2002.

Issues:

- This project is underway, and limited implementation issues exist.
- The estimated emission benefits are limited and would not likely advance the attainment date

Estimate of Emissions Benefits:

The current estimate for 2005 emissions benefits are 0.0068 tpd of VOC and 0.0215 tpd of NOx.

Calculations

Assume 7.5 miles as average commute distance, 15 miles round trip
 Total VMT is 15,000 VMT saved per day

Assume vehicle traffic at 35 mph

Milestone Year	2002	2005
VOC Stabilized Running Emission Factors	0.455	0.412
NOx Stabilized Running Emission Factors	1.441	1.299
Calculation of grams/day		
VOC x 15000 VMT	6825	6180
NOx x 15000 VMT	21615	19485
Convert to tons/day Benefits =		
VOC	0.008	0.0068
NOx	0.024	0.0215

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.21 MARC Improvements –50 new bi-level cars

Definition:

Purchase 50 new bi-level passenger cars for the MARC system to offer more carrying capacity to accommodate increased ridership. These high capacity cars will increase MARC carrying capacity up to 50%, and will not result in headway reductions.

Issues:

- This program is being implemented, minimal implementation issues exist.
- The estimated emission benefits are low and would not likely advance the attainment date.

Estimate of Emissions Benefits:

The current estimation for 2005 emissions benefits are 0.014 tpd of VOC and 0.052 tpd of NOx.

Calculations:

The MTA has received 50 bi-level commuter coaches. The bi-level coaches increase the seating capacity of a coach from 95 to 134 seats. It is believed that additional seating capacity will induce additional patrons.

Increased seating capacity for 2 peak period trains = 4602
 Percent seating capacity used by commuters shifting to MARC = 0.35
 Average one-way commute = 11 (most riders pick up the MARC closer to the city)
 VMT eliminated due to induced patrons = 35435.4
 Emission factors at 40 mph

2002			
VOC	0.39998 (gm/mile)	X 35435.4 miles =	14173.45 gm/day 0.016 tons/day
NOx	1.468 (gm/mile)	X 35435.4 miles =	52019.17 gm/day 0.057 tons/day
2005			
VOC	0.3628 (gm/mile)	X 35435.4 miles =	12855.96 gm/day 0.014 tons/day
NOx	1.323 (gm/mile)	X 35435.4 miles =	46881.03 gm/day 0.052 tons/day

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.22 MTA Online Transit Pass Store

Definition:

Development of an MTA store for use online that sells transit passes making it easier in essence for some people to purchase passes from any computer terminal in an attempt to increase ridership.

Issues:

- The effects of this program are difficult to quantify as the benefits would come from new riders that directly purchased the passes due to the ease of online service. Surveys would be needed to determine the benefits.

Estimate of Emissions Benefits:

An estimate of emissions benefits was not calculated for this strategy because of the difficulty in formulating assumptions of new riders due only to online purchase capabilities. The benefit is probably less than .001 tpd of NOx and VOC.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

E.24 MTA Email Computer Service

Definition:

Development of a program that gives service alerts to those people who sign up for this service from MTA. The goal of the program is to increase transit ridership and provide better traffic information to the public.

Issues:

- The effects of this program are difficult to quantify as the benefits would come from new riders generated from this particular service only. Surveys would be needed to determine the benefits.
- Expensive program in development and implementation, measure is currently not yet optimized.

Estimate of Emissions Benefits:

An estimate of emissions benefits was not calculated for this strategy because of the difficulty in formulating assumptions of new riders due only to online purchase capabilities. The benefit is probably less than .001 tpd of NOx and VOC.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

E.25 Upgrade New Fleet of Metro Subway Cars

Definition:

In the summer of 2000, the MTA began to upgrade program in a new fleet of 75 foot, 76,000 pound Metro subway cars. Most of the upgrades are mechanical; however, some of the upgrades include rider amenities (new floors, seats, etc.). The project is occurring at a cost of over \$80 million and is scheduled for completion in 2003.

Over the next several years, the Mass Transit Administration will be overhauling the Metro-rail cars in the Baltimore fleet. Because the railcars are 15 years old, the overhaul is necessary to help meet the vehicle life of 30 years. The overhaul of the 100 vehicles in the fleet is needed to enable MTA to replace components that are deteriorated and/or outdated technology. Additional improvements include replacing the floor, seats, brakes, axles, HVAC systems and other interior changes in the vehicles. As a result the public will find that the vehicles are safer, more reliable, more comfortable and more attractive.

Issues:

- Program is currently implemented and funded and will likely help to maintain ridership levels and may encourage future ridership growth.
- The program is expensive and it is not likely that the program can be advanced for a shorter timeframe (more credit)
- The expected emissions benefits are limited and will not likely advance attainment

Estimate of Emissions Benefits:

In other regions, federal agencies have approved the assumption that additional ridership of approximately 10% would be generated by these type transit vehicle improvements. In

order to take a conservative approach however, an increase in ridership of 5% will be applied to the improvement in the Metro vehicles in the Baltimore region. A benefit of .005 tpd of VOC and .02 tpd of NOx is estimated.

Calculations:

Assumptions:

5% increase in ridership because of improvements

47,483 riders on the Baltimore METRO during an average day.

New vehicles will be put into service between 2002 and 2005.

Average transit trip length: 6.92 miles, peak hour vehicle occupancy 1.2

Emissions factor at 40 mph average speed: VOC: .363 g/m NOx: 1.323 g/m

$47,483 \times .05 = 2,374$ additional riders

$2,374 / 1.2 = 1,978$

$1,978 \times 6.92 = 13,688$ VMT

$13,688 \text{ VMT} \times .363 \text{ gms} = 0.005 \text{ tpd VOC SAVED}$

$13,688 \text{ VMT} \times 1.323 \text{ gms} = 0.02 \text{ tpd NOx SAVED}$

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Maintenance programs such as this are not enhanced by inclusion in the SIP.

E.26 ATM Machines Installed at Metro Stations

Definition:

Installation of ATM machines near Metro stations for the purpose of providing a convenience for Metro riders.

Issues:

- Tracking the benefits of the program would be difficult to quantify
- This type of measure is part of a supporting amenity program for all the transit activities in the region
- Ridership changes would likely be limited and would not likely advance attainment.

Estimate of Emissions Benefits:

This measure was rejected based on the implementation issues above, therefore emission benefits were not calculated. A survey would be needed to calculate the benefits.

RACM Determination:

Emission benefits from this program are not sufficient to advance attainment.

E.27 Cromwell Light Rail Maintenance and Layover Facility

Definition:

Construction of a light rail maintenance and layover facility in the Cromwell area of Glen Burnie, Maryland. Project will accommodate the growth of MTA Light Rail service through the operation of 18 recently acquired Light Rail vehicles, and result in better staging and management. Project may change transit schedules and may offer better service which may enhance ridership.

Issues:

- Program benefits are difficult to quantify.
- Emission credits would likely be limited and would not likely advance attainment.

Estimate of Emissions Benefits:

Current estimations show a benefit of .01 tpd of VOC and .04 tpd of NOx.

Calculations:

Projected 2000 auto traveling an average trip length of 7 miles x 2 trips = 28,000 daily VMT

	2002	2005
VOC Stabilized Running Emission Factors	0.455	0.412
NOx Stabilized Running Emission Factors	1.441	1.299
Calculation of grams/day		
VOC x 28000 VMT	12740	11536
NOx x 28000 VMT	40348	36372
Convert to tons/day Benefits =		
VOC	0.0140	0.0127
NOx	0.0444	0.0401

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

E.28 Downtown Transit Store

Definition:

Construction of a transit store located in the downtown CBD that would offer transit tickets in an effort to enhance ridership.

Issues:

- Tracking the benefits of the program would be difficult to quantify.
- New ridership would likely be limited and would not advance attainment.

Estimate of Emissions Benefits:

An estimate completed in 2000 showed a potential benefit of 0.003 tpd of VOC and .008 tpd of NOx.

Calculations:

Approximately 5000 people are served by the store each month.

Based on recognition of transit store operations in other regions the region can take credit for the additional transit riders generated by the facility. In order to analyze the stores benefits we used the results of a survey of transit stores done in Arlington Va., as an emission analysis work done by MWCOG as an example. In VA, the Arlington transit store had 42,000 walk-ins generating 406 new transit riders. Assuming the same ratio the Baltimore store with 60,000 anticipated entrants would generate 390 new transit riders in a year.

- Number of annual walk-ins = 60,000
- Percent of new transit riders = 0.65%
- Number of new riders on average weekday = 390
- Average trip length = 15 miles
- Estimated reduced VMT = 5,850

1999		
VOC	0.62998 (gm/mile) X 5850 miles =	3685.383 gm/day = 0.004 tons/day
NOx	1.699 (gm/mile) X 5850 miles =	9939.15 gm/day = 0.011 tons/day
2002		
VOC	0.45498 (gm/mile) X 5850 miles =	2661.633 gm/day = 0.003 tons/day
NOx	1.441 (gm/mile) X 5850 miles =	8429.85 gm/day = 0.009 tons/day
2005		
VOC	0.4118 (gm/mile) X 5850 miles =	2409.03 gm/day = 0.003 tons/day
NOx	1.299 (gm/mile) X 5850 miles =	7599.15 gm/day = 0.008 tons/day

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

F. Employer Based Transportation Plans

F.1 Commuter Choice

Description:

Promote the institution of Commuter Choice programs. Commuter Choice programs refer to any one option or combination of options an employer may offer an employee to encourage commuting options other than single occupant vehicle (SOV). Typical Commuter Choice options include pre-tax transit passes, subsidized transit passes, ridesharing programs, benefits to car/vanpool such as parking preference, guaranteed ride home, cash-in-lieu of parking, and others.

Issues:

- Maryland state legislation supports this program.
- Requires education/outreach effort to private and public sector and to the public at large to maximize usage.
- Studies show a mix of results of Commuter Choice programs. Findings of a study of employers, employees, and developers, including focus groups in the Baltimore region, showed unfavorable findings on willingness to change modes (*Exploring Reactions Toward Commuter Choice Among Commuters, Employers, & Developers*, Equals Three Communications, October 2000). While this assessment of current attitudes does not exclude the implementation of commuter choice programs, it demonstrates the need (and time required) for education and outreach. However, other studies, primarily in California, demonstrate a mode shift from SOV to HOV or transit when commuter choice type programs are instituted (Shoup, 1997).
- Funding is dedicated to this program beginning in FY2001.

Estimate of Emissions Benefits:

MDOT is currently reviewing the potential emission benefits from this program. However, the analysis will not be completed in time for this assessment. The benefits of this program, in it's early implementation stages, will not be sufficient to advance attainment.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. This measure is under consideration for inclusion in the SIP.

F.2 Five Elements of Jurisdictional Level Commuter Choice

Description:

Institute the following:

1. Adopt a program that enables the local, state, or municipal employees of each jurisdiction to purchase transit and van benefits using pre-tax dollars, as provided by US tax code.
2. Provide non-taxable transit and qualified vanpool benefits up to the limit established in the US tax code, for all local, state, or municipal employees of each jurisdiction.
3. Provide the option of receiving added taxable cash income in lieu of parking for all local, state, or municipal employees of each jurisdiction who receive free parking at their workplace, as permitted by the US tax code and as encourage for private employers through Maryland tax credit
4. Adopt a requirement that recipients of contracts from the jurisdiction make available to their employees any Commuter Choice incentives that are eligible for Maryland state tax credits
5. Revise local zoning, parking, and other relevant codes and requirements related to development approvals so that when applying minimum parking or traffic mitigation obligations, appropriate credit is offered for long-term enforceable commitments by developers, property owners, and tenants for employer paid transit and cash-in-lieu of parking incentives.

Issues:

- Includes administrative procedural changes (i.e., personnel staff, training, and marketing)
- Funding requires support/approval of county/city councils (at a minimum to include start-up costs); requires education on Commuter Choice issues; includes time for approval process
- Cash in lieu of parking: please see F.3.
- May require opportunity to discuss programs/benefits with employee unions
- Requires review of potential contract issues for requiring 3rd party contract recipient to use/institute Commuter Choice programs; includes evaluation of degree of fiscal impact, economic burden for contract recipients, and/or ability to meet contract requirement in the short-term
- Zoning changes must occur through the local zoning process that differs in each jurisdiction. Zoning changes occur in cycles, each which can take several years (please see zoning section, Appendix D) with cycles at different stages between jurisdictions.
- Zoning/parking changes may require review of viability for commercial lending practices to address potential impacts to economic development.
- Benefits to employee may help with recruitment and retention.

Estimate of Emissions Benefits:

Estimated emissions benefits are 0.015 tpd VOC and 0.048 tpd NOx. This estimate assumes some degree of initiation of the above listed measures. However, the majority of activities listed above cannot be implemented in a timeframe for the effects of the activities to advance attainment. Depending of the degree of implementation and the degree of participation, the range of emissions benefits is estimated to be between 0.015–0.021 tpd VOC and 0.048–0.065 tpd NOx. The greater estimates assume 65% amenable work sites and 5% participation. In addition, please note that participation by local employees is assumed as part of the state Commuter Choice program, in line with marketing and initiation of Commuter Choice programs on the national level (see F.2.).

Calculations:

Framework for emissions estimates taken from EPA methodology, see *State Implementation Plan Development Guidance: Using Emissions Reductions from Commuter Choice Programs to Meet Clean Air Act Requirements*, EPA-420-R-98-007, December 1998). Additional (local) data may be needed to refine estimates.

Commuter Choice Tax Benefit Program

Local Government workers in Baltimore region in 1997 = 85,000

	2002	2005	2015	2020
Labor Force estimation of program region	88,894	91,316	99,876	105,392
Percent of Labor Force commute to work at all in the traditional sense	60%	60%	60%	60%
Percent of Labor Force commuting to Baltimore region	100%	100%	100%	100%

Percent of Labor Force commuting to work in SOV	85%	85%	85%	85%
Percent of Labor Force where employer work sites would offer commuter choice options	60%	60%	60%	60%
Percent of Labor Force participating in Commuter Choice	4%	4%	4%	4%
Number of workers switching from SOV to other mode	1,088	1,118	1,222	1,290
Average one-way HBW commute in the Baltimore region	15	15	15	15
Total VMT reduced	32,640	33,540	36,660	38,700
Emission Factors at 35 mph				

2002	VOC	0.45498 (gm/mile) X	32,640 miles =	14850.5472 gm/day	0.016 tons/day
	NOx	1.441 (gm/mile) X	32,640 miles =	47034.24 gm/day	0.052 tons/day
2005	VOC	0.4118 (gm/mile) X	33,540 miles =	13811.772 gm/day	0.015 tons/day
	NOx	1.299 (gm/mile) X	33,540 miles =	43568.46 gm/day	0.048 tons/day

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in a timeframe for emissions benefits to advance attainment. Some degree of participation yields emissions benefits of an amount not sufficient to advance attainment.

F.3 Discounted Pre-Paid Transit Fare Instruments

Description:

Institute/promote method for employers to provide transportation vouchers (i.e., for alternatives to SOV).

Issues:

- Maryland state legislation supports this program.
- Requires education/outreach effort to private and public sector and to the public at large to maximize usage.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

F.4 Mandatory Employer Cash Out

Description:

Require all employers with 100 or more employees to achieve a 25% increase in their employees' average vehicle occupancy, or a 20% decrease in their employees' home-based work trips.

Issues:

- Requires enabling state legislation.
- Low political feasibility.
- Would place Baltimore region at an economic disadvantage relative to neighboring regions without such mandated controls.
- Could not be implemented at all, or in a timeframe to advance attainment.

Estimate of Emissions Benefits:

1994 estimates show 1.763 tons/day VOC and 2.718 tons/day NOx. Approximate associated cost is \$9 million. Calculations were not updated in 2001 because of low political feasibility.

RACM Determination:

This measure was rejected due to implementation issues identified above.

F.5 Employer Provided Bicycles

Description:

Require employers to provide at least one bicycle for every 50 employees for mid-day employee business and personal use.

Issues:

- Requires state enabling legislation to ensure uniform implementation.
- Program may be difficult to apply to existing building owners/occupants.
- Voluntary program is not expected to yield significant emissions benefits.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

This measure was rejected due to implementation issues identified above.

F.6 Flexible Work Week

Description:

Encourage employees to schedule their workdays so that they travel during the off-peak hours or adopt a shorter workweek of 4 ten-hour days.

Issues:

- May provide other, non-air quality benefits for the employer such as increased morale, drop in tardiness, better retention. Benefits for the employee may include ability to schedule personal time and potential financial benefits if commute trips are reduced.
- Benefits to air quality are not guaranteed for two reasons: (1) potential increase in non-work trips; and (2) loss of car/vanpooling and transit usage due to off-peak/variable hours.
- Many employers (17%) in the Baltimore region have already instituted this policy, others use an informal policy. (Baltimore Region Telecommuting Baseline Study, September 1999)

Estimate of Emissions Benefits:

1994 estimates show 0.263 tons/day VOC and 0.406 tons/day NOx. Approximate associated cost is \$1.1 million. Calculations were not updated in 2001 due to the rejection of this measure as a reliable emission reduction strategy for the reasons listed above.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

F.7 Regional Telework Centers

Description:

Establish 6 telework centers in outlying areas of the Baltimore region. The centers would be shared by numerous employers, and would serve as satellite offices for employees who would not travel to their regular offices every day.

Issues:

- While it is possible to build the assumed telecenters in the region by 2005, it is unlikely that utilization of these facilities could achieve the levels assumed in this strategy.
- The market viability of such centers in the region is questionable given the findings of the Baltimore Region Telecommuting Baseline Study that documented only nominal telecenter use in the region.
- Technology advancements in recent years have greatly increased the practicality and lowered the cost of home-based telecommuting – thus reducing the viability of telecenters.

Estimate of Emissions Benefits:

Estimated reductions are 0.0151 tons/day VOC, and 0.0456 tons/day NOx. Estimated 1994 cost is \$15 million (primarily capital/start-up/equipment).

Assumptions for 2005 Telework Centers RACM:

1. Construction of a system of six telework centers in the Baltimore region by 2005. This system is based on prototype developed and analyzed in 1994 by BMC.

2. Capacity of each telework center is 100 work stations to accommodate up to 100 full time teleworkers (or a larger number of part time users). Each center would have the potential to be expanded.
3. Utilization of telework centers in 2005 is assumed to be 100%.
4. Calibration of the Telework Center EMS strategy is based on the findings of the 1999 Baltimore Region Telecommuting Baseline Study.

Year 2005 Emission Reduction Analysis

Daily telecenter users = 100 employees x 6 telecenters x 1.00 days/wk = 600 daily telecenter users

Average miles reduced on way = 27.9 mi/trip to central workplace – 2.5 mi/trip to telecenter = 25.40 mi/trip

VT reduced = 600 teleworkers x 2 VT/day = 1,200 VT/day

30,480 VMT reduced x 0.363 g/mi = 11,064 VOC g/day = 0.0122 t/day

30,480 VMT reduced x 1.323 g/mi = 40,325 NOx/day = 0.0445 t/day

1,200 VT reduced x 2.180 g/t = 2,616 VOC g/day = 0.0029 t/day

1,200 VT reduced x 0.865 g/t = 1,038 NOx g/day = 0.0011 t/day

2005 VOC reduction = 0.0122 + 0.0029 = 0.0151 t/day

2005 NOx reduction = 0.0445 + 0.0011 = 0.0456 t/day

RACM Determination:

The associated estimated emission reductions are not sufficient to advance the attainment date.

F.8 Financial Incentives for Telework Programs

Description:

Offer financial incentives to private sector employers to establish telework programs. Includes providing tax credits and low or no interest rate loans to private sector employers who implement home-based telework programs to help cover first-year start up costs.

Issues:

- The state of Maryland has adopted a telework program which seeks participation by 10% of eligible state employees, but does not offer incentives
- Legislation to provide employer incentives to increase telework in Maryland has not been successful to date.

Estimate of Emissions Benefits:

1994 estimates show a reduction of 0.071 tons/day VOC and 0.109 tons/day NOx. Approximate associated cost ranges from \$3 to \$12 million. Calculations were not updated in 2001 because legislation to offer telework incentives has not been successful.

RACM Determination:

Implementation issues hinder the ability to implement this strategy in time to advance attainment. Estimated emission reductions are not sufficient to advance the attainment date.

F.9 The BWI Business Partnership – Van Shuttle

Description:

Provide shuttle service throughout the Baltimore/Washington International Airport (BWI) business district. The service currently serves a daytime population of over 150,000 employees and visitors to the area (service provided by a non-profit TMA). Currently includes 3 routes (2 Spirit Shuttle, 1 Link), which connect to area commuter rail and major employers and a large retail center. The service is free.

Issues:

- Benefits from this measure depend on voluntary private sector participation for funding, which may interfere with viability as a control measure.
- Limited implementation issues involved in implementing an individual shuttle service.
- It may be difficult to uniformly expand this type of service to a regional scale through employer funding.

Estimate of Emissions Benefits:

Estimated benefits are 0.001 tons/day VOC, and 0.004 tons/day NOx.

Calculations:

Average Trip = 14

Estimated Round trip = 28

Usage = 100 by 1999, 200 by 2015

Average Speed 40 mph

100 users X 28 average two-way commute= 2800

1999

VOC 0.55298 (gm/mile) X 2800 miles = 1548.344 gm/day = 0.002 tons/day

NOx 1.73 (gm/mile) X 2800 miles = 4844 gm/day = 0.005 tons/day

2002

VOC 0.39998 (gm/mile) X 2800 miles = 1119.944 gm/day = 0.001tons/day

NOx 1.468 (gm/mile) X 2800 miles = 4110.4 gm/day = 0.005tons/day

2005

VOC 0.3628 (gm/mile) X 2800 miles = 1015.84 gm/day = 0.001 tons/day

NOx 1.323 (gm/mile) X 2800 miles = 3704.4 gm/day = 0.004 tons/day

RACM Determination:

Emissions benefits from this program are not sufficient to advance the attainment date.

F.10 Telework Partnership with Employers

Description:

Provide bi-regional program (Baltimore and Washington, DC) to assist large and small employers to establish home-based telecommuting programs for their employees. Program is currently established for 18-24 months

Issues:

- Since the program is active in the area, limited implementation issues exist.
- Funding available to support consultant assistance for regional companies.

Estimate of Emissions Benefits:

Estimate of benefits is 0.100 tons/day VOC and 0.490 tons/day NOx. Cost of the current program is \$1.2 million.

RACM Determination:

Emissions benefits for the program are limited in the early stages of implementation and not sufficient to advance the attainment date.

F.11 Guaranteed Ride Home Program

Description:

Promote voluntary employer-based programs in which the employer ensures that employees who rideshare or use transit will have a ride home during and after normal work hours in cases of emergency or unscheduled work need. Participation in GRH Programs is often based on frequency of rideshare or transit use by employee.

Issues

- Requires voluntary participation by employers, thereby affecting reliability of credits for attainment
- GRH tends to support existing transit and rideshare usage instead of encouraging expanded alternative commute use
- It may be difficult to document changes in alternative commute use based on the presence or absence of GRH programs and/or ensure continuation of program or participation.

Estimate of Emissions Benefits:

Estimated emissions reductions are 0.0069 tons/day VOC and 0.0181 tons/day NOx.

Calculations:

1. Early implementation of a GRH program by 2005 would be focused on the large (100+) employer group. This GRH program is assumed to be only partially integrated into a regional commuter assistance program like the MWCOG

Commuter Connections by 2005. GRH programs would be implemented by individual employers who elect to use Maryland GRH tax credit provisions.

2. 2000 employer-provided GRH program is provided by 3% of employers with 100+ employees in the region. (Source: Baltimore Region Telecommuting Baseline Study)

2000 employers in 100+ employer group = 1,757 employers (Source: 2001 D&B)

2000 average employees per employer in 100+ employer group = 580,223 employees / 1,757 employers = 330 av. (Source: 2001 D&B)

1000 employers offering GRH to employees = 1,757 employers x 0.03 = 53 employers

2000 employees participating in GRH program = 53 employers x 330 employees x 0.03 = 524 employees participating in GRH in 2000

3. 2005 100+ employer and employee growth is proportional to the total increase in projected 2005 employment (Source: BMC Round 5-C)
4. 1,522,200 employees / 1,450,600 employees = 1.0495 x 2000 employer/employee data 2005 100+ employers = 1,757 employers x 1.0495 = 1,844 100+ employers
5. Employer and employee participation in GRH program in 2005 is assumed to increase by 33% (over 2000 level) as a result of more aggressive promotion of GRH and other provision of 1999 and 2000 Maryland Commuter Assistance laws. 2005 participation rate = 0.30 x 1.33 = 0.40

1,844 employers x 0.04 = 74 employers offering GRH program in 2005

74 employers x 330 employees = 24,420 employees in 2005

24,420 employees x 0.04 GRH participation rate = 977 employees participation in GRH program in 2005

6. Net increase in GRH program usage between 2000 and 2005
977 employees – 524 employees = 453 net additional employees participating in GRH program in 2005

Average miles reduced one way = 13.00 miles (Source: BMC Travel Demand Model Validation Report)

VT/day reduced = 453 additional GRH program carpoolers x 2 VT/day = 906 VT/day

VMT/day reduced = 453 additional GRH program carpoolers x 2 VT/day = 906 VT/day
906 VT/day

11,778 VMT reduced x 0.363 g/mi = 4,275 VOC g/day = 0.0047 t/day

11,778 VMT reduced x 1.323 g/mi = 15,582 NOx g/day = 0.0172 t/day

906 VT reduced x 2.180 g/t = 1,975 VOC g/day = 0.0022 t/day

906 VT reduced x 0.865 g/t = 784 NOx g/day = 0.0009 t/day

2005 VOC reduction = 0.0047 + 0.0022 = 0.0069 t/day

2005 NOx reduction = 0.0172 + 0.0009 = 0.0181 t/day

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

F.12 Mills Corporation Activities**Description:**

A strategy developed by the Mills Corporation, entitled the Trip Reduction Program (Program). The Program is designed to provide infrastructure for modes of travel other than single occupancy vehicles for employees commuting to the Arundel Mills Mall and for commuters traveling within Anne Arundel County and other parts of the Baltimore region. These activities include a free commuter park-and-ride lot at the Arundel Mills Mall to serve commuters who travel from the Baltimore and Washington, D.C. metropolitan areas (up to 600 parking spaces including security, signage, and a waiting area for the lot), carpool/vanpool ride-matching, participation in Guaranteed Ride Home Program, expansion of existing BWI Partnership Link Shuttle Service from the BWI Light Rail Station to connect to Arundel Mills Mall, broadcasting MDE's ozone alert information, providing pre-tax transit passes to employees, and more.

Issues:

- Program is provided by an employer, the Mills Corporation, and is only committed until 2002.
- Success of the program is determined by private sector employer and depends on voluntary cooperation.

Estimate of Emissions Benefits:

Estimated benefits are 0.010 tons/day VOC, and 0.040 tons/day NOx for 2002.

Calculations:

Employee Trip Emission Reductions = Number of Employees * Percent Utilization * Vehicle Miles of Travel * Emission Factors (grams per mile)

# of Empl-oyees	% Utiliz-ation	Daily VMT ¹		VOC Emission Factors ²		VOC Emission Reductions		
		Highway	Local	Highway	Local	Grams/Day	Kilograms/Day	Tons/Day
3,500	10%	7,000	3,500	0.400	0.760	5,460	5.5	0.006
				NOx Emission Factors		NOx Emission Reductions		
				1.468	1.482	15,463	15.5	0.017

¹ Assumes a Highway trip of 10 miles and a Local trip of 5 miles.

² Assumes a Highway speed of 40 mph and Local speed of 20 mph.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date, and may be transient.

F.13 TransitPlus Program

Description:

Continue initiative (MTA program) that permits participating employees and employers to receive increased federal tax benefits along with reduced transit fares and reduced vanpool commute costs. Specifically, employees can save up to 42% of their annual commuting cost by purchasing TransitPlus monthly passes with pre-tax dollars. Employers benefit by saving approximately 10% on payroll taxes.

Issues:

- As this program currently exists, limited implementation issues exist.

Estimate of Emissions Benefits:

Emissions benefits from this program are already captured in the SIP baseline.

RACM Determination:

Since the emission reductions are captured in the baseline, no emission benefits exist and the measure will not advance attainment.

F.14 Free Parking for Carpools and Vanpools

Description:

Require employers to provide free parking for carpools and vanpools

Issues:

- Requires state-enabling legislation and cannot be implemented in timeframe to advance attainment.
- Low political feasibility.

Estimate of Emissions Benefits:

1994 estimates show 0.031 tons/day VOC and approximately .09 tpd of NOx. Calculations were not updated in 2001 due to the low political feasibility of this measure.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

G. Road and/ or Lane Restrictions

G.1 Congestion Pricing for Low Occupancy Vehicles

Description:

Implement the following: (1) eliminate toll charges for all HOV-2 plus vehicles during peak periods; (2) provide express lanes at toll plazas to reduce or eliminate delays for HOV-2 plus vehicles; and (3) continue the sale of discount toll tickets to non-HOV operators who would continue to use non-express toll lanes.

Issues:

- Requires state enabling legislation and cannot be implemented in timeframe to advance attainment
- Questionable political feasibility
- Questionable equity impacts
- MDTA has a bond holder requirement to satisfy and is limited in options to waive tolls.

Estimate of Emissions Benefits:

1994 estimates show 0.023 tons/day VOC and approximately .06 tons/day NOx. Calculations were not updated in 2001 due to the low political feasibility of this strategy.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

H. HOV Program Improvements

H.1 Build HOV Network on the Freeway System

Description:

Build/implement an HOV network on the Freeway System.

Issues:

- I-95 Corridor Study is currently underway. Preliminary reactions to study indicate that implementation by 2005 is politically infeasible.
- Future implementation of HOV lanes in the region will be determined by public acceptance of the HOV concept.
- HOV lanes for I-95 and portions of I-695 are currently included in the 1998 BRTP for future implementation.
- Strong political opposition to HOV lanes.
- Additional HOV lanes provide additional capacity.

Estimate of Emissions Benefits:

1994 estimates show 0.188 tons/day VOC and approximately .5 tons/day NOx. Calculations were not updated in 2001 as the political feasibility is low.

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

H.2 Vanpool Improvements

Description:

Institute a number of vanpool-related improvements, including (1) establish a regional vanpool insurance program; (2) provide free license plates for registered vanpool vehicles; (3) provide state fuel tax exemptions for registered vanpools; (4) provide low or no interest rate loans to cover vanpool start-up costs; (5) designate vanpool pickup sites in CBD areas and in other major activity centers; (6) establish a van loaner program to support owner operators during maintenance and emergency conditions; (7) and provide accelerated depreciation or investment tax credit for employers/owner-operators providing vanpool vehicles.

Issues:

- Some aspects of this program require legislation and cannot be implemented in a timeframe to advance attainment
- Administratively burdensome.

Estimate of Emissions Benefits:

1994 estimates show 0.259 tons/day VOC and 0.398 tons/day NOx. Estimated cost for this control measure is \$3.6 million. Calculations were not updated in 2001 because legislative changes to support programs have not been introduced to the assembly.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

H.3 Integrated Ridesharing Measures

Description:

Integrate a number of related strategies to enhance ridesharing capabilities in the region, including (1) create and fund new TMAs or satellite ridesharing centers to provide more responsive rideshare promotion/management services to previously underserved employers and employees; (2) increase financial support of existing TMAs to strengthen ridesharing services; (3) upgrading regional rideshare computer equipment; and (4) fund a regional guaranteed ride home program.

Issues:

- Implementation requires a regional and state commitment to a coordinated regional program with ongoing funding.
- Full implementation of program may not be possible in time frame that would permit advancement of the attainment date.

- A regional rideshare program would compete for financial support with continuing local staff who support other activities.

Estimate of Emissions Benefits:

1994 estimates show 0.061 tons/day VOC and 0.103 tons/day NOx. Estimated cost for this control measure is \$941,000. Calculations were not updated in 2001 because this strategy is not cost effective

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

H.4 Baltimore Regional Rideshare Program

Description:

Continue current program where local rideshare coordinators provide ridesharing information and assist employers and employees in identifying opportunities for other emission-friendly strategies such as flexible work hours, telecommuting, and the commuter choice tax benefit program.

Issues:

- Program is in place in the Baltimore region; therefore, limited implementation issues exist.
- Program does not currently have the mandate of funding needed to further increase its overall effectiveness.

Estimate of Emissions Benefits:

Estimated emissions benefits are 0.000 tons/day VOC and 0.006 tons/day NOx. Emissions reductions are not sufficient to advance the attainment date.

Calculations:

TIP	Applicants	Success rate	Vehicle trips reduced
1997-01 TIP	1200	0.398	478
1998-02 TIP	1400	0.398	557
1999-03 TIP	1500	0.398	597
2000-04 TIP	1550	0.398	617
2001-05 TIP	2300	0.398	915
Total trips reduced			3164
Percent of trips continued in horizon year			11.8%
1997-01 TIP	56		
1998-02 TIP	66		
1999-03 TIP	70		

2000-04 TIP	73		
2001-05 TIP	108		
Average Trip Length one way (miles)			14
VMT reduced			5227

Emissions factors at 40 mph

1997-01 TIP

2005

VOC	0.3628	(gm/mile) X	789	miles =	286.2475	gm/day	=	0.000	tpd
NOx	1.323	(gm/mile) X	789	miles =	1043.841	gm/day	=	0.001	tpd

1998-02 TIP

2005

VOC	0.3628	(gm/mile) X	920	miles =	333.9554	gm/day	=	0.000	tpd
NOx	1.323	(gm/mile) X	920	miles =	1217.814	gm/day	=	0.001	tpd

1999-03 TIP

2005

VOC	0.3628	(gm/mile) X	986	miles =	357.8093	gm/day	=	0.000	tpd
NOx	1.323	(gm/mile) X	986	miles =	1304.801	gm/day	=	0.001	tpd

2000-04 TIP

2005

VOC	0.3628	(gm/mile) X	1019	miles =	369.7363	gm/day	=	0.000	tpd
NOx	1.323	(gm/mile) X	1019	miles =	1348.294	gm/day	=	0.001	tpd

2000-04 TIP

2005

VOC	0.3628	(gm/mile) X	1512	miles =	548.641	gm/day	=	0.001	tpd
NOx	1.323	(gm/mile) X	1512	miles =	2000.695	gm/day	=	0.002	tpd

RACM Determination:

Estimated emissions reductions are unlikely to advance the attainment date.

H.5 Park and Ride Lots

Description:

Establish park and ride lots throughout the region.

Issues:

- This measure is currently in place and there are limited implementation issues.
- Demand and funding levels will determine rate of future construction activity.
- Survey under way to assess catchment areas for various park and ride lots which will help to determine future locations.

Estimate of Emissions Benefits:

Based on 2001 emission estimates, the benefits of the above program would be .03 tpd of VOC and .12 tpd of NOx.

Technical Assumptions

1. An off-model (sketch planning) method is used to test the emission reduction potential of this program. This method permits program and testing assumptions and calculations to be externalized for review.
2. It is assumed that the additional P&R spaces to be constructed in this program will yield a similar VMT reduction potential as the FY 1990 - FY 1996 P&R projects analyzed at the request of the Maryland Department of the Environment (MDE) in 1993. (See table below.) The additional Park & Ride spaces to be constructed will be approximately 75% transit-related and 25% HOV/bus-related.
3. The 3-step method specified by the MDE in a March 30, 2000 letter to Gene Bandy is used for calculating the emission reductions in the program for the years 2005, 2015 and 2020.
4. The 8-vehicle class mobile source emission factors for VOC, CO and NOx for the years 2005, 2015 and 2020 are from the Mobile 5B model, and are the same as those specified in the above referenced letter.

VMT Reductions from FY 1990 - FY 1996 TIP Park & Ride Projects

The VMT reduction information in this table is currently used for estimating the emission reduction potential of the un-built Park & Ride spaces in 1998 Long Range Plan

Project Name	TIP Project	VMT	VMT	VMT
<u>Transit-Related Projects</u>				
Central Light Rail Transit System (3,056 P&R)	40-9001-69	157,003 VMT	18,709 VMT	138,294 VMT
MARC Commuter Rail Service Expansion (Perryville Extension) (650 P&R)	CC-01-T	37,955 VMT	3,250 VMT	34,705 VMT
MARC BWI Station Parking Garage (1,500 P&R)	70-9326-82	39,512 VMT	7,500 VMT	32,012 VMT
Penn Station Parking Garage (530 P&R)	12-9326-02	24,168 VMT	1,590 VMT	22,578 VMT
New Relay Station (800 P&R)	70-9310-82	25,924 VMT	4,000 VMT	21,924 VMT
MARC Dorsey Station	70-9312-82	26,536 VMT	5,000 VMT	21,536 VMT

(1,000 P&R)

Odenton Station Parking Expansion - West (800 P&R)	70-9328-82	16,950 VMT	4,000 VMT	12,950 VMT
Savage Station Parking Expansion (550 P&R)	70-9314-82	12,182 VMT	2,750 VMT	9,432 VMT
West Baltimore Station Parking Expansion (125 P&R)	70-9322-82	5,025 VMT	375 VMT	4,650 VMT
Halethorpe Station High-Level Platform and Parking Exp. (150 P&R)	70-9325-82	4,566 VMT	750 VMT	3,816 VMT

HOV / Bus-Related Projects

MTA Rolling Rd/ Metropolitan Blvd. P&R Lot - Baltimore County (550 P&R) HOV, Bus	MTA	12,791 VMT	4,451 VMT	8,340 VMT
MD100/Long Gate Pkwy - P&R Lot - Howard County (301 P&R) HOV, Bus	SHA	9,006 VMT	2,872 VMT	6,134 VMT
US 29/MD 100 P&R Lot - Howard County (230 P&R) HOV, Bus	66-9404-02	6,881 VMT	2,194 VMT	4,687 VMT
MTA Rosedale P&R Lot - Baltimore County (217 P&R) HOV, Bus	MTA	6,702 VMT	2,171 VMT	4,531 VMT
Severna Park P&R Lot - Anne Arundel County (150 P&R) HOV, Bus	MTA	5,748 VMT	2,413 VMT	3,335 VMT
MD 32/Broken- land Pkwy P&R Lot - Howard County (100 P&R) HOV, Bus	66-9404-02	2,992 VMT	954 VMT	2,038 VMT
US 1/Gunpowder	SHA	2,485 VMT	628 VMT	1,857 VMT

Falls Park P&R Lot - Baltimore County (45 P&R) HOV, Bus					
MD 4/MD 258 P&R Lot - Anne Arundel County (70 P&R) HOV, Bus	61-9310-02	2,594 VMT	1,160 VMT	1,434 VMT	
I-97/Benfield Rd. P&R Lot - Anne Arundel County (82 P&R) HOV, Bus	MTA	2,073 VMT	903 VMT	1,170 VMT	
MD 4/MD 408 P&R Lot - Anne Arundel County (60 P&R) HOV, Bus	SHA	1,441 VMT	941 VMT	500 VMT	
US 29/MD 216 P&R Lot - Howard County (460 P&R) HOV	66-9404-02	13,763 VMT	7,395 VMT	6,368 VMT	
US 50/MD 8 P&R Lot - Queen Anne's County (270 P&R) HOV	SHA	13,673 VMT	6,827 VMT	6,846 VMT	
I-95/MD 543 P&R Lot - Harford County (50 P&R) HOV	9311-02	3,754 VMT	1,807 VMT	1,947 VMT	
Rt. 97/MD 26 P&R Lot Expansion - Carroll County (52 P&R) HOV	SHA	2,047 VMT	1,055 VMT	992 VMT	
MD 97/MD 26 P&R Lot Expansion - Carroll County (20 P&R) HOV	64-9306-02	788 VMT	406 VMT	382 VMT	
MD 97/MD 850H P&R Lot - Carroll County (18 P&R) HOV	SHA	709 VMT	365 VMT	344 VMT	

11,836 P&R Spaces

437,286 VMT

84,466 VMT

352,802 VMT

2005 PARK & RIDE PROGRAM EMISSION REDUCTION

12,700	Number of P&R spaces in 1994 Long Range Plan. Net additional P&R spaces to be built under the 1998 Long Range Plan by 2020 = 4,800
8,053	Spaces to be deleted to meet federal emission reduction rule = 8,053
359	Number of P&R spaces in TIP
834	Number of P&R spaces to be built by SHA by 2005
3,454	Number of P&R spaces constructed by 2005 = 3,454 spaces
11,836	Number of P&R spaces in FY 1990 - FY 1996 TIP
352,802	VMT reduction from FY 1990 - FY 1996 TIP
80%	2005 P&R space utilization
	$\text{VMT Reduction in 2005} = 0.8 \text{ space utilization factor } [(3,454 \text{ spaces} / 11,836 \text{ spaces}) \times 352,802 \text{ VMT}] = 0.8 [0.2918 \times 352,802] = 0.8 [102,948] = 82,358 \text{ VMT/day}$
82,358	VMT reduced x 0.363 g/mi = 29,896 VOC gr/day = 0.03 tons/day
82,358	VMT reduced x 1.323 gr/mi = 108,960 NOx gr/day = 0.12 tons/day

Year 2005 - Emission Reduction

2005 VOC Reduction = 0.03 tons/day

2005 NOx Reduction = 0.12 tons/day

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

I. ITS and Traffic Flow Improvements

I.1 Advanced Transportation Management System (Large Scale)

Definition:

This program would provide integrated intersection controls, freeway ramp metering and advisory signs, real time information on traffic conditions and quick response incident

management to obtain more efficient use of the transportation system. This program addresses large scale arterial infrastructure.

Issues:

- This program is expensive in nature and would require a large commitment of state funds in excess of 8 million dollars for implementation. (Assuming 4 TMS installations are completed in excess of 2 million dollars each). This project is too expensive to implement on a regional basis by 2005.
- Decreasing congestion would lead to faster average speeds and these speeds would increase NOx emissions on a regional basis. The reduction in congestion would lead to lower emissions from idling.
- The small credits associated with this project would not advance attainment.

Estimate of Emissions Benefits:

1994 estimates show .082 tpd of VOC and an increase in NOx of .16 tpd for 2005 from this program. The approximate costs of this program could be in excess of 8 million dollars. Calculations were not updated in 2001 because the strategy is not cost effective.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

I.2 Flashing Yellow in the Predominant Direction

Definition:

Implement a flashing yellow light system in predominant travel direction and a flashing red light in the minor flow direction at all low-volume intersections where safety and geometry permits.

Issues:

- Safety concerns from the local parties have prevented implementation of this program in the past.
- The potential congestion emission benefits would likely be small and would not advance attainment.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

I.3 Right Turn on Red in Central City

Definition:

Allow right turns on red signals in the central city during peak hours for the predominant traffic direction to allow for an ease in potential congestion caused by the signal system.

Issues:

- Safety concerns from the local parties have prevented implementation of this program in the past.
- The potential congestion emission benefits would likely be small and would not advance attainment.

Estimation of Emission Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

I.4 Improved Traveler Information Services

Definition:

Improvements on ITS measures that provide traffic information to public.

Issues:

- While this service will likely result in some travelers changing their travel time, route, or mode, overall system VMT and vehicle trips per day will likely not decrease.
- There are associated emission reductions from congestion management.

Estimate of Emissions Benefits:

According to an analysis completed by MDOT the expected emissions benefits from a program such as this would be 0.001 tpd of VOC and 0.009 tpd of NOx

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

I.5 Increased Adherence to 55 MPH Speed Limit

Definition:

Increase the adherence to the 55 mph speed limit to reduce the average traffic speed which in turn would lower NOx emissions. Program components include: increased points, fines and prosecutions, increased insurance rates.

Issues:

- Low political feasibility.
- Local support is needed to implement this policy successfully statewide. The effort required local funding. These funds would need to be procured prior to 2005 which could be very difficult.
- The 1994 credit estimates for this program for 2005 were less than .5 tons of either NOx or VOC. These small emission credits are not sufficient to advance attainment.
- Impacts to MVA, MD State Police, Court System.

Estimation of Emissions Benefits:

1994 estimates show .336 tpd of VOC and a decrease in NOx of .473 tpd for 2005 from this program. The approximate costs of this program could be in excess of 5 million dollars. Calculations were not updated in 2001 because this strategy was rejected for the reasons listed above.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

I.6 CHART (ITS)

Definition:

MDOT has developed and implemented a program through the State Highway Administration to reduce the congestion caused by traffic accidents and on-road breakdowns.

Issues:

- The program is currently funded and implemented and has been very successful in reducing congestion times due to incidents on main arteries.
- The program does not reduce traffic flow and focuses only on congestion due to non-recurring incidents.

Estimate of Emissions Benefits:

An update of the analysis of the benefits of the CHART program is currently underway. Previous preliminary analyses by the University of Maryland show emissions benefits less than 0.1 tons/day benefit. However, the updated analysis could not be completed in time for review in this RACM analysis. It is the professional opinion of the RACM workgroup that the expected credits from this program would not be large enough to advance attainment.

RACM Determination:

Expected emissions reductions are not sufficient to advance the attainment date.

I.7 Electronic Toll Collection

Definition:

Develop and implement an electronic toll collection program that would reduce congestion from toll plazas.

Issues:

- Congestion reductions reduce idling time but not VMT.
- Percent of vehicles using tolls versus region-wide vehicle use minimal benefit

Estimate of Emissions Benefits:**Calculations:**

The Maryland Transportation Authority has programmed the installation of electronic toll collection equipment at 5 locations in the Baltimore region. The system will be used by daily commuters. Key Bridge, Fort McHenry Tunnel, and Baltimore Harbor Tunnel are operational and are part of the analysis.

- Bay Bridge and Hatem Bridge will be in operation by 2005.
- Growth projected to increase by +3.5% annually

Locations	Participating Commuters				Delay during peak (minutes)
	1996	1999	2002	2005	
I-695 Key Bridge	11700	12972	14382	15946	3.5
I-95 Fort McHenry Tunnel	27100	30046	33313	36935	3.5
I-895 Baltimore Harbor Tunnel	23400	25944	28765	31892	3.5
US 50/301 Bay Bridge	8000	8870	9834	10903	1
US 40 Hatem Bridge	11500	12750	14136	15673	1

Idle emission factors gm/hour		
	VOC	NOx
1999	18.32	7.21
2002	12.29	6.15
2005	10.42	5.49
2015	8.76	4.2
2020	8.71	4.09

I-695 Key Bridge						
1999	12972	Participating daily commuters X	3.5	minutes of delay =	45402	vehicle minutes of delay
2002	14382	Participating daily commuters X	3.5	minutes of delay =	50338	vehicle minutes of delay
2005	15946	Participating daily commuters X	3.5	minutes of delay =	55811	vehicle minutes of delay

1999

757	Total vehicle hours of delay X	18.32	VOC GM/Hour=	13863	VOC GM/Day	0.015	Tons/Day
757	Total vehicle hours of delay X	7.21	NOx GM/Hour=	5456	NOx GM/Day	0.006	Tons/Day

2002

839	Total vehicle hours of delay X	12.29	VOC GM/Hour=	10311	VOC GM/Day	0.011	Tons/Day
839	Total vehicle hours of delay X	6.15	NOx GM/Hour=	5160	NOx GM/Day	0.006	Tons/Day

2005

930	Total vehicle hours of delay X	10.42	VOC GM/Hour=	9692	VOC GM/Day	0.011	Tons/Day
930	Total vehicle hours of delay X	5.49	NOx GM/Hour=	5107	NOx GM/Day	0.006	Tons/Day

I-95 Fort McHenry Tunnel						
1999	30046	Participating daily commuters X	3.5	minutes of delay =	105162	vehicle minutes of delay
2002	33313	Participating daily commuters X	3.5	minutes of delay =	116595	vehicle minutes of delay
2005	36935	Participating daily commuters X	3.5	minutes of delay =	129271	vehicle minutes of delay

1999

1753	Total vehicle hours of delay X	18.32	VOC GM/Hour=	32109	VOC GM/Day	0.035	Tons/Day
1753	Total vehicle hours of delay X	7.21	NOx GM/Hour=	12637	NOx GM/Day	0.014	Tons/Day

2002

1943	Total vehicle hours of delay X	12.29	VOC GM/Hour=	23883	VOC GM/Day	0.026	Tons/Day
1943	Total vehicle hours of delay X	6.15	NOx GM/Hour=	11951	NOx GM/Day	0.013	Tons/Day

2005

2155	Total vehicle hours of delay X	10.42	VOC GM/Hour=	22450	VOC GM/Day	0.025	Tons/Day
2155	Total vehicle hours of delay X	5.49	NOx GM/Hour=	11828	NOx GM/Day	0.013	Tons/Day

I-895 Baltimore Harbor Tunnel						
1999	25944	Participating daily commuters X	3.5	minutes of delay =	90804	vehicle minutes of delay
2002	28765	Participating daily commuters X	3.5	minutes of delay =	100676	vehicle minutes of delay
2005	31892	Participating daily commuters X	3.5	minutes of delay =	111621	vehicle minutes of delay

1999

1513	Total vehicle hours of delay X	18.32	VOC GM/Hour=	27725	VOC GM/Day	0.031	Tons/Day
1513	Total vehicle hours of delay X	7.21	NOx GM/Hour=	10912	NOx GM/Day	0.012	Tons/Day

2002

1678	Total vehicle hours of delay X	12.29	VOC GM/Hour=	20622	VOC GM/Day	0.023	Tons/Day
1678	Total vehicle hours of delay X	6.15	NOx GM/Hour=	10319	NOx GM/Day	0.011	Tons/Day

2005

1860	Total vehicle hours of delay X	10.42	VOC GM/Hour=	19385	VOC GM/Day	0.021	Tons/Day
1860	Total vehicle hours of delay X	5.49	NOx GM/Hour=	10213	NOx GM/Day	0.011	Tons/Day

US 50/301 Bay Bridge

1999		Participating daily commuters X	1	minutes of delay =	0	vehicle minutes of delay
2002		Participating daily commuters X	1	minutes of delay =	0	vehicle minutes of delay
2005	10903	Participating daily commuters X	1	minutes of delay =	10903	vehicle minutes of delay

1999

0	Total vehicle hours of delay X	18.32	VOC GM/Hour=	0	VOC GM/Day	0.000	Tons/Day
0	Total vehicle hours of delay X	7.21	NOx GM/Hour=	0	NOx GM/Day	0.000	Tons/Day

2002

0	Total vehicle hours of delay X	12.29	VOC GM/Hour=	0	VOC GM/Day	0.000	Tons/Day
0	Total vehicle hours of delay X	6.15	NOx GM/Hour=	0	NOx GM/Day	0.000	Tons/Day

2005

182	Total vehicle hours of delay X	10.42	VOC GM/Hour=	1894	VOC GM/Day	0.002	Tons/Day
182	Total vehicle hours of delay X	5.49	NOx GM/Hour=	998	NOx GM/Day	0.001	Tons/Day

US 40 Hatem Bridge

1999		Participating daily commuters X	1	minutes of delay =	0	vehicle minutes of delay
2002		Participating daily commuters X	1	minutes of delay =	0	vehicle minutes of delay
2005	15673	Participating daily commuters X	1	minutes of delay =	15673	vehicle minutes of delay

1999

0	Total vehicle hours of delay X	18.32	VOC GM/Hour=	0	VOC GM/Day	0.000	Tons/Day
0	Total vehicle hours of delay X	7.21	NOx GM/Hour=	0	NOx GM/Day	0.000	Tons/Day

2002

0	Total vehicle hours of delay X	12.29	VOC GM/Hour=	0	VOC GM/Day	0.000	Tons/Day
0	Total vehicle hours of delay X	6.15	NOx GM/Hour=	0	NOx GM/Day	0.000	Tons/Day

2005

261	Total vehicle hours of delay X	10.42	VOC GM/Hour=	2722	VOC GM/Day	0.003	Tons/Day
261	Total vehicle hours of delay X	5.49	NOx GM/Hour=	1434	NOx GM/Day	0.002	Tons/Day

TOTALS							
1999							
4023	Total vehicle hours of delay X	18.32	VOC GM/Hour=	73698	VOC GM/Day	0.081	Tons/Day
4023	Total vehicle hours of delay X	7.21	NOx GM/Hour=	29004	NOx GM/Day	0.032	Tons/Day
2002							
4460	Total vehicle hours of delay X	12.29	VOC GM/Hour=	54815	VOC GM/Day	0.060	Tons/Day
4460	Total vehicle hours of delay X	6.15	NOx GM/Hour=	27430	NOx GM/Day	0.030	Tons/Day
2005							
5388	Total vehicle hours of delay X	10.42	VOC GM/Hour=	56143	VOC M/Day	0.062	Tons/Day
5388	Total vehicle hours of delay X	5.49	NOx GM/Hour=	29580	NOx GM/Day	0.033	Tons/Day

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

I.8 Signal Systemization

Definition:

Promote smoother transportation flow throughout the region by linking signals in a manner that promoted the free flow of traffic.

Issues:

- Currently the program has been applied to 80 intersections located in 10 corridors in the area.
- The program has saved over 0.5 million gallons of gasoline per year.

Estimate of Emissions Benefits:

Estimated emissions benefits are 0.089 VOC and -0.005 NOx.

Calculations:

Implementation will change average travel speed from 32mph to 35mph.

Travel model VMT estimates			
	1996	2002	2005
	62835500	68253300	71042400
Average Annual	NA	0.01388	0.01344

	1999		2002		2005	
	VOC	NOx	VOC	NOx	VOC	NOx
32 MPH	0.68938	1.6924	0.49758	1.4368	0.4496	1.2948
35 MPH	0.62998	1.699	0.45498	1.441	0.4118	1.299
	0.0594	-0.0066	0.0426	-0.0042	0.0378	-0.0042

Source	Project Name	Project Length in Miles	2005	2005	2005
			Total Vehicles	VOC Benefit	NOx Benefit
97-01					
TIP	MD 450, MD 2 to MD 178	0.7	36151	0.001	0
TIP	US 1, Taylor Avenue to Fowler Ave.	0.6	43104	0.001	0
TIP	US 1 Alt, Levering Ave. to Selma	0.9	25410	0.001	0
TIP	US 40 Middle River Rd to Days Cove	4.3	47118	0.008	-0.001
TIP	MD 122, Rolling Rd to I-70 Ramps	2.8	31078	0.004	0
TIP	MD 144, Paradise Ave to Rolling Rd	2.2	19418	0.002	0
TIP	MD 150, Stemmers Run Rd to Carroll	3.3	36717	0.005	-0.001
TIP	MD, Southern Ave to MD 587	5.9	37395	0.009	-0.001
TIP	MD 151 Wise Ave to Balt. Street	4.6	20221	0.004	0
TIP	MD 166, Bloomsburg Ave. to MD 372	0.8	16705	0.001	0
TIP	MD 30, Northwoods Tr. To MD 482	1.3	17044	0.001	0
TIP	MD 140, MD 97 to Sullivan Rd.	2	45462	0.004	0
TIP	US 1 BUS, Atwood to Tollgate Rd	0.5	27191	0.001	0
TIP	MD 22, Beards Hill Rd to MD 132	1.9	15899	0.001	0
TIP	MD 152, US 40 to I-95 Ramps	0.8	19984	0.001	0
TIP	MD 175, MD 108 to Pocomoke Ave.	1.5	51499	0.003	0
TIP	MD 24, MD 924 to US 1 Bus	4.9	35789	0.007	-0.001
98-02	MD 175, Rivera Drive to Edwin Raynor	1.3	24393	0.001	0
TIP	MD 175, Higgens Rd to MD 173	5.02	32844	0.007	-0.001
TIP	MD 450, King George to USNA Gate 8	1.1	12182	0.001	0
TIP	MD 452, I 695 to Loch Raven	2.56	43811	0.005	-0.001
TIP	MD 26, Johnsonville Rd to Nonroe Ave.	2	37254	0.003	0
TIP	US 40, Old Post Road to Ostego Str.	2.77	27417	0.003	0
TIP	US 40, MD 755 to MD 24	3.5	68063	0.01	-0.001
00-04	MD 178, MD 450 to Bestgate Rd	0.34	19673	0	0
TIP	MD 2, MD 450 to MD 665	0.86	28831	0.001	0
TIP	MD 24, Tollgate Rd to MF 755	1	20916	0.001	0
TIP	MD 122, I-695 to Rolling Road	0.5	32222	0.001	0
TIP	US 1, Amberton Dr. to Business Pkwy	1	21482	0.001	0
TIP	MD 30, York Street to MD 27	0.25	21142	0	0
				VOC	NOx
TOTALS			916415	0.0089	-0.005

RACM Determination:

This measure does not produce sufficient emissions reductions to advance the attainment date.

I.9 Smart Card

Definition:

Allows an electronic fare to be used on most transit systems in Maryland including Washington area transit. The various carriers are integrated into one service and fees can be subtracted from one card that is electronically linked to the various transit services.

Issues:

- The State is currently investing over \$20 million to link all the Maryland based transit systems for this program.
- It is expected that this service will be in operation in 2002.

Estimate of Emissions Benefits:

An analysis of the benefits of this program is currently underway. However, this analysis could not be completed in time for review in this RACM analysis. It is the professional opinion of the RACM workgroup that the expected credits from this program would not be large enough to advance attainment.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date.

J. Market Based/ Economic Incentive

J.1 Graduated Tax on Vehicle Mileage

Description

Impose a tax on each passenger motor vehicle based on its annual mileage. The tax rate could be a linear increase or an exponential increase.

Issues

- Low political feasibility
- Would require state enabling legislation that is likely to be politically controversial
- Without complex regulations that define vehicle types, ages, and gas consumption characteristics, this strategy could be inequitably applied.
- Implementation would be complex and expensive
- Could be inequitable to low-income workers who may have to travel longer distance by auto to low-wage jobs.
- For higher-income drivers, this tax may be ineffective in reducing vehicle mileage.
- Revenue may go into general revenue fund and be unavailable for encouraging alternative commute use.

Estimate of Emissions Benefits:

1994 emissions estimates indicate a benefit of 0.317 tons/day of VOC.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

J.2 Pollution Fee for Gasoline Powered Vehicles

Description:

Institute an annual fee of \$500 per vehicle on every gasoline-powered vehicle in the region. Natural gas and electric vehicles would be exempt from this fee.

Issues:

- Requires legislation; difficult to implement in timeframe for credits to advance attainment (i.e., legislative process, garnering support)
- Low political feasibility
- Measure would generate additional review, but is likely to be ineffective in reducing vehicle use.

Estimate of Emissions Benefits:

Estimates of emissions benefits were not calculated for this strategy based on its inability to be implemented for reasons listed above.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

J.3 Increased Gas Tax

Description:

Increase state/regional/local gasoline tax by \$0.25 per gallon per year, resulting in \$0.75 increase throughout the region by 2005. To minimize impact on commerce, trucking services and transit operators would receive a rebate on the tax. Proceeds from the tax would be used to fund transit capital and operating costs.

Issues:

- Low political feasibility
- May be only partially or marginally effective in reducing VT and VMT because local drivers could easily travel to adjacent jurisdictions to purchase lower priced gasoline.
- Would require state-enabling legislation.
- May put Baltimore region at economic disadvantage relative to other nearby regions.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

J.4 Market Based Parking Charges at Federal Facilities

Description:

Require all federal work sites in the region to charge the equivalent of commercial parking rates. All federal employees who drive to work would be required to pay the new commercial parking rate.

Issues:

- Regional and state actions cannot require the federal government to implement such a program.
- Citizen opposition to the measure.
- Federal employment in the Baltimore region is dispersed in numerous installations, thereby potentially limiting the effectiveness of this measure since employees can park at neighboring sites.
- Program would require federal cooperation between agencies and would require substantial time for coordination, and may be infeasible for some federal agencies.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

J.5 Graduated Additional Vehicle Registration Fee

Description:

Implementation of a program that encourages the active registration of one vehicle per person in the region by making it more expensive to register the second vehicle.

Issues:

- Low political feasibility.
- The fees would not act as a deterrent to most middle income or upper income citizens, creating an environmental justice issue.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

K. Outreach/ Education

K.1 MTA's Try Transit Week

Definition:

The MTA offers a yearly program that calls for an increase in transit service for the region for one week of the year. In addition to public outreach activities, the MTA funded one day of free transit.

Issues:

- The program is sponsored on a yearly basis and funding is variable.
- The program is a promotional program and only lasts one week of the year.

Estimate of Emissions Benefits:

Due to the nature of this event, and its one week focus, it is not possible to quantify the effects of this strategy as an isolated means to increase transit ridership. However, it is assumed that outreach activities such as this one contribute to the overall increase in transit ridership.

RACM Determination:

As an isolated strategy, this measure would not produce emissions reductions of an amount expected to advance the attainment date.

K.2 Clean Air Partners Program (formerly, Endzone)

Definition:

Clean Air Partners Program is a public/private partnership working to improve air quality in the State of Maryland. The program attempts to motivate individuals to take voluntary actions that reduce emissions. Through the Ozone Action Days program actions are being taken to reduce ozone levels in the region.

Issues:

- This program is being considered for inclusion in the SIP within the framework of Maryland's "Smart Growth and Innovative Measures" SIP.
- Emission benefits from episodic measures are difficult to quantify.
- Historically, the EPA has not allowed credit from episodic control measures in the SIP.

Estimate of Emissions Benefits:

Calculations are separated into 2 different sections: Non-road and Mobile

Non-Road Calculations:

Ozone Action Day (OAD) Area Source Emission Benefit Quantification Methodology

The MDE reviewed the specific area source emission benefits identified in the OAD survey data collected in recent years. The limited information from the episodic survey indicated that reported current voluntary action in targeted categories is in the 20–40% range. Based on available data and the emission reduction levels associated with certain targets the following emission reduction goals were selected.

- Lawn and garden equipment — Behavior change that would result in a 20% reduction in the use (individual and small and large businesses or agencies) of such equipment during severe events.
- Routine painting activities—Behavior change that would result in a 20% reduction in the use (individual and small and large businesses or agencies) of paints during severe events.
- Aerosol consumer products—Behavior change that would result in a 20% reduction in the use of these products during severe events.
- For all three of the above items, the MDE took an estimate of 5% reduction.

These targets were selected because available survey data and practical experience indicate that this level of change, or an even higher level of change, is reasonable. The targets represent a conservative estimate of potential change and generate significant, but reasonable, emission reductions/SIP credit.

Methodology:

1. The MDE reviewed the available area source information for potential emission benefits using the latest approved Emissions Inventory (1996) for the Baltimore Region (5 Counties and Baltimore City).
2. The MDE reviewed the source category information and determined which source categories would be impacted by the OAD program (Commercial/ Consumer Solvents, Lawn and Garden Equipment, and Architectural Surface Coatings).
3. The MDE listed the emission inventory for each source category and totaled the emissions, then calculated what percentage of each source category would be impacted by the OAD program. This number is listed in the quantification sheets as “percentage effected”.

4. To figure out the actual VOC and NOx benefits of the program the county inventories from each source category is added and then multiplied by the percentage affected by the voluntary action. This estimate is then multiplied by the voluntary reduction percentage to get an estimate of the actual emission benefits from the program. The current survey data suggests a range of 20-40% expected reduction on Ozone Action Days. The MDE is continuously updating the survey data and new surveys will be underway in the future. The estimate being used for this analysis is 5% which is conservative in nature.
5. These benefits from the different source categories are added to get a tons per day total. On average there are 10 Ozone Action Days per year in the Baltimore region. Therefore, the daily estimate is multiplied by 10 days for a seasonal total. This estimate can be divided by the total number of ozone season days, or divided by 365 to get a yearly overall daily total.

Summary Chart

Baltimore Area

Source (VOC)	% Affected	Area Total	Voluntary Reduction %	Emission Reduction	Overall Daily Total
Lawn and Garden	100	19.22	5	0.9611	
Architectural Surface Coatings	60	19.96	5	0.5987	
Commercial/ Consumer Solvents	32	26.16	5	0.4186	
					.05 tpd

Source (NOx)	% Affected	Area Total	Voluntary Reduction %	Emission Reduction	Overall Daily Total
Lawn and Garden	100	0.32	5	0.02	
Architectural Surface Coatings	60	0	5	0	
Commercial/ Consumer Solvents	32	0	5	0	
					.0005 tpd

Emission Benefits

	VOC	NOx	
Total Daily Benefit	2.0	0.02	tons per day
Seasonal Total	19.8	0.2	tons per season
Summer Daily Total	0.13	0.001	tons per day
Overall Daily Total	0.05	0.0005	tons per day

Mobile Calculations:

Determination of the target market of the program.

- a) Obtained the total number of trips being made in the BMC region. The trips were aggregated from multiple trip tables developed by the BMC Model.

- b) Trips were converted to number of persons by assuming that a person makes 4.3 trips per day. This value was obtained from the 1995 National Personal Travel Survey (Total Trips/ 4.3 Trips per Person).
- c) The person trips calculated in step 1b were reduced by 60.4%. The 60.4% represent the number of drive alone in the region. This value was gathered from the 1993 Baltimore Regional Household Travel Survey. The reduced trips were assumed to be the target market for the program.

Number of trips reduced by program.

- d) This is one of the critical assumptions of the analysis. Survey conducted in Sacramento in 1995 and 1996 revealed that 1.04 trip per driver per action day could be expected. Due to lack of data, we assumed that we could reduce the same number of trips per person in the Baltimore Region.

Participation Rate.

- a) A survey conducted in San Francisco of 200 commuters in an action day revealed that 19% changed their travel pattern. It was assumed that the Baltimore Region might fall in the range of 2% to 6%.

Trips and VMT Reduction and Emission Benefits

- a) Assuming participation rates that fall between 2% and 6%, the corresponding number of trips reduced due to the voluntary episodic program is 16,255 and 48,674 respectively. It is estimated that transit trips will increase by 5,000 in the lower end and 15,000 in the upper end. According to MTA's home page, it provides an average of 370,000 rides per day. This means that the new trips assigned to transit will represent 1.4% and 4.1%. These values are within previous estimates made by both MDOT and COG.
- b) For the VMT calculations it was assumed a trip length of 10.9 for all trip types in the region. This value matches favorable when we compare the national average of 9.13. The trip length was derived from the BMC Model. The range in VMT reduction from the above trip reduction is 177,180 and 530,547. This leads to a reduction in VOC of .1 to 0.3 tpd and a reduction of NOx of .32 to .96 tpd.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. As episodic measures, these measures have an element of uncertainty in their implementation and emission benefit.

K.3 Clean Commute Week

Definition:

A local voluntary program that promotes the use of alternative transportation modes for daily commuters during one week of the year. The BRTB (Baltimore Regional Transportation Board) has teamed with local and state agencies and private entities to promote this outreach activity. Historically, this week has been closely coordinated with other events such as Try Transit Week and Bike to Work Day in an effort to reduce the use of single occupant cars in the region.

Issues:

- The program is sponsored on a yearly basis and funding is variable.
- This program is a promotional effort and only lasts one week of the year.

Estimate of Emissions Benefits:

Due to the nature of this event, and its one week focus, it is not possible to quantify the effects of this strategy as an isolated means to increase transit ridership, bicycling, carpooling or teleworking. However, it is assumed that outreach activities such as this one contribute to the overall increase in the use of alternative modes of transportation.

RACM Determination:

As an isolated strategy, this measure does not produce emissions reductions sufficient to advance the attainment date.

L. Parking Restrictions

L.1 Build Park and Ride Lots Near Selected Major Highways

Definition:

This program would construct new Park and Ride lots in the vicinity of selected intersections of major commuter highways in the region and in each HOV corridor identified in the 2020 Long Range Transportation Plan for the region. The particular example being reviewed for this region involves the construction of 6 freeway approach lots in the region.

Issues:

- The level of utilization of the projected lots in the 2005 timeframe does not yield significant emission reductions.

Estimate of Emissions Benefits:

According to a recently completed estimate for the 6 lots in the Baltimore region (using the same methodology used in the 1994 BMC report), the expected VOC benefit is .009 tpd and the NOx benefit is .0328 tpd.

Assumption for 2005 Park & Ride Expansion RACM

1. Construction or expansion of 6 park and ride facilities on the 6 freeway approaches into the Baltimore region by 2005.
2. Facilities will be served by rideshare and/or peak period bus service.

3. Average park and ride added per facility = 167 spaces, rounded to 200 spaces per facility. Total spaces added = 6 x 200 = 1,200 spaces. (Source: 1994 BMC Park and Ride analysis, and 2000 BMC park and ride inventory.)
4. VMT reduction per space provided = 19.00 miles/space. (Source: 1994 BMC Park and Ride analysis)

Year 2005 Emission Reduction Analysis

VMT reduced = 1,200 spaces x 19.00 VMT/space = 22,800 VMT

2005 VOC Reduction = 22,500 VMT x 0.363 VOC g/mi = 8,168 VOC g/day = 0.0090 tons/day

2005 NOx Reduction = 22,500 VMT x 1.323 g/m = 29,768 NOx g/day = 0.328 tons/day

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

L.2 Employee Parking Space Tax Outside of CBD

Definition:

Charge a parking space tax for all spaces outside of the CBD. It is assumed that this tax will be charged to employers who could pass the tax along to the employees. The revenues would be used to support transit operations.

Issues:

- Local citizen opposition as well as local government opposition would result in delay in implementation.
- Only work trips would be impacted and work trips account for only a part of the total daily vehicle trips.
- Business community members might relocate over increased fees.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

L.3 Restriction on New Parking Construction

Definition:

Restrict parking construction at new employee centers. Reduction as drastic as allowing only 1 spot per 5 employees at locations within ¼ mile of transit stop.

Issues:

- Current parking zoning regulations call for 16 spots for every 1,000 feet of retail/restaurant space.
- Large scale county changes will require the following: County Enactment, Legislative Backing, Public Process, Potential Planning Analysis – could all take several years prior to first regulation being passed.
- Individual changes in regulations for particular locations could go through the zoning and planning process within one year.
- Trade associations would pose strong opposition to the measure. Business groups have strong political favor and might stop some forms of legislative backing.
- Banks require that new loans have adequate parking. This is part of their due diligence process and is a risk management process. Banks simply find that having large parking facilities allows building uses to grow and stay profitable with the public. This allows their lenders to make income and pay the loan off. It is difficult to sway the policies of these financial institutions.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

L.4 Control of Student Parking at High Schools

Definition:

This program would restrict high school students from parking at school when the school system provides bus service.

Issues:

- This program would have very little impact since most schools are closed during the peak ozone season.
- Would require a neighborhood permit parking system since spillover parking on local streets is likely – would need changes in local codes and enhanced enforcement.
- Impacts students who need transportation for work purposes or after school activities.
- Strong citizen opposition to this restriction.

Estimate of Emissions Benefits:

1994 estimates show a VOC benefit of 0.129 tpd and a decrease in NO_x of .168 tpd for 2005 from this program. The approximate costs of this program could be in excess of 225,000 dollars (or approximately \$1,744,186 million per ton of VOC). Calculations were not updated in 2001 because the benefit does not represent a summer day estimate and the summer estimate would be significantly lower.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

M. Other Measures

M.1 Highway Ramp Metering

Definition:

Ramp metering is not a new freeway management technique. Various forms of ramp control were implemented during the late 1950's and through the 1960's in Chicago, Detroit and Los Angeles. By the early 1990's, ramp metering systems existed in twenty metropolitan areas within the United States, in addition to numerous cities around the world. In addition to on-ramp metering, freeway-to-freeway connector ramp meters have been successful in several areas including Minneapolis, San Antonio, and San Diego. The most restrictive ramp metering is ramp closure.

Principal causes of freeway congestion are: (1) incidents/accidents; (2) queues from exiting vehicles spillover onto the mainline; (3) a bottleneck exists; (4) entering demand exceeds exiting demand; and (5) mainline flow is disrupted by platooned entering demand. By regulating ramp access to the mainline, on-ramp metering aims to eliminate, or at least reduce operational problems resulting from (3), (4), and (5). The predominant goal of most, if not all ramp metering applications is to prevent, alleviate, or reduce congestion in some fashion subject to practical constraints which govern the feasibility of ramp metering implementation (e.g. ramp geometrics). A properly implemented system improves operation without causing excessive or burdensome diversion of traffic to the surface street network.

Issues:

In practice metering shortens the duration of congestion and improves overall traffic conditions. There is evidence that metering increases throughput, as many metered highways sustain peak volumes well in excess of 2,100 vph (flows up to 2450 vph have been achieved). By eliminating the stop-and-go behavior associated with congestion, metering can also result in up to 50% increases in speed and up to a 30% reduction in accidents. While diversion is an important metering concern, empirical results suggest no more than 5-10% of vehicles will be diverted.

While travel time savings is often cited as the primary benefit of metering, as described in the table below, numerous other potential benefits exist. Benefits are phrased as "potential" because results will vary with regional traffic and geometric conditions, and with the size and efficiency of the metering system.

Potential Benefits of Ramp Metering

Benefit	Description
Efficient Use of Capacity	<p>If there is excess capacity on surface streets, it may be worthwhile to divert traffic from congested freeways to surface streets, and discourage trip paths with high societal costs. A driver with a simple inexpensive alternative to a congested freeway should be encouraged to take it. If insufficient capacity exists, metering can have adverse effects.</p> <p>Ramp metering can also result in temporal diversion, where drivers shift ramp arrival time. Empirical results show these shifts can result in up to 15% reductions in pre-metering volumes. Flow peaks are thus spread out over a longer period resulting in better freeway capacity utilization.</p>
Improved Safety	<p>Reduced turbulence in merge zones can lead to reduced sideswipe and rear-end type accidents which are associated with un-metered areas. Such turbulence is generated by platoons of entering vehicles which disrupt mainline flow. Similarly, if metering prevents a bottleneck, one can also expect safer conditions through the reduced variance in speed distributions.</p>
Public Education	<p>Although benefits can be demonstrated empirically, the benefits may not be recognized by individual motorists. The most successful metering projects involved a proactive public relations campaign. Many failures to date seem to be attributed to public rejection arising from a "business as usual" attitude by the implementing agency.</p> <p>The effectiveness of the metering system is also dependent on compliance by drivers. The public should be informed that ramp meters are traffic control devices which must be obeyed. Experience has shown that advance notice to the public results in lower violation rates, and that police enforcement is also needed.</p>
Reduced Vehicle Emissions	<p>Smoother traffic flow resulting in less speed variation on a metered freeway can lead to substantial reduction in emissions and fuel savings.</p>
Travel Time Savings	<p>If properly implemented metering can significantly increase peak speeds and reduce travel times. While ramp delays increase, system wide delay reductions can be large and positive.</p>

Potential Costs of Ramp Metering

Potential Cost	Description
Diversion	<p>Diversion involves the diversion of trips from the freeway to alternate surface network routes. Factors which influence diversion include O-D patterns, trip length, ramp delays, and the quality of alternate routes. Conceptually, freeways were not designed for short trips, so diversion may be desirable if surface streets are under utilized. Even if alternate routes do not exist, experiences in Virginia, Chicago, and Denver indicate that metering can still be effective.</p>
Equity	<p>Because ramp metering favors through traffic, metering benefits longer trips at the expense of "local" motorists. Trips may be diverted to local surface streets, and residents close to the CBD may be deprived of access given to suburban dwellers. In Milwaukee, where equity proved to be a delicate subject, metering rates were adjusted so that delay to the average motorist was the same on close-in ramps and on outlying ramps.</p>

Installation and Maintenance Costs	Depending on existing ramp configuration and the size of the system, capital and maintenance costs can be sizable. Ramp metering systems typically have high costs associated with the communication medium connecting the ramps to the control center.
On-Ramp Emissions	Local emissions near the ramp may increase from stop-and-go conditions and vehicle queuing on the ramp.
Promotes Longer Trips	There is evidence that metering results in longer trips replacing shorter trips, as those trips taking up critical bottleneck capacity are also likely to use the long uncongested upstream or downstream freeway sections. Such catering to longer trips can have negative feedback effects, encouraging rather than discouraging commutes from further out.
Ramp Delay and Spill Back	Queues which back up onto adjacent arterial streets can adversely affect the surface network. Those vehicles which use the ramp are delayed as they pass through the meter.
Public Opposition	In addition to physical requirements of the ramp, the feasibility of implementing ramp metering control is dependent on public acceptance of ramp metering. The issue of public acceptance is critical, as the public is bound to be critical of a new installation.
Transfer of Land Values	Users who have been accustomed to ready freeway access may be rerouted in favor of new users, which can cause land values to change.

Above charts were copied from FHWA website.

Estimate of Emissions Benefits:

Potential benefits were not calculated because pilot programs of ramp metering in the region resulted in congestion on adjacent arterial streets.

RACM Determination:

Pilot programs did not show this strategy provided overall air quality benefits.

M.2 Trip Reduction Ordinances

Definition:

Enact requirements in an effort to reduce trips to the CBD. No drive days, alternate drive days, closure of roads are all examples of such activities.

Issues:

- Local citizen opposition and local government opposition would delay implementation of such an action.
- These types of measures would require local regulations and changes in legislation.
- Measures of this variety are draconian and would not be implemented by the attainment date.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

M.3 Value Pricing

Definition:

Variable pricing is an emerging concept that involves a system of fees or tolls, which vary according to the level of congestion. Variable pricing of congested facilities can include new/existing toll-free roads, new/existing toll facilities, or new/existing high occupancy vehicle (HOV) facilities. Higher tolls are charged when congestion is heaviest and delay is at its worst. Adding additional capacity to highways is frequently driven by peak period congestion. This measure seeks to spread out travel demand to better utilize existing highway capacity and decrease demand for additional capacity to serve rush hour. The use of limited road capacity is maximized by encouraging some peak period users to shift to off-peak periods, HOV modes, transit, or less congested routes. In addition, it could include optional fees paid by drivers of lower-occupancy vehicles to gain access to dedicated road facilities (high occupancy toll or HOT Lanes) providing a superior level of service (LOS) and offering time savings compared to the parallel free facilities.

Issues:

- MDOT/FHWA is currently funding a study of the potential for adopting a value pricing system in Maryland. The results of this study have not yet been released. However, after Phase I of the study, MDOT has decided that this program is likely to ease congestion in the area and may be a feasible tool for the region.
- The current MDOT study has found that one of the larger issues with this type of program involves public acceptance.

Estimate of Emissions Benefits:

Due to the issues identified above, an estimate on emissions benefits was not calculated. Below is a summary of the current schedule for the continued study of this idea and the study budget:

Schedule

The schedule completes the Phase I and Phase II work in twenty four (24) months after the Notice-To-Proceed (NTP) was issued. NTP was dependent on receipt of requested funds. Major schedule items and critical milestones for their completion are summarized below. Please note that this cooperative agreement between FHWA and MDOT has been in order to achieve follow up items and public interaction.

March/April 2001	Stakeholder Group Meeting #7
March/April 2001	Steering Committee Meeting #8
Late Spring 2001	Workshops
Summer 2001	Final Report Issued

The proposed budget for this variable pricing study is : \$859,420

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

M.4 Control of Extended Idling (Truck and Buses)

Definition:

This program would establish regulations with regards to idling trucks and buses. It would require a timing device to be installed which would automatically stop truck and bus engines after a delay of five minutes of idling time.

Issues:

- The control would enforce an already existing state law for idling time.
- The expense for the required equipment would be high.
- This program would not produce any changes in VMT or vehicle trips for the region.
- Based on the estimated identified below, this type of program would not advance the attainment date.
- Industry opposition would be very high.

Estimate of Emissions Benefits:

1994 estimates show a VOC benefit of 0.2 tpd and a decrease in NOx of .53 tpd for 2005 from this program. The approximate costs of this program could be in excess of 5 million dollars (or over 10 million per ton of NOx). Calculations were not updated in 2001 because the measure is not cost-effective and does not reduce VMT.

RACM Determination:

Estimated emissions reductions are not sufficient to advance the attainment date. Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

M.5 Extreme Cold Start Vehicle Emission Reductions

Definition:

Programs to reduce motor vehicles emissions, consistent with Title II, which are caused by extreme cold start conditions.

Issues:

- This program/ potential measure does not apply to the Maryland region due to a temperate climate with a relatively mild winter season.
- The only month where the average daily temperature is around the freezing mark is January, unlike other regions where average daily high temperatures are below freezing for up to four or more months.

Estimate of Emissions Benefits:

This measure was rejected based on the considerations listed above. Therefore, emission benefits were not calculated.

RACM Determination:

Implementation issues (as listed above) hinder the ability to implement this strategy in time to advance attainment.

4.0 RACM For Other Sources

For a number of years, the MDE studied control measures for all air pollution sources in an effort to attain the federal ozone standard. In particular, the MDE has worked with other states in the region and within the guidelines of the CAA in an effort to ensure that all reasonable measures were considered. Historically, the MDE has worked closely with industries to develop RACT (Reasonably Available Control Technology) assessments in an effort to reduce emissions from stationary sources. MDE has consistently and repeatedly reviewed periodic emission inventories to identify significant source categories and potential control measures. MDE also reviews current air quality control literature SIP's from other nonattainment areas, and applicable websites for advances in control technologies. MDE evaluates new controls for applicability to Maryland sources.

Currently, the MDE is working with the Ozone Transport Commission (OTC) to develop control strategies for stationary and area source controls for the SIP to meet the emission reduction shortfall identified for the attainment plan by EPA and to provide additional reductions for clean air progress. These two processes represent a strong effort from Maryland in reviewing all potential control measures for inclusion in the SIP for attainment. Therefore, MDE believes that through these processes, potential RACM for stationary sources have been reviewed. Below is a brief history of the two processes being utilized by Maryland.

OTC Measures:

The Need for Additional Reductions

In October 1998, the Ozone Transport Commission (OTC) adopted a Declaration of Principles that establishes a framework to further address the ground-level ozone problem in the Ozone Transport Region (OTR). The framework includes initiatives such as regional reductions in emissions of nitrogen oxides (NOx), considering multi-pollutant reduction benefits when adopting ozone strategies, and emphasizing regional strategies to attain the ozone standard in the OTR.

In December 1999, the U.S. Environmental Protection Agency (EPA) proposed approval of the attainment plans for ten nonattainment areas. EPA identified emission reduction shortfalls in attainment plans in several of these areas. EPA indicated it would grant states additional time to implement new measures if those states pursued a regional approach to develop control strategies. Within this context, the OTC agreed to begin addressing the emission shortfalls by developing model rules for its member states. These model rules would provide a consistent framework for air pollution regulation throughout the OTR.

Candidate Control Measures

The OTC developed a list of candidate control measures to be investigated. The candidate control measures were divided into two groups: first, those that would be investigated by February of 2001 as short term measures for early adoption (Table 1 Measures), and

second, those of a more complex nature, that would be investigated at a later date, i.e., by February 2002 (Table 2 Measures). These measures would help to attain and maintain the one-hour ozone standard, as well as make progress toward attaining the eight-hour ozone standard.

The measures listed below are identified as either "Table 1" or "Table 2" measures.

Table 1 measures are designed to limit emissions from:

1. Architectural and industrial maintenance coatings;
2. Consumer products (including portable fuel containers);
3. Mobile equipment repair and refinishing operations;
4. Solvent cleaning operations;
5. Fuels for on-road vehicles and off-road equipment (diesel and/or gasoline); and,
6. Fuel combustion sources, including cement kilns, gas turbines, stationary internal combustion engines, and industrial boilers.

Table 2 measures may be traditional control measures or innovative control approaches to reduce emissions of multiple pollutants. Measures under consideration include:

1. System benefit charges for electricity generation;
2. Environmental performance standards for electricity generation;
3. State actions to encourage energy conservation;
4. Renewable energy programs;
5. Energy efficiency programs;
6. Airport and aviation emission reduction programs;
7. Off-road engine and vehicle initiatives; and,
8. Other programs to be identified by June 2001.

State-led Workgroups

The Table 1 Measures were researched by groups of OTC member states (workgroups) convened by designated lead state representatives. As the workgroups gathered information, they sought input from the regulated community and other stakeholders in developing draft model rules. For each of the Table 1 measures, a draft model rule, or a framework for a draft model rule, was then developed. Once the workgroups completed draft model rules, the OTC Committees convened to review them and take oral and written comments from stakeholders.

In March 2001, the OTC will focus on the Table 2 measures, and state-led workgroups will follow a similar process to develop Table 2 draft model rules.

Application to RACM

During the process described above, the OTC states used a long list of potential measures to ensure that the shortfall would be properly addressed. This long list was shortened (Tables 1 and 2 discussed above) based on: credits, cost, politics, and stakeholder review. This process parallels the RACM process in reviewing cost and credits estimates for

attainment. Based on these criteria, the most reasonable programs are being implemented in a short timeframe.

The following is a summary of the process and exemplifies its connection to RACM issues:

1. A wide list of potential measures was reviewed.
2. The measures were deemed reasonable based on economics and credit potential
3. Speed of implementation and political status were closely reviewed when determining the most effective measures.

RACT Process:

In addition to the above, Maryland has been involved in the RACT process for stationary sources. This process, calling for regulations to implement Reasonably Available Control Technologies for stationary sources that produce 25 tons per day or more of NO_x and/ or VOC's, has been utilized in Maryland since the early 1990's. Within this process, which involves stakeholders and state experts on source controls, reasonable control technologies are reviewed and decided upon and regulations are developed to ensure that RACT agreements are enforced. Cost effectiveness and technical circumstances are two of the most critical decision factors in the RACT process.

Appendix A

EPA Documents

- 1. RACM Guidance**
- 2. CAA Section 108(f) Measures**

CAA Section 108(f)

CAA Section 108(f) measures:

- Programs for improved public transit;
- Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high occupancy vehicles;
- Employer-based transportation management plans, including incentives;
- Trip-reduction ordinances;
- Traffic flow improvement programs that achieve emission reductions;
- Fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service;
- Programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;
- Programs for the provision of all forms of high-occupancy, shared-ride services;
- Programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
- Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists in both public and private areas;
- Programs to control extended idling of vehicles;
- Programs to reduce motor vehicles emissions, consistent with Title II, which are caused by extreme cold start conditions;
- Employer-sponsored programs to permit flexible work schedules;
- Programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of the locality, including programs, and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;
- Program for new construction and major reconstruction of paths, tracks, or areas solely for use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest. For purposes of this clause, the Administrator shall also consult with the Secretary of the Interior;
- And programs to encourage the voluntary removal from use and from the marketplace pre-1980 model year light duty vehicles and pre-1980 light duty trucks.

Appendix B

Summary of Analytical Evaluation

Calculations:

Calculations were performed by staff of the Maryland Departments of the Environment and Transportation and the Metropolitan Planning Organization for the Baltimore region. Calculations were performed in accordance with standard practice, as used in Conformity Determinations, State Implementation Plans, and for federal Congestion Mitigation and Air Quality (CMAQ) analyses.

Methodologies:

Methodologies for emissions reductions estimates were garnered from various sources, including federal guidance, organizational sources (such as the Transportation Research Board), and academic studies. Where applicable, standard methodologies used for the above listed air quality processes were used. Where a control measure presented a new emission reduction strategy for the region or state, new source methodologies were used.

Professional Judgment:

Where applicable, professional judgment assisted with the evaluation of these control measures, particularly to assess factors such as political feasibility and timeframe for implementation. Aspects of professional judgment included initial assessment by staff of Maryland's air quality and transportation agencies, and the regional transportation body for the Baltimore region. Professional judgment also included review and assessment by transportation and environmental professionals in the field of air quality and transportation, many with 15+ years of experience in the assessment of emissions reductions, travel demand modeling, and the development and implementation of emission reduction strategies and regulations. Additional assistance was provided by consultants, specialized professions (such as Information Technology Systems (ITS)), and staff from modal administrations familiar with CMAQ assessments and implementation by mode. Federal agency review was included in the process to the extent possible.

Description of Fields in RACM Analysis Table

Number of strategy, for ease in discussion only (not rank or priority)

Source

Source of strategy, i.e., comment letter, Section 1108(f) measure, 1994 TCM Technical Review Committee, Emissions Mitigation Strategies Subcommittee (2000 – current), listed in summary document of Emissions Reduction measures in the Baltimore region (September 2000), currently active strategy in the region (conformity)

VOC/NOx Emissions reduction estimates for year 2005 in tons/day.

Estimates that were not updated from the 1994 calculations were not added to the chart, but can be found in the text of the document.

Grey shaded boxes indicate that air quality credits for this activity have been used in conformity. Dark outline boxes indicate that the activity is currently active in the region, but air quality credits have not been taken for conformity or in the SIP.

Relevant Factors

Factors about the strategy that may affect its RACM or SIP inclusion eligibility

RACM?

Whether the strategy is considered RACM

Reason

Reason(s) strategy may or may not be considered RACM (May be same as relevant factors)

Summary Table: Strategies Evaluated for RACM Determination (Please see main text for more information)

Grey shaded boxes indicate that credit for strategy is used in transportation conformity analyses; heavy borders on emissions boxes indicate that strategy is in place in the region but no credit is taken. Please see main text for most accurate information (this chart for summary purposes only)

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
1	Accelerated phase-out of diesel buses; replace with cleaner fuels such as natural gas – MTA buses to CNG	BRP letter 2/22/00; ED letter 3/28/00; MOP letter 6/28/00	.18	.447	MDOT is funding effort to replace MTA buses. Expensive turn in less than 5 years, takes 12+ years to replace fleet at normal replacement rate.	No	High cost. Timing of replacement. Implementation issues (reliability, maintenance, safety)
2	Downtown CNG Shuttle Fleet	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	.01	.005	NA	No	Implementation issues (additional cost, maintenance, infrastructure requirements); small fleet size
3	Downtown Electric Buses for Tourist Attractions	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	0.006	0.02	Emissions estimates based on MDE assumptions*one bus, 40,000 miles per year, 300 days per year, low credits. transfer of pollution from mobile to stationary	No	Does not advance attainment date; cost
4	MTA Bike Racks on Buses	Emissions Mitigation Strategies Subcommittee (2000-current) Phase Three	See Bike Ped Package	See Bike Ped Package	NA	No	Implementation issues (bus washes); trial phase determine usage/ability to implement
5	Cash for Clunkers (pre-1975)	1994 TCM Technical Review Committee Review Phase Three	1.185	0.705	Transient benefits	No	Transient benefits
6	I/M for diesel vehicles and/or roadside pull over testing of diesels	ED letter 3/28/00; MOP letter 6/28/00	--	--	Technical and cost limitations. Questionable benefits for NOx/VOC, primarily for PM; pull over testing for heavy duty diesels in place	No	Technical and cost limitations
7	CARB diesel fuel	ED letter 3/28/00; MOP letter 6/28/00	--	--	Difficult to isolate Maryland in regional market; new diesel rules	No	Difficult to isolate Maryland in regional market; benefits do not exceed new diesel rules
8	Bus engine upgrade		0.000	0.000	Low benefits, questionable benefits for NOx/VOC, primarily for PM	No	Does not advance attainment date

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
9	Revise local zoning and other codes for parking to insure paid transit and cash-in-lieu of parking incentives	BRP letter 5/11/00; 1994 TCM Technical Review Committee Review Phase Three; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase III	--	--	Requires local zoning changes. Not in timeframe for attainment.	No	Cannot be implemented in timeframe to advance the attainment date
10	Tax credit incentives for employers and employees, subsidies of transit fares	ED letter 3/28/00; 1994 TCM Technical Review Committee Review Phase Three; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase III	0.011	0.034	1994 TCM Technical Review Committee Cost = \$26,896,900 2001 analysis used private sector (CA); difficult know # rented spaces, new practice; union issues	No	Does not advance attainment date
11	Mandatory Employer Cash-Out Subsidy for Transit/HOV	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation; political infeasibility.	No	Cannot be implemented in timeframe to advance attainment date
12	Flexible Work Week/Four Day Work Week	1994 TCM Technical Review Committee Review Phase Three	--	--	Uncertainty in decrease in trips. Already substantially implemented where applicable.	No	Does not advance attainment date; Cost
13	Financial Incentives for Telework Programs	1994 TCM Technical Review Committee Review Phase Three	--	--	High cost.	No	Does not advance attainment date; Cost
14	The BWI Business Partnership- van shuttle service		0.001	0.004	NA	No	Does not advance attainment date Low emission benefits
15	Home-based telecommuting		0.490	1.270	Implementation year after 2005	No	Does not advance attainment
16	TransitPlus program		--	--	Captured in baseline, no change in enforceability	No	Captured in baseline, no change in enforceability

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
17	Congestion Pricing on Low Occupancy Vehicles	1994 TCM Technical Review Committee Review Phase Two; 1994 TCM Technical Review Committee Review Phase Three	--	--	Requires legislation. Questionable political feasibility. Questionable equity impacts.	No	Does not advance attainment date Implementation issues
18	Build (Implement) HOV Network in the Freeway System	1994 TCM Technical Review Committee Review Phase Two	--	--	Political infeasibility for early implementation. Corridor study underway.	No	Cannot be implemented in timeframe to advance attainment
19	Vanpool Improvement Program	1994 TCM Technical Review Committee Review Phase Three	--	--	Some aspects requires legislation; administratively burdensome.	No	Does not advance attainment date Implementation issues
20	Integrated Ridesharing Measures	1994 TCM Technical Review Committee Review Phase Three	--	--	Supports rideshare efforts; not possible to isolate additional benefits	No	Does not advance attainment date Implementation issues
21	Regional Vanpool Insurance Program	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation	No	Does not advance attainment date Implementation issues
22	Free Parking for Carpools and Vanpools	1994 TCM Technical Review Committee Review Phase Two	--	--	High-impact cost in CBD; low impact emissions for non-CBD (due to lack of parking charges)	No	Does not advance attainment date Implementation issues
23	Advanced Transportation Management System	1994 TCM Technical Review Committee Review Phase Three	--	--	Unreliable for credit	No	Does not advance attainment date Implementation issues
24	Flashing Yellow in the Predominant Direction (midnight to 5 AM)	1994 TCM Technical Review Committee Review Phase Two	--	--	Safety concerns.	No	Does not advance attainment date Implementation issues
25	Right Turn on Red in Central City	1994 TCM Technical Review Committee Review Phase Two	--	--	In baseline	No	Does not advance attainment date Implementation issues
26	Improved traveler information services	ED letter 3/28/00; MOP letter 6/28/00	0.001	0.009	NA	No	Does not advance attainment Low emissions benefits
27	Increased Adherence to 55 MPH Speed Limit	1994 TCM Technical Review Committee Review Phase Three	--	--	Difficulty in implementing in SIP timeframe; cost; coordination	No	Does not advance attainment date Implementation issues
28	Signal systemization		0.089	-0.015	NA	No	Low emissions benefits
29	Modified land development patterns	BRP letter 2/22/00	--	--	(Assumes implementation as mandatory restrictions)	No	Implementation issues; cannot be implemented in timeframe to advance attainment

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
30	Convenience Commercial Centers in Residential Areas	1994 TCM Technical Review Committee Review Phase Two	0.00048	0.001	Local reasons, requires zoning changes, lengthy public process	No	Does not advance attainment date Implementation issues
31	Graduated Tax on Vehicle Mileage	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation; political infeasibility	No	Does not advance attainment date Implementation issues
32	Pollution Fee for Gasoline Powered Motor Vehicles	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation; political infeasibility	No	Does not advance attainment date Implementation issues
33	Increase Gasoline Taxes by \$0.75 per Gallon	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation; political infeasibility	No	Does not advance attainment date Implementation issues
34	Market-based Parking Charges for Federal Facilities	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires federal action	No	Does not advance attainment date Implementation issues
35	Graduated Additional Vehicle Registration Fee	1994 TCM Technical Review Committee Review Phase Two	--	--	Requires legislation; political infeasibility	No	Does not advance attainment date Implementation issues
36	Highway Ramp Metering	1994 TCM Technical Review Committee Review Phase Two	--	--	Low/no emissions benefits; merely relocates congestion; public opposition; requires substantial public education; equity concerns	No	Does not advance attainment date Implementation issues
37	MTA annually implements Try Transit Week (or "Great Ride In")	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	--	--	Scope, enforceability, and scale limit SIP inclusion	No	Does not advance attainment date Low emissions benefits
38	Clean Commute Week		--	--	Scope, enforceability, and scale limit SIP inclusion	No	Does not advance attainment date Low emissions benefit
39	Employee Parking Space Tax Outside Baltimore CBD	1994 TCM Technical Review Committee Review Phase Two	--	--	Local reasons, equity impacts, Disincentive for economic development.	No	Does not advance attainment date Implementation issues
40	Employee Parking Space Tax in Baltimore CBD	1994 TCM Technical Review Committee Review Phase Two	--	--	Local reasons, equity impacts, Disincentive for economic development.	No	Does not advance attainment date Implementation issues
41	Restrict New Parking Construction	1994 TCM Technical Review Committee Review Phase Two	--	--	Local issues, zoning timeframes, backing, bank requirements, changes in banking structure	No	Does not advance attainment date Implementation issues

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
42	Control Student Parking at High Schools	1994 TCM Technical Review Committee Review Phase Two	--	--	Non-ozone season; political infeasibility.	No	Does not advance attainment date Implementation issues
43	Expansion of transit service	BRP letter 2/22/00; ED letter 3/28/00; MOP letter 6/28/00; 1994 TCM Technical Review Committee Review Phase Three	--	--	Farebox recovery requirement makes exact prediction of service unreliable. Requires legislation to change. Extensive expansion proposed as part of Governor's Transit Initiative	No	Does not advance attainment date Implementation issues
44	Free Rail Fares between 10 AM and 3 PM Weekdays	1994 TCM Technical Review Committee Review Phase Two	--	--	High cost.	No	Does not advance attainment date Implementation issues
45	Reduced or zero transit fares	BRP letter 2/22/00; 1994 TCM Technical Review Committee Review Phase Three	--	--	Farebox recovery requirement; requires legislation to change.	No	Cannot be implemented in timeframe to advance attainment Implementation issues
46	Free Transit Passes to Students	1994 TCM Technical Review Committee Review Phase Two	--	--	Farebox recovery requirement. Discounted pass program in place	No	Does not advance attainment date Implementation issues
47	Half Price Fare on Feeder Bus Service to Metro and other Rail Transit Stations	1994 TCM Technical Review Committee Review Phase Two	--	--	Farebox recovery requirement.	No	Does not advance attainment date Implementation issues
48	Single Price Public Transit Services	1994 TCM Technical Review Committee Review Phase Two	--	--	Farebox recovery requirement.	No	Does not advance attainment date Implementation issues
49	Transit priority treatment	ED letter 3/28/00; MOP letter 6/28/00; 1994 TCM Technical Review Committee Review Phase Three	--	--	Timing. Cost. Permanence. Questionable change in ridership	No	Does not advance attainment date Implementation issues
50	Transit Transfer Centers with Extensive Suburban Coverage	1994 TCM Technical Review Committee Review Phase Three	--	--	Cost. Timing. Private sector involvement. No build out in time for attainment.	No	Does not advance attainment date Implementation issues
51	Shorter Distances from Bus Stops to Buildings	1994 TCM Technical Review Committee Review Phase Two	0.060	0.135	Owner costs, route changes, potential bus delays, long planning process, local issues, urban valley effect.	No	Does not advance attainment date Implementation issues
52	Access to Jobs program		--	--	Difficult to quantify; annual funding variability, questionable SOV conversion	No	Does not advance attainment date Low emissions benefits

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
53	Bus replacement - Local bus systems- Howard County		0.000	0.012	See below	No	Does not advance attainment date Low emissions benefits
54	Bus replacement - Local bus systems-Harford		0.000	0.003	See below	No	Does not advance attainment date Low emissions benefits
55	Bus replacement - Local bus systems-Annapolis		0.000	0.003	Emissions estimates approximate based on other local bus replacement schedules (variable).	No	Does not advance attainment date Low emissions benefits
56	MTA email computer service (service alerts & customer service)		--	--	Acts as transit support service	No	Does not advance attainment date
57	Cromwell Light Rail Maintenance and Layover Facility		0.012	0.020	NA	No	Does not advance attainment Low emissions benefits
58	Downtown Transit Store		0.003	0.008	NA	No	Low emissions benefits
59	Trip-reduction ordinances	BRP letter 2/22/00; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	--	--	Preference for voluntary vs. mandatory due to political infeasibility.	No	Does not advance attainment date Implementation issues – ability to implement in timeframe to advance attainment
60	Value pricing	ED letter 3/28/00; MOP letter 6/28/00	--	--	Political infeasibility; delays in legislation; questionable equity impacts; questionable AQ benefits	No	Cannot be implemented in timeframe to advance attainment Implementation issues
61	Control of Extended Idling	1994 TCM Technical Review Committee Review Phase Three	--	--	Requires legislation.	No	Cannot be implemented in timeframe to advance attainment Implementation issues
62	Light Rail double tracking & additional vehicles		--	--	Emissions benefits captured in travel demand model network (baseline)	No	Does not advance attainment date
63	MTA On-Line Transit Pass Store		--	--	Unquantifiable- support service, assists with general transit ridership	No	Does not advance attainment date
64	ATM machines installed at three Metro stations		--	--	Supporting program	No	Does not advance attainment date

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
65	Regional Telework Centers	1994 TCM Technical Review Committee Review Phase Three	0.015	0.046	No demonstrated market demand for telecenters; high cost; home-based telework more predominant in the Baltimore region	No	Does not advance attainment Low emissions benefits
66	Guaranteed Ride Home program	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	0.007	0.018	Isolated program not as effective as comprehensive program	No	Does not advance attainment Low emissions benefits
67	Encourage Use of Alternately Fueled Vehicles; ATV Program	1994 TCM Technical Review Committee Review Phase Three; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase III	0.025	0.085	Range (0.01-0.25 (2005) VOC; 0.034-0.085 (2005))	No	Does not advance attainment date Low emissions benefits
68	Bus replacement – MTA Fleet		0.080	0.920	NA	No	Low emissions benefits; does not advance attainment
69	Commuter Choice (also, Employer-based transportation management plans, including incentives)	BRP letter 2/22/00; MOP letter 6/28/00; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three (1994 TCM Technical Review Committee Review Phase Three)	--	--	Currently under analysis by MDOT.	No	Will not advance attainment date
70	5 elements of jurisdiction-level Commuter Choice program	BRP letter 5/11/00; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	.015	.048	Local decisions.	No	Cannot be implemented in timeframe to advance the attainment date
71	Baltimore Region Rideshare program		0.000	0.006	NA	No	Does not advance attainment date Low emissions benefit
	Park-n-Ride Lots		0.012	0.048	NA	No	Does not advance attainment date Low emissions benefit
72	Electronic Toll Collection		0.052	0.033	NA	No	Does not advance attainment date Low emissions benefit

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
73	ENDZONE Partners Program (Clean Air Partners) Mobile Emissions	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	0.3	0.96	Voluntary Program	No	Does not advance attainment date Low emissions benefit
74	ENDZONE Partners Program (Clean Air Partners) Non Road Emissions	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	.05	0.005	Voluntary Program	No	Does not advance attainment date Low emissions benefit
75	The College 33 Pass program		0.014	0.032	NA	No	Does not advance attainment date Low emissions benefit
76	MARC improvements–50 new bi-level passenger cars		0.014	0.052	NA	No	Does not advance attainment date Low emissions benefit
77	Bus terminal at Penn Station		0.068	0.022	NA	No	Does not advance attainment date Low emissions benefit
78	Telework Partnership with Employers Program		0.100	0.490	Commitment only to 2002	No	Does not advance attainment date Implementation Issues
79	Accelerated bike/ped access to transit and facility improvements	ED letter 3/28/00; 1994 TCM Technical Review Committee Review Phase Three; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase III	--	--	See Bike/Ped Summary	No	Does not advance attainment date
80	Provide Bicycle Racks and Lockers at all Transit Stations	1994 TCM Technical Review Committee Review Phase Three	--	--	See Bike/Ped Summary	No	Does not advance attainment date
81	Expanded bike/ped facilities; accelerated improvements	BRP letter 2/22/00; ED letter 3/28/00; MOP letter 6/28/00; 1994 TCM Technical Review Committee Review Phase Three; Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase III	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
82	Bike-to-work Day		See Bike Ped Package	See Bike Ped Package	Scope, enforceability, and scale limit SIP inclusion [See Bike/Ped Summary]	No	Scope, enforceability, and scale limit SIP inclusion
83	Retrofit Sidewalk Program	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date
84	Retrofit Bicycle Program	Emissions Mitigation Strategies Subcommittee (2000-current) Phase Three	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date
85	Annapolis Transit Bike Racks & Shelters	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date
86	Local Bike/Ped Programs	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date
87	Employer-provided Bicycles	1994 TCM Technical Review Committee Review Phase Two	See Bike Ped Package	See Bike Ped Package	See Bike/Ped Summary	No	Does not advance attainment date
	Summary of Bike/Ped Strategies		0.969	0.111	Includes advancement of all planned bike/ped projects (2025) by 2005; Implementation and funding at the local level is prohibitive	No	Does not advance attainment date Implementation issues
88	Land use: infill redevelopment, TOD	ED letter 3/28/00; MOP letter 6/28/00	--	--	Difficult to quantify projects; annual variability;	No	Cannot be implemented in timeframe to advance attainment Implementation issues
89	Incentives for Mixed Uses at Transit Stations	1994 TCM Technical Review Committee Review Phase Two	--	--	Difficult to quantify projects; annual variability	No	Does not advance attainment date; may not be implemented in timeframe to advance attainment
90	Live Near your Work	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	--	--	NA	No	Does not advance attainment date Low emissions benefit

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
91	Neighborhood Conservation Program	Emissions Mitigation Strategies Subcommittee (2000-current) Phase Three	--	--	Not possible to quantify projects; annual variability	No	Does not advance attainment date Low emissions benefit
92	Smart Growth Transit Programs	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	--	--	Not possible to quantify projects; annual variability	No	Does not advance attainment date Low emissions benefit
93	Transit Station Smart Growth Initiative	Emissions Mitigation Strategies Subcommittee (2000-current) Phase Three	--	--	Not possible to quantify projects; annual variability	No	Does not advance attainment date Low emissions benefit
94	Infill Development: Digital Harbor	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	see below	see below	NA	No	Does not advance attainment date
95	Infill Development: Parole	Emissions Mitigation Strategies Subcommittee (2000-current) Phase Three	see below	see below	NA	No	Does not advance attainment date
96	Infill Development: Owings	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	0.000	0.000	Low/no emissions benefits in 2005 timeframe.	No	Does not advance attainment date Low emissions benefit
97	Upgrade new fleet of Metro subway cars		0.005	0.020	NA		Low emissions benefit
98	CHART (ITS)		--	--	Awaiting analysis		Low emissions benefit
99	Mills Corporation Activities		0.010	0.040	Commitment only to 2002; awaiting if will be extended to 2005		Does not advance attainment date Low emissions benefit
100	Clean Air & Transportation (\$1 M MDOT funding - \$250,000 Baltimore region)	Emissions Mitigation Strategies Subcommittee (2000-current) Review Phase Three	--	--	Included in Commuter Choice quantification		Does not advance attainment date
101	Smart Card		--	--	Awaiting analysis		Low emissions benefits

#	Strategy	Process or Status	VOC (tpd)	NOx (tpd)	Relevant Factors	RACM?	Reason
102	Build P&R Lots Near Selected Major Highway Intersections and Along HOV Facilities	1994 TCM Technical Review Committee Review Phase Three	0.009	0.328	Assumes 6 lots on freeway approaches. Level of utilization of projected lots does not yield significant emissions reductions in 2005 timeframe.	No	Does not advance attainment date Low emissions benefits
103	Increase Frequency of Commuter Rail	1994 TCM Technical Review Committee Review Phase Three	0.012	0.050	Assumes 10% increase in frequency; Operators state that frequency is already at maximum capacity.	No	Does not advance attainment date Low emissions benefit
104	Discounted pre-paid transit fare instruments, reduced transit fares, and fare free zones	ED letter 3/28/00; MOP letter 6/28/00	--	--	NA	No	Does not advance attainment date Implementation issues

Appendix C

1994 BMC TCM Report

Appendix D

Planning Process Issues (composite from conversations with Anne Arundel County, Baltimore County, and Baltimore City Planning and Zoning Departments) for large scale planning revisions

Agency Recommendation



Meet and discuss with planning and zoning



Meet and discuss with area being impacted



Meet and discuss with stakeholders



Find legislative backing to seek county enactment



Meet and discuss with development management office



Traffic Analysis Study



Public Hearing Process



Zoning Board of Appeals (ZBA) Process (will involve public)



Planning and Zoning Board Meetings and Public process



Final Change in Development Plan (for zoning change or setback change)



Approval of Plan