COMMUTER CONNECTIONS
TRANSPORTATION DEMAND MANAGEMENT
EVALUATION PROJECT

TRANSPORTATION EMISSION REDUCTION MEASURES (TERMS)
REVISED EVALUATION FRAMEWORK
2008 – 2011

Prepared for:

National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments
777 North Capitol Street, NE, Suite 300
Washington, DC 20002-4290

Prepared by:

LDA Consulting
Washington D.C.
PH (202) 548-0205

In conjunction with:

Eric N. Schreffler, Transportation Consultant
and
CIC Research, Inc

May 18, 2010

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EXECUTIVE SUMMARY

The Commuter Connections Program of the Metropolitan Washington Council of Government (COG), in concert with program partners, is responsible for implementing five Transportation Emission Reduction Measures (TERMs) in support of the metropolitan Washington region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Maryland and Virginia Telework – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.
- Employer Outreach – Provides regional outreach to encourage large, private-sector employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and improved in-house trip reduction programs.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute.
- Integrated Rideshare-Software Upgrades Project – Improves the quality and delivery of alternative mode information and provides transit, park & ride, and telecenter information to all commuters who receive a matchlist.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all the TERMs described above.

This report provides a framework and methodology for evaluating the transportation and air quality impacts of these TERMs. This methodology and numerous surveys and other data collection tools described later in this report have been developed to estimate the TERMs' impacts for the period from July 2008 through June 20011 (FY 09-11). These impacts then will be compared against the goals established for each TERM by COG's National Capital Region Transportation Planning Board (TPB), the region's designated Metropolitan Planning Organization (MPO). The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

At the early stages of the TERMs' implementation, Commuter Connections elected to undertake significant evaluation for each TERM. The TERM evaluation and analysis process has been ongoing since 1997. The objective of the evaluation process is to provide timely, useful, and meaningful information on the performance of the TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and Transportation Management Associations (TMA); and employers and commuters who comprise Commuter Connections' clients.

Four previous evaluation frameworks have been prepared, the first for the January 1997 through June 1999 period (1997-1999) period, the second for the July 1999 through June 2002 period (1999-2002), the third for July 2002 through June 2005 (2002-2005), and the fourth for July 2005 through June 2008

(2005-2008). The evaluation framework presented in this document builds on the framework used in the 2005-2008 analysis. Several changes have been made to the TERM evaluation framework for 2008-2011 to address changes in some TERMs, such as end of the InfoExpress Kiosk component of the Integrated Rideshare TERM and the end of the Virginia component of Maryland and Virginia Telework in June 2009. Changes also were made to the framework to update the methodology to reflect methods applied in the 2005-2008 TERM analysis. These are described later in this document.

The evaluation process outlined in this framework allows for both on-going estimation of program effectiveness and for annual and triennial evaluations. Two types of performance measures are included in the evaluation process to assess effectiveness. First, measures reflecting commuters' and users' awareness, participation, utilization, and satisfaction with the program, and their attitudes related to transportation options are used to track recognition, output, and service quality.

Second, program impact measures are used to quantify six key outcome results, including:

1) Vehicle trips reduced
2) Vehicle miles of travel (VMT) reduced
3) Emissions reduced: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), Particulate Matter ($PM_{2.5}$), and Carbon Dioxide (CO2) and other associated greenhouse gases
4) Energy reduction (fuel saving)
5) Consumer saving (commuting cost saving)
6) Cost effectiveness, in terms of cost per benefit obtained (e.g., cost per trip reduced)

The evaluation process uses several calculation factors derived from surveys of Commuter Connections' program applicants and/or the public-at-large. These factors include: 1) placement rate (percent of commuters who shift to alternative modes), 2) vehicle trip reduction (VTR) factor (average daily trips reduced for each commuter placed), 3) average commute trip distance, and 4) proportion of ridesharers and transit users that drive alone to the location where they meet their carpool, vanpool, bus, or train.

These performance measures and factors are applied within the basic methodology steps listed below to calculate program impacts for each TERM.

1) Estimate commuter population "base" for the TERM (e.g., all commuters, GRH applicants, rideshare matching applicants, Employer Outreach employees, etc.)
2) Calculate "placement rate" – Percentage of commuters in the population base who made a travel change as a result of the TERM
3) Estimate the number of new alternative mode placements – Multiply placement rate by the population base for the evaluation period
4) Calculate the vehicle trip reduction (VTR) factor for new placements – Average daily vehicle trips reduced per placement
5) Estimate vehicle trips reduced – Multiply number of placements by the VTR factor
6) Estimate vehicle miles traveled (VMT) reduced – Multiply number of vehicle trips reduced by average commute distance
7) Adjust vehicle trips and VMT for access mode – Discount vehicle trips reduced and VMT reduced to account for commuters who drive alone to meet rideshare modes and transit

8) Estimate NOx, VOC, $PM_{2.5}$, and CO_2 emissions reduced – Multiply adjusted vehicle trips and VMT reduced by emissions factors consistent with the regional planning process

9) Estimate the energy and commuter cost savings – Multiply VMT reduced by fuel efficiency and vehicle operating cost factors

10) Estimate cost effectiveness – Divide program or TERM costs by the program impact measures

The calculations outlined above have been embedded into a spreadsheet used by Commuter Connections and its partners to track estimated results on a quarterly basis. An annual summary of these results is included in Commuter Connections' Annual Report. The factors used in the spreadsheet are updated as new surveys relevant to each TERM are completed. At the end of the three-year evaluation period, a TERM Analysis Report is prepared to summarize reductions in vehicle trips, VMT, and emissions and progress toward goals in each of these performance indicators for the three-year period.

Throughout the evaluation period, additional reports are prepared to present results of major data collection efforts, such as the rideshare applicant placement survey, the "State-of-the-Commute" survey of regional commuting trends and attitudes, GRH Applicant survey, and others. These reports are distributed to program partners, policy makers, and other with an interest in regional transportation.

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SECTION 1 OVERVIEW

This report provides a framework and methodology for evaluating the transportation and air quality impacts of five Transportation Emission Reduction Measures (TERMs) implemented by the Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in support of the Washington metropolitan region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Maryland and Virginia Telework – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.
- Employer Outreach – Provides regional outreach to encourage large, private-sector employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and improved in-house trip reduction programs.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute.
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Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all the TERMs described above.

The evaluation framework serves two purposes. First, it assesses Commuter Connections' progress in meeting the transportation and air quality goals established by COG's National Capital Region Transportation Planning Board (TPB) for the TERMs for the period July 2008 through June 2011 (FYs 09-11). Second, it guides COG's future evaluation efforts to assess the effectiveness and cost effectiveness of the TERMs. The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group. The framework describes an overall evaluation process for the program and specific evaluation techniques for each TERM.

This report represents an update to four previous evaluation framework documents developed to evaluate results and progress toward goals during four three-year periods: January 1997 through June 1999,[1] July 1999 through June 2002[2], July 2002 through June 2005[3], and July 2005 through June 2008[4], respectively.

[1] Commuter Connections Transportation Demand Management Evaluation Project: Transportation Control Measures Evaluation Framework, June 30, 1997.
[2] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 1999-2002, MWCOG, March 20, 2001.

The evaluation seeks to quantify the impacts of these five TERMs, results which will be used in calculations of the region's air quality conformity from the TERM Tracking Sheet. Commuter Connections had previously provided traditional ridematching services. This service is included in the "baseline" of travel and air quality indicators for the purposes of assessing regional air quality conformity.

This evaluation framework report is organized into seven sections following this overview. Section 2 defines evaluation objectives and issues guiding the process. Section 3 enumerates performance measures to be used in assessing program effectiveness and cost effectiveness. This section also presents a proposed approach to determine if new performance indicators are needed to support regional or local transportation initiatives and what indicators will be appropriate.

Section 4 discusses evaluation components specific to each of TERMs, Maryland and Virginia Telework, Guaranteed Ride Home, Employer Outreach / Employer Outreach for Bicycling, and Mass Marketing. This section also presents evaluation activities relevant for the Commuter Operations Center (COC) and the Software Upgrade component of the Integrated Rideshare TERM, which was combined with the COC in the 2005-2008 evaluation period.

Section 5 describes the data sources and data collection tools to be used to collect evaluation data. The next section, Section 6, outlines the method to calculate travel, air quality, energy, and consumer cost impacts of the TERMs. Section 7 presents recommendations for the evaluation schedule and responsibilities. Two additional sections were added to the evaluation framework for this evaluation period. Section 8 describes several tools currently used to report Commuter Connections' evaluation results to various stakeholder audiences and an approach to expand communication of Commuter Connections' evaluation results.

[3] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2002-2005, MWCOG, March 16, 2004.
[4] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2005-2008, MWCOG, May 15, 2007.

SECTION 2 EVALUATION OBJECTIVES AND ISSUES

PURPOSE OF THE EVALUATION

The objective of the evaluation process is to provide timely, useful, and meaningful information on the performance of the TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients. This information includes travel and air quality impacts, such as vehicle trips and miles of travel reduced and emissions reduced from the five TERMs implemented by the Commuter Connections program.

EVALUATION OBJECTIVES

The ultimate goal of this evaluation is to provide sound, definitive, and useful information about the results of TERMs to document program benefits for conformity reporting, identify program enhancements, and guide future decision-making about funding priorities. To this end, the framework defines a specific evaluation objective of providing useful information to the following groups:

- Regional policy-makers – Information on the effectiveness and cost effectiveness of TERMs in contributing to regional goals for reducing congestion, improving air quality, reducing energy consumption, and improving mobility and accessibility. This includes the development of policy reports that document TERM impacts in simple, clear language.

- Regional policy-makers and TERM program staff – Information to help establish regional commute trends and attitudes and provide an indication of the collective effect of all Commuter Connections programs on regional traffic and air quality, including impacts that are not specifically assigned in the evaluation to one of the four TERMs. One new evaluation-related activity that will be undertaken during this evaluation period is an assessment of future performance measures and communication tools that might assist program managers to report the benefits of the TERMs in ways that are most meaningful to policy-makers and funders.

- Program funders – Information on the effectiveness and cost effectiveness of the TERMs being implemented via the Commuter Connections program.

- Commuter Connections staff and program partners – Information on potential program enhancements to increase effectiveness and efficiency.

- Employers and commuters – Information on the collective, regional impacts of individual participation. Evaluation information can also be useful in showing employers the types of trip reduction strategies that might be cost effective for their specific worksite conditions

Additionally, the evaluation process follows accepted and recognized evaluation techniques; and is rigorous, ongoing, resource efficient, unobtrusive for COG partners, and compatible with regional, state, and national practices.

EVALUATION ISSUES

Prior to discussing the specific evaluation approach for each TERM, it is useful to discuss several key evaluation issues that are addressed in this framework that should be kept in mind as COG utilizes and modifies the process over time.

Purpose of the Evaluation

- The evaluation uses common, quantitative performance measures for all evaluation components to allow for comparisons among TERMs and between TERMs and other strategies that could be implemented to address congestion and air quality concerns. A crucial function of this evaluation process is to estimate the combined impacts of TERMs to assess the overall effectiveness of the Commuter Connections Program. Consistent and comparable methodologies also enhance confidence in the results. These common measures are enumerated in Section 3.

- The evaluation framework allows for quarterly activity reporting and benefits projection as a program management information tool. While assessment of travel and air quality benefits is the key purpose of the evaluation, the process must equally provide information to direct the day-to-day activities of the Commuter Connections program.

Separating Impacts of Program Elements

- The evaluation separates the impacts of individual Commuter Connections programs to avoid double counting benefits. For example, carpools might be formed as a joint result of Employer Outreach and GRH program benefits. These impacts must either be credited to one of the two TERMs or divided between the TERMs. Program benefits are not necessarily additive.

- Similarly, the evaluation separates the baseline impacts of Commuter Operations Center "basic" services from the impacts of the new TERM programs. The method for attributing impacts to a specific TERM or service is discussed in Section 6. This is especially important for the Mass Marketing TERM, because its impacts can be "direct," meaning the marketing effort alone motivated use of alternative modes, or "referred," meaning the marketing effort influenced commuters to utilize another Commuter Connections program, such as ridematching. In such cases, the travel and air quality impacts will be distributed to the TERM or to the Commuter Operations Center, based on their respective influences.

- When possible, the evaluation recognizes and attempts to address the possible impacts of exogenous factors. Travel decisions also are influenced by the extent of congestion, work and home locations, economic factors, fuel prices, and other factors. User surveys must carefully query commuters who shift to alternative modes to define the relative importance of TERMs in influencing their mode choices. Data collected through the State-of-the-Commute survey also should support this objective by suggesting exogenous factors that could have influenced travel changes.

Accounting for Prior Mode and Access Mode

- Prior mode is an important variable in this evaluation, because a shift to an alternative mode does not always mean a vehicle trip was eliminated. Vehicle trips are reduced only in three cases: 1) if the commuter shifts from driving alone to an alternative mode, 2) if the commuter increased the frequency of use of an alternative mode, or 3) if the commuter shifted to a higher-occupancy mode (e.g., from carpool to vanpool). Section 6 describes the development of vehicle trip reduction

(VTR) factors that are used to convert the number of new alternative modes placements into the number of vehicle trips reduced, taking into account the three change factors listed above.

- Finally, for air quality evaluation purposes, it is necessary to know the access mode of carpoolers, vanpoolers, and transit riders. Access mode refers to how carpoolers, vanpoolers, and transit riders travel from home to bus stops, train stations, Park & Ride lots, or other places where they meet their rideshare partners. Access mode is a minor issue in the evaluation of travel impacts, because access trips generally account for a small portion of the total trip and the alternative mode generally is used in the most congested and longest portion of the trip. However, commuters who drive alone to the meeting point still make a vehicle trip and accumulate some drive alone VMT, which must be subtracted from the vehicle trips reduced and VMT reduced in the air quality analysis.

Updating Calculation Factors and Assumptions Used in the Evaluation

- The TERM evaluation methodology applies calculation factors developed from surveys and other research conducted during the evaluation period. Specific revisions will be incorporated in the 2008-2011 evaluation as noted later in this report for each TERM. Additionally, regional emissions factors will be updated to reflect factors that will apply in 2011.

Including Greenhouse Gas Reductions

- The 2008 TERM Analysis estimated reductions in Carbon Dioxide (CO2), the primary greenhouse gas. This new emission calculation was added to the evaluation to provide data for regional climate change mitigation assessments.

Specific Evaluation Issues for Individual TERMs

In general, the TERM analysis approaches documented in the 2008 TERM Analysis Report are used as the basis for the TERM evaluation methods described in this framework. A sample of the TERM calculations are included in Appendices C through G, as excerpted from the 2008 TERM Analysis Report.

- Maryland and Virginia Telework – Maryland and Virginia Telework is a resource service to help employers, commuters, and program partners initiate telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to teleworking, the mode on non-telework days, and mode and travel distance to telework centers. Telework impacts are primarily estimated from the State of the Commute survey and by surveys conducted of employers directly requesting information from Commuter Connections. Note that the Virginia component of this program ended on June 30, 2009. The impacts for this TERM will be discounted to reflect availability of the TERM in Virginia for one of the three years of the evaluation period.

- Guaranteed Ride Home (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to alternative modes. Because past evaluation results showed that a sizeable portion of GRH applicants were ridesharing before they registered for GRH, the TERM analysis also explores benefits from the continuation and expansion of existing ridesharing arrangements. Thus, the evaluation for GRH will estimate the influence of GRH availability on both mode shifts and frequency of ridesharing. Enhancements made over the past several evaluation periods include discounting of VMT reductions made outside the COG non-attainment area and the derivation of one placement rate for both GRH applicants and one-time exemptions.

- Employer Outreach – Employer outreach applies a two-faceted approach employing empirical data on employer programs and modeled impacts. The empirical data come from the ACT! database of employer contacts, including information on the trip reduction strategies implemented at each worksite. The EPA COMMUTER model (v 2.0) applies these empirical data to project the likely change in employee commuting behavior for given change in the employer's program. The Model uses time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. In 2008, COG completed a new Household Travel Survey, collecting data that will be used to revise the regional travel models. This is expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If new coefficients are adopted during the 2008-2011 evaluation period, the coefficients used in the COMMUTER Model v. 2.0 will be updated to be consistent with the new coefficients.

  Additionally, the 2008-2011 methodology will distinguish between "new" impacts and "continuing" impacts. New impacts include impacts from employers that joined the program on or after July 1, 2008 and employers that were involved in Employer Outreach before July 1, 2008 but that enhanced their commute assistance services after that date. Continuing impacts include those from employers that joined before July 1, 2008 and made no changes since that date. These impacts are considered part of the new Employer Outreach baseline. Impacts from program reductions will be "back-filled" from new or expanded programs instituted on or after July 1, 2008.

  Finally, employer bicycle programs, which were evaluated separately from other Employer Outreach services in 2002 and 2005 under the Employer Outreach for Bicycling TERM, will be addressed within the Employer Outreach TERM. But the contribution of these bicycle programs will continue to be calculated and reported separately.

- Mass Marketing – The critical issue for this TERM is attributing changes in attitudes and behavior to the mass marketing campaign versus another TERM. Two types of impacts are possible for Mass Marketing: "direct" impacts generated by commuters who cite the regional marketing campaign as the reason for their commuting change and "referred" impacts that are generated when advertising encourages commuters to submit rideshare and GRH applications. This is explained further in Section 4. The evaluation will be accomplished using a variety of data sources, including the State-of-the-Commuter survey and COC tracking data.

- Integrated Rideshare-InfoExpress Kiosks Project – In the 2005-2008 framework, the InfoExpress Kiosk project was analyzed as one of five TERMS. This program ended on January 31, 2007, thus has been deleted from this framework.

- Integrated Rideshare–Software Upgrades Project – Impacts for this TERM project will continue to be evaluated as part of the Commuter Operations Center (COC) under the Integrated Rideshare TERM. However, their impacts will be calculated and reported as a distinct sub-set of the Commuter Operations Center.

The evaluation activities described in the sections below elaborate on these issues.

SECTION 3 PERFORMANCE MEASURES

The previous evaluation frameworks established performance measures for each TERM. This framework updates and expands on those measures. Performance measures are measures of a program's success; how well the program is meeting its goals. Generally, we recommend that performance measures be established in the following two categories:

- Program awareness, attitudes, participation, utilization, and satisfaction
- Program impacts

Program awareness provides an indication of how well known the Commuter Connections program and its service are to commuters. Awareness will assume a larger role in this evaluation period since awareness is a primary goal of the new Mass Marketing TERM. A related type of measure is commuters' *attitudes* toward their commute and toward various commute modes. These measures examine commuters' personal feelings about travel modes and their willingness to consider and try new modes of travel.

Participation, utilization, and satisfaction measures could include, for example, the number of commuter assistance requests, number of matchlists provided, the speed with which assistance is delivered, and users' satisfaction with the assistance. These measures are important for tracking funding, estimating staffing, and identifying program improvements.

They generally also are needed to calculate the ultimate performance measures, *program impacts*, such as changes in mode split, vehicle trips reduced, and emissions reduced. This section describes several common performance measures recommended for each TERM and for the program as a whole. Performance measures specific to each TERM are listed in Section 4.

AWARENESS AND ATTITUDES

- Awareness – Program awareness will be measured in the proportion of residents and commuters who recognize the Commuter Connections "branding" and the range of services it provides or facilitates and are aware of transportation facilities available to them. Awareness will be assessed by both unaided and prompted questions in surveys of the public at large.

- Attitudes – A second area of exploration is attitudes toward commuting and solutions to congestion. One goal of the Mass Marketing TERM is to address growing frustration levels among commuters that congestion is worsening and that there are few alternatives to sitting alone in rush-hour traffic. The evaluation will document travel attitudes over time, including commute ease and trial use of alternatives to driving alone. This information is currently captured in the State of the Commute survey and will continue to be tracked as more general population surveys are conducted.

PROGRAM PARTICIPATION, UTILIZATION AND SATISFACTION

These performance measures gauge services provided and the use of those services.

- Program Participation – Program participation refers to the number of clients who request services and the number who are assisted. Participation could include the numbers of new employer clients, GRH applicants, telework employer sites, etc. A primary participation measure will be *number of applicants*, but other measures, specific to individual TERMs, also are described in Section 4.

- Utilization – Utilization is defined as the number of "placements," commuters who shift to alternative mode arrangements as a result of the Commuter Connections services. These commuters could be new carpoolers, vanpoolers, transit riders, teleworkers, etc. The primary utilization measure will be the *placement rate*, the ratio of the number of commuters who shifted to an alternative to the number of total users of the TERM services.

- Program Satisfaction – A qualitative, but important set of performance measures is suggested to assess client satisfaction, an important feedback mechanism to determine whether services are meeting customers' needs and their expectations. This is important for Commuter Connections to gauge satisfaction of various customers: employers, commuters, GRH users, and teleworkers, for example.

PROGRAM IMPACTS

Program impact measures estimate travel, air quality, energy, and commuter cost saving benefits of the TERMs. The five impact measures include: vehicle trips reduced, vehicle miles traveled (VMT) reduced, emissions reduced, energy saving, consumer cost saving, and cost-effectiveness.

- Vehicle Trips Reduced – The number of vehicle trips reduced is the first of two transportation impact measures. It estimates the number of daily vehicle trips removed from the road. This is a primary measure of congestion relief, as fewer vehicles on the road during peak hours could reduce delay, increase travel speed, reduce commute time, and improve service levels on roads. It is also a primary input (trip end emissions) to the air quality analysis.

  Vehicle trip reduction is estimated using a *vehicle trip reduction (VTR) factor*, the average number of vehicle trips reduced per day for each person placed into an alternative mode (placement). This rate accounts for shifts from drive alone to alternative modes, for shifts among alternative modes (e.g., from carpool to vanpool and from transit to carpool), and for increases in the frequency (days per week) that a commuter uses an alternative mode. Shifts from alternative modes to drive alone are not included in the VTR factor, since these changes are not the intended result of commuters' contact with Commuter Connections, but generally an unintended effect. Appendix A describes how the VTR factor is calculated. Appendix B shows a sample VTR factor calculation.

- Vehicle Miles of Travel (VMT) Reduced – VMT reduced, the second transportation impact measure, estimates the total miles of vehicle travel removed from the road daily. VMT reduction is particularly important to the air quality and energy evaluation.

- Emissions Reduced – Emissions reduced measures the decrease in mobile source (tailpipe) emissions that result from reductions in vehicle trips or VMT. From the start of the TERM evaluations, the primary pollutants of concern were Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), which are both ozone precursors. The 2008 TERM Analysis added calculation of impacts for two components of particulate matter (PM): direct PM2.5 emission, and NOx precursors, and for Carbon Dioxide (CO2), the primary greenhouse gas. These measures also will be estimated in the 2008-2011 evaluation.

- Energy Saving – The energy saving, defined as the reduction in the number of gallons of gasoline used, resulting when commuters reduce VMT.

- Consumer Cost Saving – A fifth measure of program impacts is the aggregate cost savings realized by commuters who reduce daily vehicle trips and VMT.

- Cost-Effectiveness – Cost effectiveness, the final program impact measure, is calculated as the cost expended to achieve the benefits noted above, for example, the cost per vehicle trip reduced.

PROCESS TO REVIEW AND UPDATE PERFORMANCE INDICATORS

The impact indicators described above were developed primarily to report TERMs' performance compared to regional goals set for them for conformity determination. Conformity remains central to Commuter Connections' evaluation, but it increasingly is being joined by sustainability, climate change, congestion, mobility, quality of life, and economic vitality as forces shaping the transportation policies of the region. Unstable gas prices and national and regional economic pressures are influencing the choices commuters make in how, when, and where they travel. Local and state jurisdictions are developing and exploring HOT lanes, Bus Rapid Transit, and other new transportation facilities that could further alter the travel dynamics of Commuter Connections' service area. And regional and local transportation agencies are integrating TDM into regional and local transportation planning, in new and substantial ways.

The primary impact indicators used in the TERM analysis focus on regional mobility (vehicle trips, VMT), air quality (emissions), and energy (fuel consumption). These measures are very common in the TDM industry, but are not the same measures used in other urban transportation disciplines, such as highway operations, and other policies areas, such as economic development, quality of life, or environmental justice. Additionally, they are regionally-focused and do not currently address local-area impacts.

This suggests that in addition to assessing regional travel and emissions impacts, TERMs might be judged also on their contribution to solving other local or regional problems, requiring modifications in how TERMs' performance is measured. The current performance indicators are not immediately translatable to key public issues, such as congestion relief, quality of life, or accessibility, or others as identified by COG.

A major purpose of the TERM analysis is to provide program management and decision making data about Commuter Connections' programs to COG staff, funders, regional policy-makers, and Commuter Connections partners. The TERM evaluation will offer additional value if it provides information that can be used to respond to policy questions that might arise in the next few years as well as those that have been addressed in the past.

Adding new performance measures to the TERM Analysis Evaluation Framework should be based on policy-making needs and involve a forward-looking assessment of key policy objectives for the future. What might the role of TDM be in addressing urban transportation and livability issues in the region in the next 10 or 20 years or more? Following is a brief outline of a process Commuter Connections could undertake to identify and develop new performance indicators. Note that if any new performance indicators are recommended from this process, the indicators will be incorporated into the evaluation framework for 2011-2014.

Proposed Process

A four-step process might be undertaken with the Commuter Connections Subcommittee, the TDM Evaluation Group, and other stakeholders as appropriate to assess potential connections between emerging regional priorities and the TERM analysis process:

1. Explore regional transportation policy objectives that are expected to be prominent in the next three to five years
2. Define the future role of TDM in these policies
3. Discuss potential performance indicators and analytic techniques that might be associated with these objectives.
4. Define data needs and schedule for introducing these indicators.

Key questions to be addressed include:

- What new near/mid-term transportation policies and initiatives are being discussed by local or regional agencies?
- What role will / could TDM / TERMs play in supporting the objectives of these policies / initiatives?
- Are the existing TERM performance indicators appropriate to assess TDM's contribution to fulfillment of these objectives or will new performance indicators be needed?
- Can data collected in the 2008-2011 TERM analysis period inform this process?
- What new data or analytic techniques might be required?
- When should these performance measures be introduced?

SECTION 4 EVALUATION COMPONENTS FOR INDIVIDUAL TERMS

Sections 2 and 3 stated the objectives and issues guiding the evaluation process and defined several common performance measures that will be used for all TERMs. This section details the specific evaluation approach for each of the four TERMs and for the Commuter Operations Center.

The TERMs included are:

- Maryland and Virginia Telework
- Guaranteed Ride Home
- Employer Outreach/Employer Outreach for Bicycling
- Mass Marketing
- Commuter Operations Center/Integrated Rideshare

For each TERM, the following information is provided:

- TERM description
- Goals defined by TPB for the TERM for 2011
- Nature of the evaluation
- Performance measures recommended for the TERM
- Data needed to measure TERM impacts and recommended data sources

Section 5 of this report provides a more detailed description of the surveys and other data sources enumerated in this section. Section 7 presents a schedule for the collection of data and recommends a party to be responsible for collecting the data. Included in the appendices are examples of how travel and emission impacts are calculated for each TERM. These are taken from the 2008 TERM Analysis Report to provide real examples of how the calculations were performed in the last evaluation period. These calculation methods form the basis for the refinements included in this evaluation framework.

The specific data required for each TERM to calculate vehicle trips reduced and VMT reduced are described in the individual TERM evaluation component sections that follow. Additionally, some common data are needed to calculate emissions, cost, and energy impacts of each TERM, including:

- Access mode and distance to meeting locations for alternative mode users (to perform air quality analysis)
- Regional emissions factors (to determine emission reductions)
- Regional fuel economy data in average miles per gallon consumed (to calculate energy saving)
- Program costs (to derive cost effectiveness)

4-A MARYLAND AND VIRGINIA TELEWORK

Program Description

In Maryland and Virginia Telework (Telework TERM), Commuter Connections, working with numerous partners in Maryland and Virginia, assists employers to establish worksite telework programs and arrangements and provides telework information to individual commuters. The Telework TERM estimates the impact of the portion of regional telework that is attributable to Commuter Connections' telework assistance.

TERM Evaluation Changes Since 2005-2008

- Define Discount for Partial Application of Virginia Component – The Virginia component of this TERM ended on June 30, 2009. Impacts for the TERM will be discounted to reflect availability of the service in Virginia for only the first year of the three-year evaluation period. Impacts during the second and third year will include only impacts generated from the program in Maryland.

Stated Goals

The purpose of Maryland and Virginia Telework is to increase the number of full-time or part-time home-based and telework center-based teleworkers in the region. COG/TPB defined five regional goals for this TERM for 2011:

- Maintain 31,854 teleworkers
- Reduce 11,830 daily vehicle trips
- Reduce 241,208 daily miles of travel
- Reduce 0.1222 daily tons of NOx
- Reduce 0.0723 daily tons of VOC

Nature of Evaluation

The populations of interest for this TERM include two groups:

- All regional teleworkers who are influenced by Maryland and Virginia Telework services / assistance to begin teleworking
- Telework employees at Maryland and Virginia worksites assisted by Commuter Connections

The evaluation first determines the number of teleworkers who either live or work in Maryland and Virginia who were influenced or assisted by the Maryland and Virginia Telework services to begin teleworking and the travel impacts of their teleworking.[5] Data for this component come from the State of the Commute survey:

1) Number of new teleworkers in the region who either live or work in Maryland and Virginia
2) Their frequency of teleworking
3) How they commute on non-telework days
4) How they learned about teleworking

[5]The Maryland and Virginia Telework TERM provides services to commuters who either work or live in Maryland or Virginia. Residents of the District of Columbia who also work in the District would not be eligible for Maryland and Virginia Telework services. But residents of the District who work in Maryland or Virginia would be included. Similarly, residents of Maryland and Virginia who work in the District also would be included.

Placement rates and average trips reduced per placement are derived for home-based teleworkers and for those working at telecenters or other non-home locations.

Second, the evaluation estimates the portion of teleworking influenced by Maryland and Virginia Telework through direct telework assistance to employers, direct information assistance to commuters, and general promotion of teleworking to the public-at-large.

Thus, the evaluation will define the universe of Maryland and Virginia-based teleworking and examine employers' and commuters' sources of information or assistance for teleworking and the value of that information or assistance in their starting or expanding teleworking programs to estimate the share of teleworking attributable to the TERM.

Performance Measures

Performance measures recommended to evaluate Maryland and Virginia Telework include:

Participation, Utilization, and Satisfaction Measures:

- Number of Maryland and Virginia employers that receive telework information or assistance from Commuter Connections
- Number of Maryland and Virginia employers that implement/expand telework programs after receiving assistance
- Number of commuters who receive telework information or assistance from Commuter Connections
- Number of commuters who live or work in Maryland or Virginia who begin teleworking after receiving assistance
- Number of new Maryland and Virginia-based teleworkers – home-based and non-home based
- Telework placement rate

Program Impact Measures:

- Vehicle trips reduced (number of daily trips reduced)
- VMT reduced (in miles)
- Emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to assess Maryland and Virginia Telework impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Regional home-based teleworkers	State of the Commute (SOC) survey
• Non-home-based teleworkers	SOC survey
• Telework frequency (days/week)	SOC survey
• Percent drive-alone on non-telework days	SOC survey
• Travel distance on non-telework days	SOC survey
• Travel distance to telework centers	SOC survey
• Commuters' source of telework information	SOC survey
• TW at assisted employers worksites in MD and VA	TW assistance survey

Proposed timing of data collection

- SOC survey – February-April 2010
- Commuter Connections Telework assistance survey – Early 2011

To avoid double counting benefits, the portion of travel and emissions impacts attributable to the employer assistance component of Maryland and Virginia Telework will be subtracted from the Employer Outreach TERM.

4-B GUARANTEED RIDE HOME TERM

Program Description

The Guaranteed Ride Home (GRH) program eliminates a real or perceived barrier to use of alternative modes, the fear of being stranded without a personal vehicle. GRH provides free return transportation by taxi or rental car in the event of an unexpected personal emergency or unscheduled overtime to commuters who carpool, vanpool, use transit, or bike or walk to work at least two times per week on average. Commuters pre-register for GRH and may use the service up to four times per year. The program also allows "one-time exception" rides provided to non-registered commuters who used an alternative mode on the day a GRH trip was needed. Commuters who wish to use GRH again in the future must then register.

TERM Evaluation Changes Since 2005-2008

- No changes

Stated Goals

COG/TPB defined the following regional goals for GRH for 2011:

- Maintain 36,992 GRH applicants
- Reduce 12,593 daily vehicle trips
- Reduce 355,136 daily vehicle miles of travel
- Reduce 0.1766 daily tons of NOx
- Reduce 0.0970 daily tons of VOC

Nature of Evaluation

GRH is intended to encourage drive alone commuters to shift to alternative modes. Additionally, GRH is expected to help maintain existing alternative mode arrangements and increase frequency of alternative mode use. The evaluation measures the number of new alternative mode users whose shifts were influenced by GRH and the number of commuters who used alternative modes before registering who were influenced to continue using the modes.

Two populations are of interest for the GRH TERM evaluation:

- Commuters who registered for GRH
- One-time exception users – did not register for GRH but took an "exception" trip

Performance Measures

The following performance measures are used for GRH:

Participation, Utilization, and Satisfaction Measures:

- Number of GRH applicants
- Number of one-time exception users
- GRH placement rate
- Percent of GRH participants who take a GRH trip
- Satisfaction of GRH users with the service

Program Impact Measures

- Vehicle trips reduced (number of daily trips reduced)
- VMT reduced (in miles)
- Emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to estimate GRH impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• GRH applicants	Commuter Connections applicant database and archived GRH database
• One-time GRH exception users	Commuter Connections applicant database and archived GRH database
• GRH placement rate	GRH Applicant survey
• GRH VTR factor	GRH Applicant survey
• Average travel distance (trip length)	GRH Applicant survey

Proposed timing of data collection

- Commuter Connections GRH database – ongoing
- GRH Applicant surveys – April-May 2010

Two subgroups are identified for GRH. The first sub-group includes participants who both live and work within the Washington, DC Metropolitan Statistical Area (MSA). The second group includes participants who work within the MSA but live outside it. Placement rates, VTR factors (average trips reduced per placement), and travel distances are estimated for each of the two sub-groups. This distinction is made because credit for the "out of MSA" participants is discounted to eliminate the VMT reduction that occurs outside the MSA.

The analysis of GRH also includes steps to avoid credit double counting from overlap with two other TERMs. Overlap occurs between GRH and the Commuter Operations Center because some GRH applicants also ask for rideshare information. The COC impacts are discounted to account for this overlap. GRH results also will be adjusted to assign a portion of the GRH TERM's impacts to the Mass Marketing TERM to recognize that some GRH applicants will be influenced to contact Commuter Connections and apply for GRH by hearing a Mass Marketing advertisement.

4-C EMPLOYER OUTREACH TERM

Program Description

The Employer Outreach TERM is designed to encourage employers to implement new commute assistance programs and to expand the services they offer in existing programs. In this TERM, jurisdiction-based sales representatives contact employers, educate them about the benefits commuter assistance programs offer to employers, employees, and the region and assist them to develop, implement, and monitor worksite commuter assistance programs. Commuter Connections assists the sales force with the following services, designed to enhance regional coordination and consistency:

- Computerized regional employer contact database
- Marketing and information materials
- Employer outreach sales and service force training
- Annual evaluation program
- Support to Employer Outreach Committee

TERM Evaluation Changes Since 2005-2008

- Differential Between New and Continued Impacts – When the Employer Outreach TERM was adopted, the TPB established a goal that was to be achieved by June 2005 and evaluations conducted for periods through June 2005 measured impacts against this goal. Beginning with the 2008 Analysis, the goals for Employer Outreach were re-set to include a goal for the overall program and a goal for new program activity since 2005. For this reason, the 2008 TERM Analysis defined two categories of Employer Outreach impacts: "new" impacts and "continued" impacts. New impacts included impacts from employers that joined the EO program on or after July 1, 2005 and employers that were involved in EO before July 1, 2005 but that expanded their commute assistance services after that date. Continued impacts included those from employers that joined EO before July 1, 2005 and made no changes since that date. These impacts were considered part of the baseline for EO as of 2005.

  A similar approach will be applied for the 2008-2011 evaluation. New impacts will be defined for new or expanded employer programs since July 1, 2008. Continued impacts will include those from employers that joined EO before July 1, 2008 and made no changes since that date. Additionally, impacts from program reductions will be "back-filled" from new or expanded programs instituted on or after July 1, 2008.

- Employer Outreach for Bicycling – In the 2002 and 2005 TERM evaluations, bicycle programs offered by employers were evaluated separately from other Employer Outreach services under the Employer Outreach for Bicycling (EOB) TERM. In the 2008 evaluation, EOB was incorporated into the overall EO TERM and will be addressed similarly in 2011. However, the contribution of these bicycle programs to the overall EO impact will continue to be calculated and reported separately.

- Apply Batch Methodology for COMMUTER Model Runs – Evaluations conducted prior to 2008 classified employers into categories defined by their location and commute program services. Then trip reduction and VMT reduction factors derived from the COMMUTER Model as characteristic of those location and program types were applied to all employers with similar programs. The 2008 TERM Analysis applied an improved method, in which the COMMUTER model was run in a batch format that allowed each employer's program components to be modeled separately.

The analysis thus calculated trip reduction for each employer individually. This will not change the results of the analysis, but will enable Commuter Connections to define individual employers' contributions to the impacts, should Commuter Connections or local jurisdictions choose to do so.

- COMMUTER Model Coefficients – The EPA COMMUTER model (v 2.0) that will be used for the 2011 analysis predicts likely change in employee commuting behavior for given changes in an employer's commute assistance program. The Model applies time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. In 2008, COG completed a new Household Travel Survey, collecting data that will be used to revise the regional travel models. This is expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If MWCOG adopts new coefficients during the 2008-2011 evaluation period, the coefficients used in the COMMUTER Model v. 2.0 will be updated to be consistent with the new coefficients.

Stated Goals

COG/TPB has defined the following regional goals for Employer Outreach for 2011:

- Maintain 581 total participating employers (100+ employees); 520 without bicycle support and 61 with bicycle support
- Reduce 64,644 daily vehicle trips
- Reduce 1,065,851 daily vehicle miles of travel
- Reduce 0.5485 daily tons of NOx
- Reduce 0.343 daily tons of VOC

Nature of Evaluation

Employer Outreach is aimed at increasing the number of private employers implementing worksite commuter assistance programs, but Employer Outreach is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes. Two primary evaluation questions are thus important. First, how many employers start or expand commuter assistance programs? And second, how many employees use alternative modes in response to new employer-sponsored services at the worksite? The populations of interest for this TERM are:

- Employers that participate in Employer Outreach
- Employees at Employer Outreach worksites
- Employers that offer bicycle services (Employer Outreach for Bicycling)
- Employees at worksites that offer bicycle services

Performance Measures:

The following performance measures are recommended for Employer Outreach:

Participation, Utilization, and Satisfaction Measures:

- Number of employer clients (employers with commuter assistance programs and employers with bicycle programs) – total and new
- Number of employees at client worksites (worksites with commuter assistance programs and bicycle programs) – total and new
- Level/extent of employers' commuter assistance programs
- Alternative mode use at worksites with commuter assistance programs (placements)
- Employer satisfaction with outreach assistance and services

Program Impact Measures:

- Vehicle trips reduced (number of daily trips reduced)
- VMT reduced (in miles)
- Emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data items will be used to calculate program impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Employers participating in Employer Outreach Program	ACT! database
• Participating employers that offer bicycling services to employees	ACT! database
• Employer characteristics	ACT! database
• Commuter assistance services at worksite	ACT! database
• Starting Average Vehicle Ridership (AVR)	Employee baseline surveys
• Ending AVR (estimated)	EPA COMMUTER Model 2.0
• Average travel distance	SOC survey

Proposed timing of data collection

- ACT! database – ongoing
- Employee baseline surveys – ongoing
- SOC survey – February-April 2010

The Employer Outreach TERM is the only TERM for which placement rates and VTR factors are not used to determine the number of new participants, vehicle trips reduced, or VMT reduced. This is because employee survey data cannot feasibly be collected to assess employees' post-program travel behavior. These missing evaluation elements are modeled using the EPA COMMUTER Model v. 2.0.

To estimate impacts, employers' starting mode shares and commuter assistance program strategies are input into the COMMUTER Model v. 2.0 and the model estimates "after" mode split and average vehicle ridership, that is, with the program in place. The TERM analysis used this model in the 1999-2002, 2002-2005, and 2005-2008 evaluations.

During the 2005-2008 evaluation, COG and the evaluation team compared the estimation capabilities of the COMMUTER Model to those of the CUTR Worksite Trip Reduction Model. COG staff decided to continue using the COMMUTER Model for the analysis, largely because it was compatible with the regional travel models used in the COG region and could utilize regional cost and time coefficients tailored to the Washington region. The cost coefficients were adjusted, however, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. A description of the adjustment and the original and adjusted coefficients are presented in Appendix C.

In 2008, COG completed a new Household Travel Survey, collecting data that will be used to revise the regional travel models. This is expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If COG adopts new coefficients during the 2008-2011 evaluation period for the regional model, the coefficients used in the COMMUTER Model v. 2.0 will be updated to be consis-

tent with the new coefficients. The consulting team will also assess any other modifications to other parameters and default factors, such as average trip length, vehicle occupancy, employment characteristics, etc., and will update these parameters as needed for the 2011 TERM Analysis.

4-D MASS MARKETING TERM

Program Description

In 2003, Commuter Connections embarked on an ambitious effort to educate the region's commuters about alternatives to stress-filled solo commuting and to raise awareness of commute assistance services available through Commuter Connections and its partners. Radio, direct mail, and other media are used to create a new level of public awareness and to provide a call to action to entice commuters to switch to alternative modes. Support for Bike to Work Day was added to the Mass Marketing TERM in the 2005-2008 evaluation. The objectives of the Mass Marketing TERM are to:

- Raise regional awareness about the Commuter Connections brand
- Address commuters' frustration with congestion
- Induce commuters to try and adopt alternative commute modes

TERM Evaluation Changes Since 2005-2008

- None

Stated Goals

COG has defined the following regional goals for Mass Marketing for 2011:

- Encourage 11,023 commuters to switch modes
- Reduce 7,758 daily vehicle trips
- Reduce 141,231 daily vehicle miles of travel
- Reduce 0.0721daily tons of NOx
- Reduce 0.044daily tons of VOC

Nature of Evaluation

The Mass Marketing TERM has three populations of interest:

1) All commuters in the Commuter Connections service area
2) Commuter Connections rideshare and GRH applicants who were influenced by the marketing campaign to request Commuter Connections services
3) Commuters who participate in the Bike-to-Work Day event

The Mass Marketing TERM presents two challenges not encountered in most of the other TERMs. First, it is more difficult to assess influence on the general commuting public than it is to identify and track program participants. Second, when commuters who changed travel behavior can be identified, it is still necessary to identify what motivated their change – the media campaign or another influence.

The Mass Marketing evaluation method examines impacts from two types of change, which are measured separately. The first is ***"directly"*** influenced change. These are mode shifts that are made when the ads motivate commuters to change mode with no intermediate contact with Commuter Connections. An example of this type of change would be a carpool formed when a commuter hears the ad and asks a co-worker to carpool. Direct influences can only be assessed through a regional survey of commuters that asks about mode change and the reasons for the changes.

This influence of Mass Marketing on the general commuting population will be assessed through questions in the State of Commute survey that estimate the incidence of mode shifting in the region and what

prompted the shift. If the shift is attributed to a message that is part of the Mass Marketing campaign, the associated trip, VMT, and emissions reductions can be credited to the campaign.

The second is "referred change." These are mode shifts that occur among commuters who are influenced by the ads to contact Commuter Connections. These changes would include, for example, a commuter who hears the ad, requests a ridematch list from Commuter Connections, then forms a new carpool.

Referred influences are best measured by tracking changes in the volume of requests of information and services through two Commuter Connections' traditional programs: the Commuter Operations Center and GRH. A comparison of the volumes of requests received during periods of media activity to periods without media activity can provide an estimate of the change in requests as a result of the ads. A pro-rated share of the impacts of these other TERM impacts then can be assigned to Mass Marketing.

The Mass Marketing TERM will, therefore, use data from the State of the Commute survey as well as ongoing tracking data from the Commuter Operations Center and tracking of timing of MM ads. Separate direct and indirect placement rates, VTR factors, and impacts will be estimated for each of these two components.

Participation, Utilization, and Satisfaction Measures:

- Percentage of regional commuters who are aware of ad campaign and messages
- Percentage of commuters with positive attitudes toward alt modes (e.g., willingness to try alt mode)
- Percentage of regional commuters aware of Commuter Connections programs/services
- Number of contacts to Commuter Connections (e.g., call volumes, web hits, registrants)
- Direct change placement rates (temporary and continued change)

Bike to Work Day – Participation, Utilization, and Satisfaction Measures:

- Number of riders participating in Bike to Work Day event
- Participants' frequency of bike commuting before and after the Bike to Work Day event

Program Impact Measure (direct and indirect):

- Vehicle trips reduced (number of daily trips reduced)
- VMT reduced (in miles)
- Emissions reduced (in tons of pollutants)

Data Needs and Sources

Assess changes in awareness, attitudes, information (Population-at-large):

- In SOC survey, assess commuters' awareness and recall of specific marketing messages and awareness of Commuter Connections commuter assistance services. Were commuters aware of commute advertisements and the specific messages conveyed? Were commuters who heard the advertisements more willing to consider using alternative modes?

Assess increase in contacts (Population-at-large and Commuter Connections clients):

- Monitor volume of inquiries to Commuter Connections program information sources (phone, internet). Did contact increase during periods of mass marketing advertisement waves?
- In SOC survey, ask about use of regional services that might correspond to awareness of the Mass Marketing campaign.

Assess trial and permanent behavior change (Population-at-large):

- In SOC survey, assess travel behavior changes among commuters who recall hearing message and cite influence of marketing campaign. Also compare incidence of change with and without TERM influence. Need to correct for double counting with commuters who also cite influence of other TERMs on change.
- Track changes in call and internet email request volumes to COC and assign incremental increase in placements to the Mass Marketing TERM.

Data Needs	*Data Source*
Advertising Campaign	
• Regional commuters aware of ads / messages	SOC survey
• Percentage of commuters with positive attitudes toward alternative modes	SOC survey
• Regional commuters aware of CC services	SOC survey
• Contacts to CC info sources	SOC survey and COC tracking
• MM placement rates (temporary and continued)	SOC survey and COC tracking
• MM VTR factors	SOC survey, GRH survey, CC Applicant Placement survey
Bike to Work Day (BTWD)	
• Number of BTWD participants	BTWD survey
• Before and after travel behavior	BTWD survey
• Average travel distance	BTWD survey

Proposed timing of data collection

- SOC survey – February-April 2010
- CC Applicant Placement survey – November 2008 (completed)
- GRH Applicant survey – April-May 2010
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2010

Not all increases in program inquiries resulting from indirect impacts will be assigned to the Mass Marketing TERM. The share of GRH and COC indirect impacts to be assigned to MM will be determined by estimating the increase in applications that occur during period when MM ads are run. These credits will be subtracted from GRH or COC to avoid double counting.

4-E COMMUTER OPERATIONS CENTER

Program Description

For many years Commuter Connections has offered basic commute information and assistance, such as ridematching. Because these services were available when the emissions baseline was developed for regional conformity, only benefits above this 1997 baseline are included as a TERM.

The function of the Commuter Operations Center is to increase commuters' awareness of alternative modes, through regional and local marketing and outreach programs and to encourage and assist commuters to form ridesharing arrangements. Encouraging commuters who drive alone to shift to alternative modes is a priority for the COC, but the COC also assists commuters who now use alternative modes to continue to do so, by offering ridematching and transit assistance when carpools break up or commuters' travel patterns change and disrupt existing alternative mode arrangements.

Commuter Connections program services include: carpool and vanpool matchlists, transit route and schedule information, information on Park & Ride lot locations and HOV lanes, telework information, commute program assistance for employers, GRH, and bicycling and walking information. Commuters obtain services by calling a toll-free telephone number or by submitting a ridematch application obtained from COG, an employer, a local partner assistance program, a transportation management association (TMA), or through the internet.

Included within the Commuter Operations Center program is the Integrated Rideshare TERM-Software Upgrades Project. The Integrated Rideshare TERM provides improvements to the quality and delivery of alternative mode information and provides transit, park and ride, telecenter, and bicycling information through the Commuter Connections web-based TDM system and the Operations Center.

These services are upgrades to the original ridematching services. The Software Upgrade Project element is captured under the Commuter Operations Center, but impacts are reported separately in the regional TERM tracking sheet.[6]

TERM Evaluation Changes Since 2005-2008

- None

Stated Goals

COG has defined the following goals for the Commuter Operations Center for 2008:

Commuter Operations Center (basic services)

- Register 152,356 commuters
- Reduce 10,399 daily vehicle trips
- Reduce 296,635 daily vehicle miles of travel
- Reduce 0.1474 daily tons of NOx
- Reduce 0.0808 daily tons of VOC

[6] The Integrated Rideshare TERM originally had two components; Ridematching Software Upgrades, and Inf-Express Kiosks. The InfoExpress Kiosk project was discontinued during the 2005-2008 evaluation period.

Integrated Rideshare-Software Upgrade Project (additional to Basic COC)

- Reduce 2,370 daily vehicle trips
- Reduce 62,339 daily vehicle miles of travel
- Reduce 0.031 daily tons of NOx
- Reduce 0.017 daily tons of VOC

Nature of Evaluation

Since the basic Commuter Connections ridematching and information services are covered in the conformity baseline, this evaluation component seeks to credit the program with any increases in effectiveness due to program enhancements not covered by other TERMs. Thus, the basic approach is to determine the total transportation and air quality impacts for all Commuter Connections services and subtract out impacts assigned to GRH, Mass Marketing, and any other TERM that overlaps with the COC. The balance of impacts equals the impacts of the COC.

The Integrated Rideshare-Software Upgrade component is directed to a subset of Commuter Connections clients; applicants who remember receiving transit and/or Park and Ride, Telecenter locations, and bicycling information with other ridematching information provided through the Commuter Operations Center. This program is aimed at improving the quality and availability of commute information and encouraging commuters to try transit and telework for occasional and full-time use, even if they did not have these options in mind when they contacted Commuter Connections for assistance. Integration of transit and Park & Ride, Telecenter locations, and bicycling information into the computer system will be evaluated through the applicant placement rate survey, described in Section 5. From this survey, a separate placement rate can be derived for those who shifted to an alternative mode after receiving transit or Park & Ride, telework, and bicycling information.

Performance Measures

The following performance measures are proposed for the Commuter Operations Center:

COC (Basic) – Participation, Utilization, and Satisfaction Measures

- Number of commuter applicants to the COC
- Percent of applicants who receive matchnames on their matchlist
- COC placement rate
- Applicant satisfaction with COC service

Integrated Rideshare-Software Upgrades Project – Participation, Utilization, and Satisfaction Measures:

- Number of applicants who remember receiving transit, P&R, or telework information on ridematch letter or email
- Number of applicants who contact a transit agency or use P&R or telework information received
- Software upgrade placement rate (percentage of applicants who use the software upgrade information to shift to an alternative mode)

Program Impact Measures (basic COC and Software Upgrades):

- Vehicle trips reduced (number of daily trips reduced)
- VMT reduced (in miles)
- Emissions reduced (in tons of pollutants)

Data Needs and Sources:

The following data items will be used to calculate program impacts for the Commuter Operations Center, including the improved transit information from the software upgrades. Each data source is described in Section 5.

Data Needs	*Data Source*
Commuter Operations Center (Basic)	
• Commuter Connections (CC) applicants	Commuter Connections applicant database
• CC placement rate	CC Applicant Placement survey
• CC VTR Factor and average travel distance	CC Applicant Placement survey
• Vehicle trips and VMT assigned to other TERMs	Results of other TERM evaluations
Integrated Rideshare–Software Upgrades (IR-SU)	
• Database applicants	Commuter Connections database
• Applicants who remember receiving transit and Park & Ride information	CC Applicant Placement survey
• IR-SU placement rate	CC Applicant Placement survey
• IR-SU VTR Factor	CC Applicant Placement survey
• Average travel distance	CC Applicant Placement survey

Proposed timing of data collection

- Commuter Connections database – ongoing
- CC Applicant Placement survey (November 2008) - completed
- SOC survey – February-April 2010

Double counting is avoided by subtracting the credit assigned to the Integrated Rideshare-Software Upgrades from the impacts calculated for the Commuter Operations Center (Basic).

SECTION 5 DESCRIPTION OF DATA SOURCES

Much of the data needed to perform the evaluation outlined in this framework is available from two basic sources. Data on program participation will be obtained from ongoing monitoring activities of Commuter Connections and its partners in the form of application records, GRH registration forms, etc. The basic source of travel impact and attitudinal information is periodic surveys of applicants, service users, or the public-at-large. All the surveys proposed for 2008-2011 have been used in past years; all will be reviewed and modified as needed for the 2008-2011 evaluation. The data sources and surveys can be divided into three groups as follows:

Ongoing Monitoring

- ACT! Employer Contact database
- Maryland and Virginia Telework database
- Bike to Work Day participant records
- Commuter Connections applicant database (COC, GRH, internet applicants)
- Archived applicant GRH database
- Commuter Operations Center activity tracking

Existing/Ongoing Surveys

- Commuter Connections applicant Placement Rate survey (completed in November 2008)
- GRH survey
- State of the Commute survey
- Employee commute surveys (voluntarily administered by employers)
- Telework assisted employer follow-up survey
- Bike-to-Work Day participant survey

Analysis Tools

- EPA COMMUTER Model (v 2.0)

Each data source, survey, and analysis tool is described below, noting the TERM or TERMs for which it collects evaluation data. Table 1 serves as a quick reference for the proposed uses of each data source. In general, the data are used for either or both of two purposes. The first, TERM tracking, monitors use of and user satisfaction with the TERMs. The second purpose, conformity analysis, refers to the calculation of transportation, air quality, energy, and cost impacts of the TERM. This evaluation framework document deals primarily with the second of the purposes.

Table 1
Data Collection Activities
Applicable TERMs and Uses of the Data

Evaluation Activity/Tool	Applicable TERM	Use of Data
Ongoing Monitoring		
• ACT! Employer Contact Database	Employer Outreach	TERM tracking, conformity analysis
• Telework assistance database	MD and VA Telework, Employer Outreach	TERM tracking, conformity analysis
• Bike to Work Day participant records	Mass Marketing (BTW component)	TERM tracking, conformity analysis
• Commuter Connections Applicant Database	COC, Integrated Ride-share-Software Up-grades, GRH, Mass Marketing	TERM tracking, conformity analysis
• Archived GRH Database	GRH	TERM tracking, conformity analysis
• Commuter Operations Center website and call volume tracking	COC, Mass Marketing, GRH	TERM tracking, conformity analysis
• Documentation of media / market-ing activities	Mass Marketing	Conformity analysis
Existing/Ongoing Surveys		
• GRH Applicant Survey	GRH	Conformity analysis
• Commuter Connections Applicant Placement Rate Survey	COC, Integrated Ride-share-Software Up-grades, Mass Marketing	TERM tracking, conformity analysis
• State of the Commute Survey	MD and VA Telework, Mass Marketing	Commute trend analysis, conformity analysis
• Bike-to-Work Participant Survey	Mass Marketing (BTW component)	TERM tracking, conformity analysis
• Employee Commute Surveys (em-ployer administered)	Employer Outreach	TERM tracking, conformity analysis
• Telework assisted employer fol-low-up survey	MD and VA Telework	TERM tracking, conformity analysis
Analysis Tools		
• COMMUTER Model	Employer Outreach	Conformity analysis

ONGOING MONITORING

Program activity and utilization tracking is an ongoing function already performed by COG staff and regional partners. Included here are records of services provided (e.g., number of employers contacted and GRH rides provided) and information on requests received (e.g., number of ridematch applications). It is important to track these activities by program element, especially for activities within TERM programs.

The information gathered in the ongoing tracking process is summarized in a quarterly Commuter Connections "report card" that shows participation and utilization data and applies factors generated from the most recent placement rate survey to estimate travel, air quality, energy and consumer savings benefits for the quarter. This tool is used primarily by COB/TPB staff and staff of regional Commuter Connections partner programs as a quarterly check of progress in various activity and program areas. Annual Commuter Connections evaluation results also are reported to other policy-makers and to program funding agencies. Additional details on how Commuter Connections evaluation results will be reported are presented in Section 8.

- Commuter Operations Center Activity Tracking – Ongoing tracking of telephone and internet information requests, GRH registration, and ridematching applications received for processing. *(Used for GRH and Mass Marketing TERMs, and Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project.)*

- ACT! Employer Client Database – Tracks the number of employers participating in Employer Outreach Program and the commuter assistance services they offer in worksite programs. Sales representatives who assist employers to begin and maintain commuter assistance programs update the database when new employers join the program and when employers already participating in EO change their commuter assistance services. The database includes information on employer characteristics (e.g., size, location, type of employer) and on the strategies (e.g., transit subsidies, GRH, preferential parking, teleworking) employers include in their programs. *(Used for Employer Outreach TERM and Maryland and Virginia Telework)*

- Telework Assistance Databases – This database records contact information for employers assisted with telework information. The database also records the information that was provided to the employers. *(Used for Maryland and Virginia Telework TERM)*

- Bike-to-Work Day Records – Provides information on commuters who register to participate in Bike-to-Work Day. *(Used for Mass Marketing TERM)*

EXISTING/ONGOING SURVEYS

Several surveys are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction. These surveys also provide data used to estimate program impacts. Some of the surveys, such as the Applicant Placement survey and GRH Survey, also provide information used by Commuter Connections staff to fine tune program operations and policies.

- GRH Applicant Survey – Commuters who register with the GRH program or use a one-time exception trip will be surveyed to establish how the availability and use of GRH influenced their decision to use an alternative mode and to maintain that mode. Satisfaction with GRH services also will be polled. Some data collected in the survey, such as current and previous mode, travel distance, and access mode, will be used to develop the GRH placement rate and VTR factor.

  In past TERM evaluations, interviews for the GRH survey have been conducted via telephone. But in 2008, Commuter Connections transitioned to an online ridematching and GRH system. This will facilitate the use of the internet for some data collection. A pilot internet GRH survey was conducted as a companion to the 2007 GRH survey to test the potential of this method. The pilot documented

that the results for the telephone and Internet samples were not statistically different in any variable that was important to the TERM analysis and that either an internet alone or an internet / telephone combination would be a valid option.

For this reason, the methodology for the GRH survey has been modified to use a combination of internet and telephone methods for interviewing. COG's online database vendor has programmed the GRH survey questionnaires for online application. This tool will be used to survey applicants who have provided an email address. To ensure that all GRH registrants are eligible for the survey, telephone interviews will be conducted with a sample of respondents who did not provide an email address. The data from the two methods will be combined for analysis of the GRH survey.

- Commuter Connections Applicant Placement Rate Survey – Since May 1997, Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center and other program components. Data from the applicant placement surveys are used to calculate placement rates for the Commuter Operations Center and for the Mass Marketing TERM (referred impacts). Additionally, Vehicle Trip Reduction factors are derived from this survey. The surveys also assess users' perceptions of and satisfaction with the services provided.

  One placement survey will be used in the 2008-2011 evaluation period. This was conducted in November 2008 for FY 2009. Results of the survey conducted during this evaluation period were presented in a survey report. [7] Reported results are primarily for internal use by program and technical staff, but results also can be summarized for policy makers, such as the TPB, the TPB's Technical Committee, and other regional policy makers. In the future, selected results may also be summarized for distribution to the media, employers, commuters, and the public-at-large. *(Used for the Mass Marketing TERM, Commuter Operations Center (Basic), and Software Upgrades)*

- State of the Commute Survey – The SOC survey, a random sample survey of employed adults in the Washington metropolitan region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance, and awareness and attitudes about commuting, and awareness and use of transportation services, such as HOV lanes and public transportation, available to commuters in the region. To this end, it will be compared to the 2001, 2004, and 2007 State of the Commute Surveys.

  SOC survey data also are used to estimate the impacts of TERMs that have a possible influence on the population-at-large. Specifically, the survey generates information on teleworking, a TERM that has broad application and for which it is not possible to identify all users from any Commuter Connections database. The survey also is used to assess awareness and penetration of the regional GRH program.

  Finally, by querying respondents about commuters' sources of information on alternative modes and their reasons for choosing alternative modes, the survey will also suggest how other commuter service programs and marketing efforts influence commuting behavior in the region. In this way, it will also help to establish the influence of the Mass Marketing advertising messages on mode switching and use of Commuter Connections services.

[7] Fiscal Year 2009 Applicant Database Annual Placement Survey Report, Applications Received During July-September 2008 (November, 2008 Survey), May 19, 2009.

The State of the Commute survey is a triennial survey and will be conducted in early 2010. *(Used for Maryland and Virginia Telework, and Mass Marketing TERMs)*

- Employee Commute Surveys – Some employers conduct baseline surveys of employees' commute patterns, before they develop commuter assistance programs and follow-up surveys after the programs are in place. The results of these surveys also are available through the database. COG reviews the results semi-annually. *(Used for Employer Outreach TERM)*

- Employer Telework Assistance Follow-up Survey – Sent to employers that received telework assistance from Commuter Connections to determine if and how they used the information they received. Specifically, the survey asks if the employer has started or expanded a telework program since receiving the information and if the information was helpful. This information is used to estimate the number of teleworkers directly influenced by the Maryland and Virginia Telework TERM to start teleworking. *(Used for Maryland and Virginia Telework)*

- Bike-to-Work Day Participant Survey – A survey among registered participants in the Bike-to-Work Day event is undertaken to assess travel behavior before and after the Bike-to-Work Day, as well as commute distance and travel on non-bike days. *(Used for Mass Marketing TERM)*

ANALYSIS TOOLS

During the 2008-2011 evaluation period, the EPA COMMUTER Model will be used as part of the Employer Outreach TERM analysis and included in the Analysis Report. The Model uses time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. In 2008, COG completed a new Household Travel Survey, collecting data that will be used to revise the regional travel models. This is expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If new coefficients are adopted during the 2008-2011 evaluation period, the coefficients used in the COMMUTER Model v. 2.0 will be updated to be consistent with the new coefficients.

SECTION 6 BASIC METHOD FOR CALCULATING PROGRAM IMPACTS

This section presents the methodology for calculating and quantifying the travel, air quality, energy and commuter cost impacts of the TERMs. Following are the basic calculation steps common to all TERMs (except Employer Outreach, which uses a modeled method and Mass Marketing, which uses information from the State of the Commute and COC activity tracking to assess mode change due to the campaign). Specific examples of the evaluation calculations and unique methodological elements for each TERM and for the Commuter Operations Center are included in Appendices D through I:

- Appendix D – Maryland and Virginia Telework
- Appendix E – Guaranteed Ride Home
- Appendix F – Employer Outreach
- Appendix G – Mass Marketing
- Appendix H – Commuter Operations Center
- Appendix I – Integrated Rideshare – Software Upgrades Project

DOCUMENTING PROGRAM PARTICIPATION AND UTILIZATION

The evaluation of program impacts requires first an accurate documentation of the participation of employers and commuters in each TERM program. Commuter Connections staff and local jurisdiction program partners will need to consistently and continuously track the number of participants or users of each TERM. Specifically, we propose that the following be counted:

- Private and non-profit employers participating in the Employer Outreach TERM.

- Commuters who request Commuter Connections assistance also will be tracked, as will the type of information requested (e.g. ridematching, transit information, telework assistance, bicycle information, etc.) and information on where they heard about Commuter Connections (advertisement, employer, friend, etc.). Using the results of the applicant placement survey and other surveys conducted under this project, separate placement rates will be developed for the Commuter Operations Center and for the Software Upgrade component previously included in the Integrated Rideshare TERM but now part of the COC section in this report.

- GRH registrants and one-time exception users should be tracked as a group, separately from all applicants. A GRH placement rate and VTR factor will be developed from the GRH survey.

- Employers participating in Commuter Connections' Maryland and Virginia Telework activities should be tracked through telework contact records. Telework placement rates (proportion of employees at the worksites who become teleworkers) and a corresponding VTR factor will be developed from data collected in the telework follow-up survey.

- Commuters participating in Bike-to-Work Day should be tracked to determine the total number of participants as part of the Mass Marketing TERM.

The purpose of this tracking process is to determine the "population base" to be used to quantify impacts and then to credit those impacts to the TERM from which they were derived. Other program informa-

tion, in addition to participation and utilization, also should be tracked and documented for use in program refinement.

Information on participation and utilization will be included in quarterly and annual program summaries. The intent is for Commuter Connections and its partners to input participation results, credited to each TERM, into a form that allows for the calculation of impacts. This is accomplished with a simple spreadsheet that includes the factors discussed below.

CALCULATING PROGRAM IMPACTS

The following subsection provides an example of how program impacts will be calculated for the five TERM programs and for the Operations Center. As each of these services has become fully operational, tailored surveys have been developed to produce unique placement rates and VTR factors for each TERM.

The calculation method is designed to:

- Quantify the benefits of the program
- Compare projected impacts to actual results
- Be simple to understand and apply
- Be inserted into simple spreadsheet program for quarterly and annual reporting

Ten basic steps are used to calculate program impacts. These steps are described on the next page. A hypothetical numerical example of the steps is presented in Figure 1 for one TERM.

TERM Evaluation
Basic Program Impact Calculation Methodology Steps

1. Estimate commuter "population base" for the TERM	= e.g., all commuters, GRH applicants, CC applicants, EO employees
2. Calculate placement rate (from commute survey data)	= Proportion of commuters who made a travel change as a result of the TERM
3. Estimate number of "placements"	= Population base x placement rate
4. Estimate VTR factor (from commute survey data)	= Average daily vehicle trips reduced per placement
5. Estimate vehicle trips (VT) reduced	
- GRH, COC, Telework, MM	= placements x VTR factor
- Employer Outreach	= Modeled method
6. Estimate VMT reduced	= Vehicle trips reduced x avg. trip length
7. Adjust VT and VMT for SOV access	
- Adjusted vehicle trips reduced	= Total vehicle trips – SOV access trips
- Adjusted VMT reduced	= Total VMT – SOV access VMT
8. Estimate emissions reduced	= Vehicle trips x "trip end" emission factors = VMT x "running" emission factor
9. Estimate energy and commuter savings	= VMT reduced x average fuel consumption = VMT reduced x average vehicle operating cost
10. Estimate cost-effectiveness	= total annual TERM budget ÷ annual emissions reduced by TERM

Figure 1
Example of Basic Program Impact Calculation Methodology Steps for a TERM

(Caution: this is a hypothetical example. The factors used and results generated from this example should not be used for actual evaluation purposes)

1. Estimate TERM "population base"	= 8,000 commuters
2. Calculate placement rate	= 20%
3. Estimate number of "placements"	= 8,000 x 0.2 =1,600 commuters placed
4. Estimate VTR factor	= 0.7 daily vehicle trips reduced per placement
5. Estimate vehicle trips (VT) reduced	= 1,600 x 0.7 trips reduced per placement = 1,120 daily vehicle trips reduced
6. Estimate VMT reduced	= 1,120 vehicle trips reduced x 25 miles/trip = 28,000 daily VMT reduced
7. Adjust VT and VMT for SOV access	(assume 60% of placements have SOV access and drive 5 miles to meeting point)
- Adjusted vehicle trips reduced	= 1,120 trips – 0.6 x 1,120 = 1,120 - 672 = 448 vehicle trips (without SOV access)
- Adjusted VMT reduced	= 28,000 VMT – (0.6 x 1,120 x 5 miles) = 28,000 – 3,360 = 24,640 VMT
8. Estimate emissions reduced VOC	= 448 trips x 1.5364 gm/trip = 688 gm = 24,640 VMT x 0.1631 gm/VMT = 4,019 gm = (688 gm + 4,019 gm) / 907,185 gm/ton = 0.0052 daily tons VOC reduced

Similar calculations are performed to estimate reductions of NOx, PM2.5 NOx precursors, PM2.5, and CO2

9. Estimate energy and commuter savings Energy saving (gallons of fuel)	= 28,000 daily VMT / 23.8 mpg = 1,176 gallons per day x 250 work days/yr = 294,000 gallons saved per year
Commuter cost saving ($)	= 28,000 VMT x $0.164/mile = $4,592 per day x 250 work days/year = $1,148,000 saved per year / 1,600 placements = $727 saved per placement per year

Step 1 – Determine Commuter Population Base

It is important first to establish the population base, or population of interest, relevant to the specific TERM. This is the population that potentially could have been influenced by the TERM. Depending on the TERM being evaluated, this could be all commuters, GRH applicants, kiosk users, teleworkers, or some other population. In the example shown in Figure 1, the population base is 8,000 commuters.

Step 2 – Calculate Placement Rate

The next step in determining program impacts is to calculate the placement rate for the population base exposed to the TERM. The placement rate is equal to the percentage of commuters in the population base who shift to an alternative mode (carpool, vanpool, public transportation, walk/bike, telework) after receiving assistance under the TERM. Placement rates are calculated from survey data.

Two placement rates are calculated for each TERM, to account for the length of time the commuter uses the alternative mode after shifting: continued rate (did not shift back to original mode), and temporary rate (tried new alternative mode but shifted back to original mode within the evaluation period).

For simplicity, Figure 1 shows only one placement rate, 20%. This means that 20% of the commuters in the population base made a change to an alternative mode as a result of the TERM. The placement rates for one TERM will not necessarily be the same as the placement rates for any other TERM.

Step 3 – Estimate Number of New Placements

Step 3 estimates the number of new commuter placements in alternative modes. This is the actual number of commuters who are expected to have made the shift to alternative modes as a result of the TERM. It is calculated by multiplying the placement rate (calculated in Step 2 from a survey of a sample of commuters in the population base) by the total population base. In our example in Figure 1, the calculation of placements is as shown below:

Placements = 8,000 commuters (population base) x 0.2
= 1,600 placements

Step 4 – Estimate VTR Factor

From the same survey data used to calculate placement rate, the Vehicle Trip Reduction (VTR) factor is next calculated. This is equal to the average daily vehicle trips reduced per placement. As described in Section 3, not all commuter placements will reduce the same number of trips. Three types of commute shifts are captured in the VTR factor:

1) Drive alone applicants shifting to alternative modes
2) Alternative mode users shifting to different alternative modes (e.g., carpool to transit)
3) Alternative mode users increasing the number of days they use alternative modes

The number of trips commuters reduce also depends on the frequency with which they use the alternative mode, compared to the number of days they used it before. The VTR factor combines the varied trip reduction results of all commuter placements to develop an average reduction per placement. An explanation of how the VTR Factor is calculated is provided in Appendix A and a numeric example is shown in Appendix B. As for placement rate, VTR factors might be different for different TERMs.

As shown in Figure 1, the VTR factor for the TERM in our hypothetical example is 0.70. This means that each of the placements for this TERM reduces, on average, 0.7 vehicle trips per day.

Step 5 – Estimate Daily Vehicle Trips Reduced

The number of daily vehicle trips reduced for the TERM is then estimated by multiplying the number of commuter placements from Step 3 by the VTR factor, the average number of daily trips reduced per placement, calculated in Step 4. The calculation of vehicle trips reduced for the example shown in Figure 1 would be as follows:

Vehicle trips reduced = 1,600 placements x 0.7 trips reduced per placement
= 1,120 daily vehicle trips reduced

Step 6 – Estimate Daily VMT Reduced

The total daily VMT reduced is calculated by multiplying the number of daily vehicle trips reduced (Step 5) by the average commute distance for the population of interest. The average distance for the population is calculated from the same survey data used to calculate the placement rate and VTR factor. The example in Figure 1 assumes that the average distance is 25 miles per one-way trip. Using this distance, the total VMT reduced for 1,120 vehicle trips is:

VMT reduced = 1,120 vehicle trips reduced x 25 miles per trips
= 28,000 daily VMT reduced

Step 7 – Adjust Vehicle Trips and VMT for SOV Access

Because a basic purpose for implementing the TERMs is to meet regional air quality standards and resulting emission reduction targets, single occupant vehicle (SOV) access to alternative modes must be considered. Emission reduction, as explained in Step 8, is calculated by multiplying vehicle trips reduced and VMT reduced by emission factors. But because commuters who drive-alone to meet a carpool, vanpool, bus, or train do create a "cold start," their trips must be subtracted from the vehicle trip reduction to assess the air quality impact of TERMs. Additionally, the distance they travel to the meeting point must be subtracted from the VMT reduced to obtain an accurate VMT count. It is these "adjusted" vehicle trips reduced and VMT reduced, rather than the initial totals, that are used to calculate emissions reduced.

In our example, it is assumed that 60% of the commuter placements drive alone to the rideshare or transit meeting point and that the average distance to this point is 5 miles. Using these figures, the "adjusted" vehicle trips reduced and VMT reduced are shown below:

Adjusted vehicle trips reduced = 1,120 trips – (1,120 x 0.6 with SOV access)
= 1,120 trips – 672 trips
= 448 vehicle trips reduced (for emissions calculation)

Adjusted VMT reduced = 28,000 VMT – (1,120 trips x 0.6 SOV access x 5 miles)
= 28,000 – 3,360
= 24,640 VMT reduced (for emissions calculation)

Step 8 – Estimate Daily Emissions Reduced

As noted in Step 7, daily emissions reduced are estimated by applying two regional emission factors, a "trip end emissions" factor and a "running emissions" factor, respectively, to the number of vehicle trips or "trip ends" reduced and to the VMT reduced to determine the pollutants (in this case NOx and VOC) reduced as result of the program. The trip end emissions factor accounts for the emissions created from a "cold start," when a vehicle is first started, and a "hot soak," that occur when the vehicle is later turned off. The running emission factor accounts for the emissions generated per mile of travel by a warmed-up engine.

For 2011, the 2008-2011 TERM Analysis target year, the emission factors[8] are:

Emission Factors	NOx	VOC	PM2.5 NOx	PM2.5	CO2
• Trip end *(gm / one-way vehicle trip)*	0.582	1.5364	0.6652	0.0	0.0
• Running *(gm / mile)*	0.383	0.1631	0.4038	0.115	455.7

To estimate total daily emissions, the trip end emission factor is multiplied by the adjusted daily vehicle trips reduced (Step 7) and the running factor is multiplied by the adjusted daily VMT reduced (Step 7). These two products are then added to determine total daily NOx and VOC reductions in grams. This total is then divided by 907,185 grams per ton to convert the emissions reduced to tons per day. Using these emissions factors, the total VOC reduced for our example in Figure 1 is:

VOC = 448 trips x 1.5364 g/trip = 688 g
= 24,640 VMT x 0.1631 g/VMT = 4,019 g
= (688 gm + 4,019 g) / 907,185 g/ton

= 0.0052 daily tons VOC reduced

The emission reductions for the other four pollutants (NOx, PM2.5 NOX precursors; PM2.5, and CO2) are calculated similarly, using the emission factors noted above for each pollutant. However, emissions for PM2.5, PM2.5 NOx precursors, and CO2 are reported as annual reductions, rather than daily reductions. This additional calculation is made by multiplying the daily tons of emissions reduced by 250 working days per year.

Step 9 – Estimate Energy and Commuter Cost Savings

While air quality is the primary impact driving the TERM analysis, energy and consumer benefits also are real and tangible benefits from commuter assistance programs. For this analysis, energy and commuter cost savings factors are applied to the VMT reduced. These factors are as follows:

- Energy savings are based on an average fuel consumption factor of 23.8 miles per gallon for the Washington metropolitan area fleet of light duty vehicles (2008 data, provided by MWCOG staff)
- Consumer savings are based on an average marginal operating cost per mile (oil, gasoline, maintenance) for a mix of vehicle types and average distance driven per year. The American Automobile Association estimated a composite national average cost to be 17.0 cents per mile in 2008, the most recent period for which AAA prepared cost estimates. When the 2011 TERM analysis is conducted, the cost per mile will be updated to reflect expenses at that time.

[8] The emission factors presented here are derived from the MOBILE 6.2 emission model. If the model parameters or inputs change, the emission factors also could change.

For this analysis, energy and commuter cost savings are calculated by multiplying the energy and consumer cost factors to the total (not adjusted) VMT reduced. As shown in Figure 1, the daily and annual energy and cost savings for the example TERM are as follows:

Energy saving (gallons of fuel)	= 28,000 daily VMT / 23.8 mpg
Daily saving	= 1,176 gallons per day
Annual saving (250 work days)	= 294,000 gallons saved per year
Commuter cost saving ($)	= 28,000 VMT x $0.170/mile
Daily saving	= $4,760 per day
Annual saving (250 work days)	= $1,190,000 saved per year
Annual saving per commuter (based on 1,600 placements)	= $744 saved per placement per year

Step 10 – Estimate Cost-Effectiveness

The final step in the impact calculation is that of estimating TERM cost-effectiveness. The simplest means to calculate cost effectiveness is to divide the annual program results (number of vehicle trips reduced, VMT reduced, and tons of NOx and VOC reduced attributed to each TERM area by the cost of funding that TERM. This will create the following measures:

- Cost per vehicle trip reduced
- Cost per VMT reduced
- Cost per ton of NOx and VOC reduced

A complicating issue is that of the longevity of impacts. Even though a new ridesharer placed in 2009 should be credited against the cost of the program in 2009, that new ridesharer may be in a carpool for two or three years. Therefore, the "benefits" stream may be greater than one year.

SAMPLE CALCULATIONS OF IMPACTS FOR EACH TERM

The impact calculation methodology described above described the basic steps applied to all TERMs and provided one hypothetical numerical example. However, each TERM has unique placement rates and VTR factors and some of the steps differ slightly. Specific examples are presented for each TERM in Appendices C through H.

It should be noted that the numbers shown in the example are from the 2008 TERM Analysis Report, which forms the basis of this evaluation framework. The actual 2008-2011 values for placement rates, VTR factors, trip distances, SOV access percentages, and other calculation variables will be computed after the appropriate surveys have been completed and are likely to be somewhat different that the values shown in the appendices examples. The appendices are provided for illustrative purposes only.

SECTION 7 REPORTING AND COMMUNICATION OF EVALUATION RESULTS

The objective of the evaluation process is to provide timely, useful, and meaningful information on the performance of TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients.

These evaluations have provided detailed assessments of the effects of programs such as telework outreach, guaranteed ride home, employer outreach, mass marketing and ridematching. Because the TERMs were adopted to support the region's efforts to meet the conformity requirements of federal transportation and clean air mandates, these evaluations have focused primarily on analyzing travel and air quality impacts, such as vehicle trips and miles of travel reduced and emissions reduced from use of Commuter Connections program and reporting the results in technical reports.

EXISTING REPORTING

Commuter Connections currently uses four primary reporting mechanisms to disseminate program evaluation results:

- Survey reports and presentations
- Quarterly "Report Card"
- Program Annual Report
- TERM Analysis Report

Commuter Connections and/or a contractor produces a technical report for each data collection activity, such as the GRH survey report and the State of the Commute survey report. These reports present technical details of the survey methodology and results. Additionally, the responsible party also prepares presentation materials to summarize highlights of the research for technical audiences, such as the TDM Evaluation Group, Commuter Connections Subcommittee, the Transportation Planning Board, and the TPB Technical Committee.

COG/TPB's Commuter Connections staff prepare quarterly report card summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. And the Program compiles an annual report distributed to COG/TPB staff, local jurisdiction program partners, and regional policy-makers for administrative purposes. Finally, Commuter Connections produces a triennial TERM Analysis Report that documents the impacts of the TERMs for the three-year TERM evaluation period. Formal review of each of these documents is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

But Commuter Connections' TERM evaluation activities collect a wealth of data on current travel patterns and trends, program utilization, and customer satisfaction that could be useful for many audiences and many purposes beyond conformity determination. By expanding the range of data transmitted and by focusing the presentation of data on the needs and interests of other audiences, Commuter Connections could expand the value of its data collection and analysis investment and provide value to various new audiences. Following is a brief outline of a process Commuter Connections could undertake to identify and develop new communication opportunities.

PROCESS TO DEVELOP NEW COMMUNICATION OPPORTUNITIES

The outline presents three key issues to be defined:

- What audiences might be interested in receiving information from Commuter Connections?
- What information would interest them and be useful to them?
- What communication tools would be most appropriate, at what level of detail?

Audiences and Possible Focus

A first step would be to define audiences that might be receptive to receiving new or additional information and determine what information would be of value to them. Existing and new audiences could include the following:

- Transportation technical staff, including local TDM agencies – agency program operations; customer satisfaction and needed improvements, traveler needs and interest in proposed new programs, likely impacts of local program initiatives
- Local transportation planners – transportation system operation, impact of TERMs on operation
- State and local government policy makers – effectiveness and cost effectiveness of TERMs, policy and funding implications of new Commuter Connections initiatives, local and regional travel trends, traveler needs, customer satisfaction
- Elected officials – local transportation benefits, travel trends, traveler needs
- Employers – benefits of implementing worksite TDM strategies
- Public at large / media – travel trends, societal impacts of TERMs (e.g., carbon footprint)

Possible Tools

Commuter Connections could consider a range of different communication tools targeted to various audiences and presenting information at different levels of detail and access. A sample of possible formats might include performance dashboards, prospectus, podcasts, on-demand streaming media recordings of presentations, social media postings (Facebook, Twitter) and/or brief summaries of program highlights.

Proposed Process

A four-step process might be undertaken with the Commuter Connections Sub-committee, the Evaluation Group, and other stakeholders as appropriate:

1. Define stakeholder / audience groups
2. Define relevant information and performance indicators (PIs) for each group – what information and results will be meaningful?
3. Define communications tools for each group – what media / format will reach the group most effectively?
4. Develop a communications plan for disseminating results:
   - To whom will information be communicated?
   - What will be communicated and in what form?
   - How will information be packaged / disseminated?

- When will information be disseminated?
- Who will prepare the information?

Key questions to be addressed include:

Current communication and areas for improvement

1. How effectively does Commuter Connections communicate evaluation results now?
2. What would you change, if anything about the current reporting (info conveyed, length/depth of analysis, format, frequency, etc.)? How will these changes improve communication?
3. Are there potential benefits of Commuter Connections' services that are not being reported?
4. What tools does Commute Connections have available? For example, MWCOG uses podcasts but Commute Connections hasn't used it for reporting TERM results.

Current local use of CC info and local needs for info

5. How do or could various organization use Commuter Connections' evaluation results (planning, budgeting, public relations, etc.)?
6. Are there transportation-related questions that organizations would like to answer but for which they do not have data now?
7. How much value would organizations place on alternative means of communicating the results of the evaluation to their stakeholders? These might include dashboards, podcasts, on-demand streaming media recordings of the results, social media (Facebook, Twitter), etc.

Communications Plan

The outcome of this process would define new communications opportunities, which could be detailed in a communications plan for disseminating results. The plan would describe the following:

- Audiences – To whom will information be communicated?
- Information – What will be communicated and in what form?
- Presentation – How will information be packaged / disseminated?
- Schedule – When will information be disseminated?
- Responsibilities – Who will prepare the information?

SECTION 8 EVALUATION SCHEDULES AND RESPONSIBILITIES

The key to any successful evaluation effort is for evaluation information to be generated and reported in a timely manner to decision makers. Commuter Connections prepares quarterly summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. Annual or triennial evaluation results are reported to COG/TPB staff, local jurisdiction program partners, and regional policy-makers in a useful, easily-digestible manner for policy purposes. Formal review of the results is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

Evaluation activities fall into three categories, with various recommended schedules as described in Table 2. The first column shows evaluation activities in three categories: surveys, on-going tracking, and reporting. The second column indicates the recommended frequency for administering surveys and on-going tracking. The specific schedule for all data collection activities has been established by Commuter Connections and is included as Appendix I. The final column of Table 2 indicates the party that would be responsible for collecting or maintaining the data.

Table 2 also shows recommended results reporting activities. It is assumed that reports will be prepared following each survey (placement survey, GRH survey, SOC survey, etc.) to document the results of the survey and calculate updated placement rates and VTR factors (if applicable) for the populations surveyed. As Table 2 indicates, in addition to these reports, internal activity and evaluation reports also are produced to report the progress of the Commuter Connections program as a whole and for individual TERMs. A full TERM Analysis Report will be developed every three years to document the TERM impacts during the previous three-year period. Finally, as described in Section 7, Commuter Connections is considering additional methods to present and disseminate results of its TDM evaluations. The specific schedules for these activities will be documented as the activities are defined.

RECOMMENDED EVALUATION RESPONSIBILITIES

The primary responsibility for performing quarterly and annual evaluations will reside with COG/TPB. COG/TPB will assume responsibility for managing regular and special Commuter Connections survey efforts conducted by outside contractors and will conduct some surveys, such as the GRH satisfaction survey, using in-house staff. COG/TPB staff also will assemble ongoing monitoring data, oversee all activities, and seek input to ensure consistency with accepted TERM analysis methods.

Commuter Connections local jurisdiction program partners will play a role in tracking some ongoing activities, especially in Employer Outreach, and will review and provide input on TERM evaluation activities.

Contractors may be used for some data collection and evaluation activities as directed by Commuter Connections staff. GRH service providers will provide data on usage as required in their contracts. Finally, employers will work with the Commuter Connections network members to provide information on program service utilization.

Table 2
Data Collection and Reporting Activities
Frequency and Responsibility

Evaluation Activity/Tool	Frequency	Responsibility
Ongoing Monitoring		
• ACT! employer contact database	Monthly	Sales representatives
• Telework Employer Records	Ongoing	CC
• Bike-to-Work Day participant records	Annual	CC
• Commuter Connections Applicant Database	Ongoing	CC
• GRH Applicant Database	Ongoing	CC
• Commuter Operations Center activity tracking	Ongoing	CC
Existing/Ongoing Surveys		
• CC Applicant Placement Survey	Triennial	Contractor to CC
• State of the Commute Survey	Triennial	Contractor to CC
• GRH Survey	Triennial	CC
• Bike-to-Work Participant Survey	Triennial	CC
• Employee Commute Surveys	Ongoing	Contractor to CC
• Telework-assisted Employer follow-up Survey	Triennial	CC
Evaluation Results Reporting		
• Commuter Connections "Report Card"	Quarterly	CC
• CC Program Annual Report	Annual	CC
• TERM Evaluation Report	Triennial	Contractor to CC
• Commuter Connections survey reports	As produced	Contractor to CC

CC – Commuter Connections

LIST OF APPENDICES

APPENDIX A
BASIC CALCULATION OF VTR FACTOR

The vehicle trip reduction (VTR) factor represents the average number of vehicle trips that a commuter "placed" in an alternative mode would reduce per day. The VTR factor combines the trip reduction results of three possible types of travel changes that new commuter placements might make:

1. Drive alone commuters shifting to an alternative mode
2. Commuters who currently use an alternative mode shifting to another alternative mode (e.g., from carpool to transit)
3. Commuters who currently use an alternative mode increasing their weekly frequency of alternative mode use (e.g., from carpool one time per week to carpool three times per week).

Shown below is a brief example of how the VTR factor would be calculated for seven commuter who made the following travel changes:

- Placement 1 – shifts from driving alone, 5 days per week, to a two-person carpool, 5 days per week
- Placement 2 – shifts from driving alone, 5 days per week, to transit, 5 days per week
- Placement 3 – shifts from driving alone, 5 days per week, to teleworking, 2 days per week and driving alone 3 days per week
- Placement 4 – shifts from driving alone, 5 days per week, to two-person carpool, 2 days per week and driving alone 3 days per week
- Placement 5 – shifts from a two-person carpool, 5 days per week, to transit, 5 days per week
- Placement 6 – shifts from transit, 5 days per week, to a two-person carpool, 5 days per week
- Placement 7 – increases the frequency of carpool from 1 day per week to 3 days per week, driving alone the other 2 days

The VTR factor is calculated by determining the number of vehicle trips all placements would reduce together and dividing that total by the number of placements. We assume that a commuter makes two trips a day, one from home to work and a second from work to home. Thus a commuter who drives alone would make 2 vehicle trips each day. If the commuter carpools, he would make ½ vehicle trip to work and ½ trip back home, for a total of 1 vehicle trip per day. A commuter who uses transit, bikes, or walks is assumed to make 0 vehicle trips. A commuter who teleworks also makes 0 vehicle trips for telework days.

Shown on the next page are the travel modes and the numbers of vehicle trips each of the seven commuters described above would make for each day of the week before the shift to an alternative mode and after the shift. The third column shows the net vehicle trips (number of trips after the shift minus number of trips before the shift). The final column shows the total weekly trips reduced. Note that commuter placement #6 actually increases his weekly commute trips, because he shifts from a higher occupancy alternative mode (transit) to a lower occupancy mode (carpool).

APPENDIX A (CONT.)

Sample VTR Calculation
Travel Modes Before and After Shifts to Alternative Modes
By Commuter and by Day of the Week

	Vehicle Trips Before Shift					Vehicle Trips After Shift					Vehicle Trips Net Trips					Weekly
	M	**T**	**W**	**T**	**F**	**M**	**T**	**W**	**T**	**F**	**M**	**T**	**W**	**T**	**F**	**Change**
Placement 1	D	D	D	D	D	C	C	C	C	C						
DA to 2p CP	2	2	2	2	2	1	1	1	1	1	-1	-1	-1	-1	-1	-5 trips
Placement 2	D	D	D	D	D	T	T	T	T	T						
DA to TR	2	2	2	2	2	0	0	0	0	0	-2	-2	-2	-2	-2	-10 trips
Placement 3	D	D	D	D	D	D	D	C	C	C						
DA to TC/DA (part-time)	2	2	2	2	2	2	2	2	0	0	0	0	0	-2	-2	-4 trips
Placement 4	D	D	D	D	D	D	D	C	C	C						
DA to CP/DA (part-time)	2	2	2	2	2	2	2	2	1	1	0	0	0	-1	-1	-2 trips
Placement 5	C	C	C	C	C	T	T	T	T	T						
2p CP to TR	1	1	1	1	1	0	0	0	0	0	-1	-1	-1	-1	-1	-5 trips
Placement 6	T	T	T	T	T	C	C	C	C	C						
TR to 2p CP	0	0	0	0	0	1	1	1	1	1	+1	+1	+1	+1	+1	+5 trips
Placement 7	D	D	D	D	C	D	D	C	C	C						
DA/CP to CP (part-time)	2	2	2	2	1	2	2	1	1	1	0	0	-1	-1	0	-2 trips
Total weekly trips	11	11	11	11	10	8	8	7	4	4	-3	-3	-4	-7	-6	-23 trips

Total placements	= 7 placements (travel for each shown above)
Total trips reduced per week	= 23 trips per week (all placements together)
Total trips per day (all placements together)	= 23 trips per week / 5 days per week =4.6 trips per day
Average trips reduced per placement	**= 4.6 trips per day / 7 placements** **= 0.66 trips per placement**

The seven commuter placements would reduce a total of 4.6 trips during a single day, thus the average number of trips reduced per day by each of the seven placements would be 0.66. This is the VTR factor.

APPENDIX B
SAMPLE FULL CALCULATION OF VEHICLE TRIP REDUCTION (VTR) FACTOR

Summary of Current and Previous Mode for Survey Respondents Who Made a Shift to an Alternative Mode

	Current One-Way Weekly Person Trips				Previous One-Way Weekly Person Trips				New One-Way Weekly Person Trips (current – prev)		
	DA	RS	TR	RSOcc.	DA	RS	TR	RSOcc.	DA	RS	TR
Drive alone shift to Transit											
	0	0	8	0	8	0	0	0	-8	0	8
	0	0	10	0	2	0	8	0	-2	0	2
	0	0	10	0	10	0	0	0	-10	0	10
Total	**0**	**0**	**28**		**20**	**0**	**8**		**-20**	**0**	**20**
Drive alone shift to Rideshare											
	2	6	0	2	8	0	0	0	-6	6	0
	0	2	8	8	2	0	8	0	-2	2	0
	0	10	0	3	2	8	0	2	-2	2	0
	0	10	0	2	10	0	0	0	-10	10	0
	0	10	0	3	10	0	0	0	-10	10	0
	0	8	0	13	8	0	0	0	-8	8	0
Total	**2**	**46**	**8**		**40**	**8**	**8**		**-38**	**38**	**0**
Rideshare shift to Transit *											
	0	0	10	0	0	2	8	3	0	-2	2
	0	0	10	0	0	10	0	3	0	-10	10
	0	0	10	0	0	10	0	4	0	-10	10
	0	0	10	0	0	8	2	2	0	-8	8
Total	**0**	**0**	**40**		**0**	**30**	**10**		**0**	**-30**	**30**
Rideshare shift to Rideshare (ex. carpool to vanpool)											
	0	5	0	3	0	5	0	2	0	0	0
	0	5	0	3	0	5	0	13	0	0	0
	0	10	0	3	0	10	0	3	0	0	0
Total	**0**	**20**	**0**		**0**	**20**	**0**		**0**	**0**	**0**
Transit shift to Other Transit (ex. bus to train) *											
	0	0	10	0	0	0	10	0	0	0	0
	0	0	10	0	0	0	10	0	0	0	0
Total	**0**	**0**	**20**	**0**	**0**	**0**	**20**		**0**	**0**	**0**
Transit shift to Rideshare*											
	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	12	0	0	10	0	0	10	-10
	0	10	0	4	0	0	10	0	0	10	-10
	0	10	0	3	0	0	10	0	0	10	-10
Total	**0**	**50**	**0**		**0**	**0**	**50**		**0**	**50**	**-50**
Average RS Occupancy			**4.5**					**4.0**			

APPENDIX B – SAMPLE CALCULATION OF VTR FACTOR (CONT.)

Summary of Travel Changes for all Respondents

Current One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Weekly person trips	2	116	96
Average RS occupancy	1	4.5	N/A
Weekly Vehicle trips (Person trips/RS occupancy)	2	25.8	0

Previous One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Person trips	60	58	96
Average RS occupancy	1	4.0	N/A
Vehicle trips	60	14.5	0

Net One-way Weekly Trips (all respondents) = current trips – previous trips

	DA	RS	TR/BW
Person trips	-58	58	0
Vehicle trips	-58	11.3	0

Weekly person trips reduced *(DA + RS+ TR/BW)*	0
Weekly vehicle trips reduced *(DA + RS + TR/BW)*	-46.7
Respondents with change	23
Average weekly vehicle trips reduced *(Weekly vehicle trips reduced / # of respondents)*	-2.03
Average daily vehicle trips reduced *(Average wkly vehicle trips reduced / 5 days per week)*	**-0.41**

* For purpose of VTR calculation, Transit category also includes bike/walk

NOTE: Numbers shown in this sample calculation are not based on actual survey data. Data were created as a hypothetical example for illustration only.

APPENDIX C
2008 ADJUSTMENT TO COMMUTER MODEL COEFFICIENTS

Impacts for the Employer Outreach TERM are calculated using the EPA COMMUTER model (v 2.0). Prior to the 2008 analysis, the default cost and time coefficients for the Washington DC region were used in model runs. Analysis performed by the LDA Consulting team for COG in 2007, suggested the COMMUTER model overestimated the likely impacts of employers' strategies, in particular those related to financial incentives. Thus the team examined possible adjustment to the COMMUTER model to give more conservative results for the 2005-2008 TERM analysis.

The results of the analysis suggested the most acceptable option was to reduce the cost coefficient to a level that could be expected to produce a vehicle trip reduction (VTR) change that approximated employee survey results of employers for which before commuter programs were implemented and after implementation. Because "with program" employee survey data were not available for the MWCOG region, the team used data from the Seattle, WA metropolitan region and determined the Seattle cost coefficient that would have predicted the result found in the Seattle survey data. The team then applied a proportional reduction to the current MWCOG cost coefficient.

The team performed a coefficient sensitivity analysis to estimate the VTR result at various cost coefficient levels. Two sensitivity cases were run, to test two different employer situations. The first included employers that had maintained or expanded the services in their commute programs, regardless of their program level (Level 1-4). The second case included employers that would have been classified as Level 3 or Level 4 in the TERM analysis, regardless of the changes they had made in their program. This case was run because it was consistent with the TERM analysis methodology.

Table 1 below shows the results for the Level 3-4 employer case, which was deemed more appropriate for this analysis.

Table 1 - COMMUTER model Vehicle Trip Rate (VTR) change prediction by travel cost coefficient - Level 3 and 4 Employers (Sample size 609)

Travel Cost Coefficient	Survey VTR Change	COMMUTER VTR Change
-0.0009	-2.32	-1.89
-0.0013	-2.32	-2.19
-0.0015	-2.32	**-2.35**
-0.0019	-2.32	-2.66
-0.0024*	**-2.32**	-3.06
-0.0029	-2.32	-3.46
-0.0031	-2.32	-3.62
-0.0034	-2.32	-3.86
-0.0039	-2.32	-4.26
-0.0043**	-2.32	-4.58
-0.0047	-2.32	-4.9
-0.0049	-2.32	-5.06

Coefficient -0.0024 vs -.0015,
Difference of 0.0009
VTR change difference 0.74

VTR difference 0.74
Coefficient difference of 0.009
-0.0043 vs -0.0034

*Coefficient for Seattle **Coefficient for MWCOG region

As shown, the VTR reduction measured from the Seattle survey for these employers was -2.32. The COMMUTER model, using the Seattle cost coefficient of -0.0024 would have predicted a VTR result of -3.06, or a difference of about 0.74. To obtain a result of -2.32, the cost coefficient would have to have been -0.0015, or a reduction of 0.0009.

When the sensitivity results were plotted with coefficient on one axis and the VTR change on the other, it was clear that the change in VTR was directly proportional to the change in coefficient. Thus, it was reasonable to apply the same 0.74 difference from the Seattle VTR results to the MWCOG predicted result to estimate the coefficient that would produce a proportionately accurate result in the MWCOG region.

The cost coefficient used with the COMMUTER model in the 2002-2005 TERM analysis was -0.0043. Referring again to Table, 1, a coefficient of -0.0043 would predict a VTR change of -4.58. Applying the 0.74 difference in the VTR change result from the Seattle case to the MWCOG coefficient would result in a new VTR change of -3.84. This number does not match the -2.32 VTR change result for the Seattle data, not is it reasonable to expect that it would, since the Seattle area survey results reflect Seattle area conditions. It is not unreasonable to assume that the MWCOG area could have a higher VTR change when similar commuter program conditions are in place.

To obtain this -3.84 VTR value, the coefficient for MWCOG would have to be -0.0034. The VTR result of -3.84 would represent about a 16% reduction in impact compared to that produced using the -0.0043 cost coefficient.

With these changes, the old (2005) and new (2008) coefficients used in the COMMUTER Model were as follows. Note that no changes were made to the time coefficients.

	2008 Coefficients	2005 Coefficients
IVTT- In-vehicle travel time - all modes (minutes)	-0.0300	-0.0300
OVTT - Transit walk time (minutes)	-0.0750	-0.0750
OVTT - Transit wait time (minutes)	-0.0750	-0.0750
Cost - Auto parking (cents)	-0.0034	-0.0034
Cost - Transit fare (cents)	-0.0034	-0.0034

APPENDIX D
SAMPLE CALCULATIONS OF MARYLAND AND VIRGINIA TELEWORK IMPACTS

Populations of Interest

• All regional teleworkers (TW)	456,636	(from SOC survey)
• Employees at worksites assisted by TW	127,161	(from TW assistance survey)

Telecommute Placement Rates

• Directly assisted TW	9.6%	(% of TW assisted by TW, from SOC survey)
• Assisted worksites	4.1%	(% of new TW at sites, from TW assistance survey)

Placements

Mixed home and Non-home based

• Directly assisted TW	43,762	(regional TW x directly assisted placement rate)
• TW at TW asst. sites	5,264	(employees at assisted sites x asst site placement rate)
Total assisted TW	**49,027**	

Breakdown of placements by Location (home-based and telecenter-based)

• % Home-based TW	95%	(from SOC survey)
• % Non-home (NH)-based TW	5%	(from SOC survey)
• Home-based TW	46,575	(total assisted TW x % Home-based TW)
• NH-based TW	2,451	(total assisted TW x % NH-based TW)

Daily Vehicle Trips Reduced

VTR Factors

• Home-based factor	0.45	(from SOC survey)
• NH-based factor	0.31	(from SOC survey)
• Home-based VT reduced	21,097	(HB TW x HB VTR factor)
• NH-based VT reduced	769	(NH-based TW x NH VTR factor)

Total Daily Vehicle Trips Reduced 21,866

Appendix D, continued

Daily VMT Reduced

Ave one-way trip distance (mi)

• Home-based TW	18.5	(SOC survey)

Telecenter reductions (TC days) – other than MWTC

• VMT reduction – Non-home days	19.4	(SOC survey)
• Ave. days/wk at TC	1.0	(SOC survey)
• VMT reduction – home TW days	31.8	(SOC survey)
• Ave. days/wk at home	0.9	(SOC survey)
• Total weekly VMT reduction	47.8	
• Daily reduction per teleworker	9.6	

VMT reductions on TW days

• Home-based VMT reduced	390,290	(HB VT reduced x ave trip distance)
• NH-based VMT reduced	23,412	(NH-based TW x daily miles reduced)
Total Daily VMT Reduced	**413,702**	

Daily Emissions Reduced – NOx and VOC

		08 Emission		**08 Emission**		
NOx	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	21,866	0.6291			13,758	0.0152
• Running (40 mph)			413,703	0.4287	177,396	0.1955
Total NOx reduced (tons)						**0.211**

		08 Emission		**08 Emission**		
VOC	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	21,866	1.7343			37,922	0.0418
• Running (40mph)			413,703	0.1836	75,956	0.0837
Total VOC reduced (tons)						**0.126**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

		10 Emission		**10 Emission**		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	21,866	0.000			0	0.000
• Running (40mph)			413,703	0.0115	4,758	0.005
					Daily	**0.005**
Total PM 2.5 reduced (tons)					**Annual**	**1.3**

Appendix D, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	21,866	0.6652			14,545	0.016
• Running (40mph)			413,703	0.4038	167,053	0.184
					Daily	**0.200**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**50.0**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	21,866	0.000			0	0.
• Running (40mph)			413,703	455.7	188,524,584	208
					Daily	**208**
Total CO2 reduced (tons)					**Annual**	**51,953**

APPENDIX E
SAMPLE CALCULATIONS OF GUARANTEED RIDE HOME IMPACTS

Populations of Interest		
• GRH registrants	15,644	(GRH database)
• Re-registrants	9,114	
• One-time exceptions	406	(GRH database)
Total GRH base	**25,164**	
Within MSA	68%	17,112
Outside MSA	32%	8,052
GRH Placement Rates (continued rates only)		
• Within MSA placement rate	33.9%	(GRH survey)
• Outside MSA placement rate	44.9%	(GRH survey)
Placements (continued only)		
• Within MSA	**5,801**	(Within MSA base x within MSA placement rate)
• Outside MSA	**3,615**	(Outside MSA base x outside MSA placement rate)
Total Placements	**9,416**	
Daily Vehicle Trips Reduced		
VTR Factors (continued only)		
• Within MSA	0.92	(GRH survey)
• Outside MSA	1.19	(GRH survey)
VT Reduced (continued only)		
• Within MSA	**5,336**	**(**Within MSA placements x within MSA VTR factor)
• Outside MSA	**4,303**	(Outside MSA placements x outside MSA VTR factor**)**
Total Daily VT Reduced	**9,639**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)		
• Within MSA	26.2	(from GRH survey)
• Outside MSA	26.2	(discounted from actual 47.0 miles from GRH survey)
VMT reduced		
• Within MSA	139,823	(Within MSA VT reduced x trip distance)
• Outside MSA	112,726	(Outside MSA VT reduced x trip distance)
Total Daily VMT Reduced	**252,549**	

Appendix E, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

Inside MSA

- SOV access percentage 50% (GRH survey)
- SOV access distance (mi) 4.8 (GRH survey)

Outside MSA – not applicable – all access outside MSA

VT Reduction

- No SOV access 6,971 (VT x non-SOV access %)

Total VT for AQ analysis **6,971**

VMT Reduction

- No SOV access 182,637 (VT x SOV % x trip distance)
- With SOV access 57,103 (VT x SOV % x (trip distance – access distance)

Total VMT for AQ analysis **239,740**

Daily Emissions Reduced – NOx and VOC

		08 Emission		08 Emission		
NOx reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	6,971	0.6292			4,386	0.005
• Running			239,740	0.4288	102,801	0.113
Total NOx reduced (tons)						**0.118**

		08 Emission		08 Emission		
VOC reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	6,971	1.7343			12,090	0.013
• Running			239,740	0.1836	44,016	0.049
Total VOC reduced (tons)						**0.062**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

		10 Emission		10 Emission		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	6,971	0.000			0	0.000
• Running (40mph)			239,740	0.0115	2,757	0.003
					Daily	**0.003**
Total PM 2.5 reduced (tons)					**Annual**	**0.80**

Appendix E, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	6,971	0.6652			4,637	0.005
• Running (40mph)			239,740	0.4038	96,807	0.107
					Daily	**0.112**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**28.0**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	6,971	0.000			0	0.0
• Running (40mph)			239,740	455.7	109,249,733	120
					Daily	**120**
Total CO2 reduced (tons)					**Annual**	**30,107**

Correction for Overlap with MM TERM

Total GRH apps FY 06, 07, 08	25,164	
New GRH apps FY 06, 07, 08	15,644	62%
Estimated MM share of new GRH	16%	
Estimated MM share of GRH impact	10%	

	GRH base	MM	Net GRH
Placements	9,416	937	8,480
VMT reduced	9,639	959	8,680
VMT reduced (mi)	252,549	25,121	227,428
Daily Emissions Reduced			
NOx (T)	0.118	0.012	0.106
VOC (T)	0.0632	0.006	0.056
Annual Emissions Reduced			
PM 2.5 (T)	0.80	0.10	0.70
PM 2.5 Precursor NOx (T)	28.0	2.8	25.2
CO2 (T)	30,107	2,995	27,112

APPENDIX F
SAMPLE CALCULATION OF EMPLOYER OUTREACH

Populations of Interest

Level 3 or 4 sites (data from ACT! database)

	Employers	Employees
• 2005 continued programs	709	205,160
• Expanded programs	57	22,790
• New programs	137	84,723

Average Vehicle Occupancy (AVO)

Starting AVO from employee survey data, Final AVO from COMMUTER model

	Starting AVO	Ending AVO
• 2005 continued programs	1.34	1.53
• Expanded programs	1.38	1.52
• New programs	1.21	1.40

Daily person trips

Total employees x 2 one-way trips per day
Starting (pre-program) and ending (with-program)

	Starting	Ending
• 2005 continued programs	410,320	410,320
• Expanded programs	45,580	45,580
• New programs	169,446	169,446

Daily vehicle trips

Total employees / starting AVO)
Starting (pre-program) and ending (with-program)

	Starting	Ending	Difference
• 2005 continued programs	306,688	268,552	38,136
• Expanded programs	33,098	30,020	3,078
• New programs	140,310	120,878	19,432

Total Daily Vehicle Trips Reduced

• 2005 continued programs	38,136
• New/expanded programs	22,510

Daily VMT

Total employees / starting AVO)
Starting (pre-program) and ending (with-program)

• 2005 continued programs	620,638
• Expanded programs	50,037
• New/expanded programs	322,369

Appendix F, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

- SOV access percentage 28% (from SOC survey)
- SOV access distance (mi) 3.1 (from SOC survey)

VT Reduction without SOV access – used as base for AQ analysis

(VT reduced x non-SOV access %)

- 2005 continued programs 27,458
- New/expanded programs 16,207

VMT Reduction without SOV access

(Total VT reduced – (VT reduced x SOV % x trip distance)

- 2005 continued programs 587,536
- New/expanded programs 352,867

Emissions Reduced

Continued from 2005

Daily Emissions Reduced – NOx and VOC

		08 Emission		08 Emission		
NOx reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	27,076	0.6292			17,276	0.019
• Running			586,356	0.4288	251,936	0.277
Total NOx reduced (tons)						**0.297**

		08 Emission		08 Emission		
VOC reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	27,076	1.7343			47,620	0.052
• Running			587,356	0.1836	107,872	0.119
Total VOC reduced (tons)						**0.171**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

		10 Emission		10 Emission		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	27,076	0.000			0	0.0
• Running (40mph)			586,356	0.0115	6,757	0.007
					Daily	**0.007**
Total PM 2.5 reduced (tons)					**Annual**	**1.9**

Appendix F, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	27,076	0.6652			18,265	0.020
• Running (40mph)			586,356	0.4038	237,247	0.262
					Daily	**0.282**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**70.4**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	27,076	0.000			0	0
• Running (40mph)			586,356	455.7	267,740,286	295
					Daily	**295**
Total CO2 reduced (tons)					**Annual**	**73,783**

New / Expanded in 2008

Daily Emissions Reduced – NOx and VOC

NOx reduced	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start + hot soak	16,207	0.6292			10198	0.012
• Running			352,867	0.4288	151,310	0.167
Total NOx reduced (tons)						**0.179**

VOC reduced	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start + hot soak	16,207	1.7343			28,108	0.031
• Running			352,867	0.1836	64,786	0.071
Total VOC reduced (tons)						**0.102**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	16,207	0.000			0	0.0
• Running (40mph)			352,867	0.0115	4,058	0.004
					Daily	**0.004**
Total PM 2.5 reduced (tons)					**Annual**	**1.1**

Appendix F, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	16,207	0.6652			10,781	0.012
• Running (40mph)			352,867	0.4038	142,488	0.157
					Daily	**0.169**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**42.2**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	16,207	0.000			0	0
• Running (40mph)			352,867	455.7	160,801,698	177
					Daily	**177**
Total CO2 reduced (tons)					**Annual**	**44,313**

Correction for Overlap with TW TERM and Impacts for EO for Bicycling

	EO base	TW	Net EO	EO-bike
Vehicle Trips Reduced	60,645	1,483	59,163	188
VMT Reduced (miles)	993,044	23,870	969,174	1,127
Daily Emissions Reduced				
NOx (tons)	0.456	0.0123	0.443	0.001
VOC (tons)	0.274	0.0077	0.266	0.001
Annual Emissions Reduced				
PM 2.5 (T)	3.0	0.1	2.9	0.0
PM 2.5 Precursor NOx (T)	112.6	2.9	109.7	0.2
CO2 (T)	118,097	2,996	115,099	142

APPENDIX G
SAMPLE CALCULATION OF MASS MARKETING IMPACTS

4 impact components
- Part 1 - Commuters influenced by ads to change mode – no contact CC
- Part 2 – Commuters influenced by ads to contact CC
- Part 3 – GRH credit
- Part 4 – Bike to Work Day

PART 1

Populations of Interest – commuters influenced by ads to change mode – no contact CC

Total commuters in region	2,426,248	(SOC)
• % recall commute message	35%	(SOC)
• % chg to alt mode after ads	0.1%	(SOC)
• % chg influenced by ad	100%	(SOC)
Placements – no contact with CC	**628**	(COC – monthly applicant analysis)
Placement Rates		
• Continued placement rate	19%	(SOC)
• Temporary placement rate	81%	(SOC)
Placements		
• Continued placements	119	(Placements x continued placement rate)
• Temporary placements	509	(Placements x temporary placement rate)
Daily Vehicle Trips Reduced		
VTR Factors		
• Continued VTR factor	1.00	(SOC)
• Temporary VTR factor	1.70	(SOC)
• Continued VT reduced	119	(Continued placements x continued VTR factor)
• Temporary VT reduced	399	(Temporary placements x temporary VTR factor x 0.46 discount for temporary use)
Total Daily Vehicle Trips Reduced	**518**	
Daily VMT Reduced		
• Ave one-way trip dist (mi)	31.2	(SOC)
Total Daily VMT Reduced	**16,175**	

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	28%	(from CC placement survey)
• SOV access distance (mi)	3.1	(from CC placement survey)

Appendix G, continued

PART 1 (cont.)

VT Reduction

• No SOV access	373	(VT x non-SOV access %)
Total VT for AQ analysis	**373**	

VMT Reduction

• No SOV access	11,646	(VT x SOV % x trip distance)
• With SOV access	4,079	(VT x SOV % x (trip dist – access dist)
Total VMT for AQ analysis	**15,725**	

Daily Emissions Reduced – Part 1

		08 Emission		08 Emission		
NOx reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	373	0.6292			235	0.0003
• Running			15,725	0.4288	6,743	0.0074
Total NOx reduced (tons)						**0.0077**

		08 Emission		08 Emission		
VOC reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	373	1.7343			647	0.0007
• Running			15,725	0.1836	2,887	0.0032
Total VOC reduced (tons)						**0.0039**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

		10 Emission		10 Emission		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	6,971	0.000			0	0.0000
• Running (40mph)			239,740	0.0115	181	0.0002
					Daily	**0.0002**
Total PM 2.5 reduced (tons)					**Annual**	**0.05**

		10 Emission		10 Emission		
PM 2.5 Precursor NOx	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	6,971	0.6652			248	0.0003
• Running (40mph)			239,740	0.4038	6,350	0.007
					Daily	**0.007**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**1.8**

		08 Emission		08 Emission		
CO2	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	6,971	0.000			0	0
• Running (40mph)			239,740	455.7	7,166,004	8
					Daily	**8**
Total CO2 reduced (tons)					**Annual**	**1,975**

Appendix G, continued

PART 2

Populations of Interest – commuters influenced by ads to contact CC

New CC apps (does not include re-apply or follow-up)

• FY 2006	13,479	(CC database)
• FY 2007	11,364	(CC database)
• FY 2008	13,418	(CC database)
Total applicants	**38,261**	

Commuters influenced by ads to contact CC	15%	(COC – monthly applicant analysis)
New apps 06-08 as % of total	21%	(new apps FY04, 05 / total CC apps)
% all apps influenced by ads	3.1%	

CC Impacts – FY 06-08	**Total**	**MM Share**
• CC placements	77,627	2,400
• CC Vehicle trips reduced	24,639	762
• CC VMT reduced	791,211	24,461

CC Impacts – FY 05-08 – Discounted for AQ Analysis

	Total	**MM Share**
• CC Vehicle trips reduced	14,248	440
• CC VMT reduced	721.303	22,300

Daily Emissions Reduced – NOx and VOC (Part 2)

		08 Emission		**08 Emission**		
NOx reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	440	0.6292			277	0.0003
• Running			22,300	0.4288	9,562	0.0105
Total NOx reduced (tons)						**0.011**

		08 Emission		**08 Emission**		
VOC reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	440	1.7343			764	0.0008
• Running			22,300	0.1836	4,094	0.0045
Total VOC reduced (tons)						**0.005**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2 (Part 2)

		10 Emission		**10 Emission**		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	6,971	0.000			0	0.0
• Running (40mph)			239,740	0.0115	256	0.01
					Daily	**0.01**
Total PM 2.5 reduced (tons)					**Annual**	**2.6**

Appendix G, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	6,971	0.6652			293	0.0003
• Running (40mph)			239,740	0.4038	9,005	0.001
					Daily	**0.010**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**2.6**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	6,971	0.000			0	0
• Running (40mph)			239,740	455.7	10,161,901	11
					Daily	**11**
Total CO2 reduced (tons)					**Annual**	**2,800**

PART 3 – GRH Credit

From GRH Analysis

Total GRH apps FY 06, 07, 08	25,164	
New GRH apps FY 06, 07, 08	15,644	62%
Estimated MM share of new GRH	16.0%	
Estimated MM share of GRH impact	9.9%	

	GRH base	MM
Placements	9,416	937
VT reduced	9,639	959
VMT reduced	225,549	25,121
Daily Emissions Reduced		
NOx (T)	0.118	0.012
VOC (T)	0.062	0.006
Annual Emissions Reduced		
PM 2.5 (T)	0.8	0.1
PM 2.5 Precursor NOx (T)	28.0	2.8
CO2 (T)	30,107	2,995

Appendix G, continued

Part 4 - Bike to Work Day Credit

Participants' riding percentage and frequency

Number of riders	6,846	(BTWD registration data, 2005, 2006, 2007)
% biking to work before event	78.9%	(BTWD survey)
% new riders	9.6%	(BTWD survey)
Number of new riders	657	
% who increase riding days	12.3%	
Number of increased riders	842	
Total new + increased riders	1,499	Placement

Change in Bike Days

Pre-Event		
% biking before event	78.9%	
Ave days riding before event	2.5	(BTWD survey)
Weekly bike days before	13,342	
Summer Biking		
% biking after event	88%	(BTWD survey)
Ave days riding after event	2.6	(BTWD survey)
Weekly bike days after	15,596	
Fall Biking		
% new riders biking late fall	76%	(BTWD survey)
Weekly bike days late fall	1.04	(BTWD survey)
Weekly new bike days fall	518	
% increased riders biking late fall	72%	(BTWD survey)
Weekly new bike days late fall	0.92	(BTWD survey)
Weekly increased bike days	555	

New Bike Days

• New wkly bike days summer	2,254	(riders x % new after event x ave days summer)
• New wkly bike days fall	1,073	(riders x % new riders x still ride winter x ave days)
• Total new bike days summer	63,124	(wkly summer days x 28 wks – Apr-Oct)
• Total new bike days winter	23,601	(wkly winter days x 22 wks – Nov-Mar)
• Total new bike days-year	86,725	(summer bk days + winter bk days)
• New bike trips - year	173,450	(annual bike days x 2)

New Bike Trips and VT Reduction

• Ave new daily bk trips	694	(Annual new bike trips / 250)
• % DA/RS on non-bike days	49%	(BTWD survey)
• Daily vehicle trips reduced	338	(daily new bike trips x DA %

BTWD Daily Vehicle Trips Reduced 338

Appendix G, continued

Daily VMT Reduced

- Ave trip distance (mi) 10.4 (BTWD survey)

BTWD Daily VMT Reduced **3,518** (vehicle trips reduced x average trip distance)

Total Daily Vehicle Trips Reduced **338** (Bike program VT reduced + BTWD VT reduced)
Total Daily VMT Reduced **3,518** (Bike program VMT reduced + BTWD VMT reduced)

Daily Emissions Reduced – NOx and VOC

		08 Emission		08 Emission		
NOx reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	338	0.6292			213	0.0002
• Running			3,518	0.4288	1,508	0.0017
Total NOx reduced (tons)						**0.0019**

		08 Emission		08 Emission		
VOC reduced	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	338	1.7343			587	0.0006
• Running			3,518	0.1836	646	0.0007
Total VOC reduced (tons)						**0.001**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2 (Part 2)

		10 Emission		10 Emission		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	338	0.000			0	0.000
• Running (40mph)			3,518	0.0115	40	0.000
					Daily	**0.0**
Total PM 2.5 reduced (tons)					**Annual**	**0.0**

Appendix 4, continued

		10 Emission		10 Emission		
PM 2.5 Precursor NOx	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	338	0.6652			225	0.002
• Running (40mph)			3,518	0.4038	1,420	0.0016
					Daily	**0.002**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**0.5**

		08 Emission		08 Emission		
CO2	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	338	0.000			0	0
• Running (40mph)			3,518	455.7	1,602,954	1.8
					Daily	**1.8**
Total CO2 reduced (tons)					**Annual**	**442**

Appendix G, continued

Mass Marketing
Total – PART 1, PART 2, PART 3, AND PART 4

	No Contact	CC Contact	GRH	BTWD	Total MM
Placements	628	2,400	937	1,499	**5,464**
VT reduced	518	762	959	338	**2,577**
VMT reduced	16,175	24,461	35,121	3,518	**69,274**
Daily Emissions Reduced					
NOx (T)	0.008	0.01	0.012	0.002	**0.032**
VOC (T)	0.004	0.005	0.006	0.001	**0.017**
Annual Emissions Reduced					
PM 2.5 (T)	0.05	0.07	0.08	0.01	0.21
PM 2.5 Precursor (T)	1.8	2.6	2.8	0.45	7.6
CO2 (T)	1,975	2,800	2,995	442	8,212

APPENDIX H
SAMPLE CALCULATION OF COMMUTER OPERATIONS CENTER IMPACTS

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2006	63,358	(CC database)
• FY 2007	58,221	(CC database)
• FY 2008	64,060	(CC database)
Total assisted commuters	**185,639**	

Within MSA (69%)	128,091
Outside MSA (31%)	57,548

COC Placement Rates	**In MSA**	**Out MSA**
• Continued rate	25.0%	31.3%
• Temporary rate	15.7%	13.2%
• Total	40.7%	44.3%

Placements

• Continued	32,023	17,897	(Apps x cont. rate)
• Temporary	20,110	7,596	(Apps x temporary rate)
• **Total placements 77,627**			

Daily Vehicle Trips Reduced

VTR Factors

• Continued	0.44	0.48
• Temporary	0.61	0.45
• Temporary discount	12.7%	11.7%

• Continued trips reduced	14,090	8,591	(Placements x cont. VTR factor)
• Temporary trips reduced	1,558	400	(Placements x temp VTR factor)
Total VT reduced 24,639			

Daily VMT Reduced

Ave one-way trip distance (mi)

• Continued	32.2	32.2	(Actual Outside dist. 54.4 miles)
• Temporary	31.1	31.1	(Actual Outside dist. 57.9 miles)

• Continued VT reduced	453,698	276,623	(Vehicle trips x ave distance)
• Temporary VT reduced	48,452	12,438	

Total VMT Reduced 791,211

Appendix H, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	67%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	6.6	0.0	(CC placement survey)
• Non-SOV access % - Temporary	61%	0%	(CC placement survey)
• SOV access dist (mi) – Temporary	8.0	0.0	(CC placement survey)

VT Reduction

• Cont VT with SOV access	9,440	0	
• Temp VT with SOV access	950	0	(VT x non-SOV access %)

Total SOV VT access **10,391**

VMT Reduction

• SOV access (cont)	62,306	0	(VT x SOV % x (dist – access dist))
• SOV access (temp)	7,603	0	

Total SOV VMT access **69,909**

Total VT for AQ analysis **14,248**
Total VMT for AQ analysis **721,303**

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**08 Emission Factor**	**VMT**	**08 Emission Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	14,248	0.6292			8,965	0.010
• Running			721,303	0.4288	309,295	0.341
Total NOx reduced (tons)						**0.351**

VOC	**Trips**	**08 Emission Factor**	**VMT**	**08 Emission Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	14,248	1.7343			24,710	0.027
• Running			721,303	0.1836	132,431	0.146
Total VOC reduced (tons)						**0.173**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**10 Emission Factor**	**VMT**	**10 Emission Factor**	**Tot gm**	**Tot ton**
• Cold start	14,248	0.000			0	0.00
• Running (40mph)			721,303	0.0115	8,295	0.009
					Daily	**0.009**
Total PM 2.5 reduced (tons)					**Annual**	**2.3**

Appendix H, continued

PM 2.5 Precursor NOx	Trips	10 Emission Factor	VMT	10 Emission Factor	Tot gm	Tot ton
• Cold start	14,248	0.6652			9,478	0.020
• Running (40mph)			721,303	0.4038	291,262	0.321
					Daily	**0.332**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**82.9**

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	14,248	0.000			0	0
• Running (40mph)			721,303	455.7	328,697,658	362
					Daily	**362**
Total CO2 reduced (tons)					**Annual**	**90,582**

Correction for Overlap with Integrated Rideshare and GRH TERMs

	COC base	MM	Kiosk	Soft Upg	GRH	Net COC
Placements	77,627	2,400	134	8,628	4,288	62,177
Vehicle Trips Reduced	24,639	762	43	4,523	1,361	17,951
VMT Reduced (miles)	791,211	24,461	1,363	146,441	43,705	575,237
Daily Emissions Reduced						
NOx Reduced (tons)	0.351	0.011	0.001	0.065	0.019	0.256
VOC Reduced (tons)	0.173	0.005	0.000	0.032	0.010	0.13
Annual Emissions Reduced						
PM 2.5 (T)	2.3	0.1	0.0	0.4	0.1	1.7
PM 2.5 Precursor (T)	82.9	2.6	0.1	15.2	4.6	60.4
CO2 (T)	90,582	2,800	157	16,669	5,003	65,953

Notes:
MM influenced commuters – from MM analysis
Kiosk – 0.2% of COC base applications obtained through kiosks
GRH – 13.3% of new apps/reapps ask for GRH and other info = 5.7% of COC total after MM adjustment

APPENDIX I
SAMPLE CALCULATION OF INTEGRATED RIDESHARE - SOFTWARE UPGRADE PROJECT IMPACTS

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2006	63,358	(CC database)
• FY 2007	58,221	(CC database)
• FY 2008	64,060	(CC database)
Total assisted commuters	**185,639**	

Within MSA (69%)	128,091
Outside MSA (31%)	57,548

COC Placement Rates	**In MSA**	**Out MSA**	
• Continued rate	2.7%	5.0%	
• Temporary rate	1.6%	0.9%	
• Total	4.3%	5.9%	

Placements

• Continued	3,458	2,877	(Apps x cont. rate)
• Temporary	2,049	518	(Apps x temporary rate)
• **Total placements 8,903**			

Daily Vehicle Trips Reduced

VTR Factors

• Continued	0.65	0.75	
• Temporary	0.64	0.60	
• Temporary discount	17.0%	12.0%	
• Continued trips reduced	2,248	2,158	(Placements x cont. VTR factor)
• Temporary trips reduced	223	37	(Placements x temp VTR factor)
Total VT reduced 4,666			

Daily VMT Reduced

Ave one-way trip distance (mi)

• Continued	32.3	32.3	(Actual Outside dist. 56.9 miles)
• Temporary	33.8	33.8	(Actual Outside dist. 57.2 miles)
• Continued VT reduced	72,610	69,705	(Vehicle trips x ave distance)
• Temporary VT reduced	7,537	1,260	

Total VMT Reduced 151,113

Appendix I, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	85%	0%	(CC placement survey)
• SOV access % - Temporary	86%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	6.6	0.0	(CC placement survey)
• SOV access dist (mi) – Temporary	8.0	0.0	(CC placement survey)

VT Reduction

• SOV access (cont + temp)	2,103	0	(VT x non-SOV access %)
Total VT for AQ analysis	**2,564**		

VMT Reduction

• SOV access (cont + temp)	14,145	0
Total VMT for AQ analysis	**136,967**	

Daily Emissions Reduced – NOx and VOC

		08 Emission		08 Emission		
NOx	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	2,564	0.6292			1,613	0.002
• Running			136,967	0.4288	58,732	0.065
Total NOx reduced (tons)						**0.067**

		08 Emission		08 Emission		
VOC	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	2,564	1.7343			4,446	0.005
• Running			136,967	0.1836	25,147	0.028
Total VOC reduced (tons)						**0.033**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

		10 Emission		10 Emission		
PM 2.5	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	2,564	0.000			0	0.00
• Running (40mph)			136,967	0.0115	1,575	0.002
					Daily	**0.002**
Total PM 2.5 reduced (tons)					**Annual**	**0.4**

		10 Emission		10 Emission		
PM 2.5 Precursor NOx	**Trips**	**Factor**	**VMT**	**Factor**	**Tot gm**	**Tot ton**
• Cold start	2,564	0.6652			1,705	0.002
• Running (40mph)			136,967	0.4038	55,307	0.061
					Daily	**0.063**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**15.7**

Appendix I, continued

CO2	Trips	08 Emission Factor	VMT	08 Emission Factor	Tot gm	Tot ton
• Cold start	2,564	0.000			0	0
• Running (40mph)			136,967	455.7	62,415,955	69
					Daily	**69**
Total CO2 reduced (tons)					**Annual**	**17,200**

Correction for Overlap with MM TERM

Total CC applications FY 06, 07, 08	186,373	
New CC applications FY 06, 07, 08	38,261	21%
Estimated MM share of new CC	15%	
Estimated MM share of IR impact	3.1%	

	SU Base	MM	Net SU
Placements	8,903	275	8,628
VT reduced	4,666	144	4,522
VMT reduced	151,113	4,672	146,441
Daily Emissions Reduced			
NOx reduced (T)	0.067	0.002	0.064
VOC reduced (T)	0.033	0.001	0.032
Annual Emissions Reduced			
PM 2.5 (T)	0.4	0.01	0.4
PM 2.5 Precursor (T)	15.7	0.5	15.2
CO2 (T)	17,200	531	16,669

APPENDIX J
COMMUTER CONNECTIONS TERM EVALUATION SCHEDULE – 2008-2011

Measure	Data Collection Activity	Deadline(s)	FY Completion
MD/VA Telework	State of the Commute Survey	June 2010 (Draft Report) June 2011 (Final Report)	FY10 & 11
	Employer Survey	January 2011	FY11
Employer Outreach	Database Information Analysis From ACT!	December 2010 (interim) June 2011 (final)	FY11
GRH	GRH applicant survey	June 2010 (Draft Report) December 2010 (Final Report)	FY10 FY11
Commuter Operations Center	Placement Rate survey *(survey completed)*	July – September 2011 3rd Quarter Survey by Oct/Nov 2011	FY09
Marketing	State of the Commute Survey	June 2010 (Draft Report) June 2011 (Final Report)	FY10 & 11
Bike To Work Day	2010 Participant Survey	Nov/Dec 2010 (Draft Report) June 2011 (Final Report)	FY11
ALL	State of the Commute Survey	June 2010 (Draft Report) June 2011 (Final Report)	FY10 & 11
ALL	2008 - 2011 TERM Analysis Report	June 2011 (Draft Report) January 2012 (Final Report)	FY11 & 12

APPENDIX K
GLOSSARY OF ACRONYMS

AVR	-	Average Vehicle Ridership
CC	-	Commuter Connections
CCWP	-	Commuter Connections Work Program
CO2	-	Carbon dioxide (primary greenhouse gas)
COC	-	Commuter Operations Center
COG	-	Council of Governments
DDOT	-	District of Columbia Department of Transportation
FHWA	-	Federal Highway Administration
GRH	-	Guaranteed Ride Home
HOV(s)	-	High Occupancy Vehicle(s)
MTA	-	Maryland Transit Administration
MDOT	-	Maryland Department of Transportation
MWAQC	-	Metropolitan Washington Air Quality Committee
MWCOG	-	Metropolitan Washington Council of Governments
NO_X	-	Nitrogen Oxides
P & R	-	Park and Ride
PM	-	Particulate Matter
PM2.5	-	Particulate Matter, 2.5 microns
SOC	-	State of the Commute
SOV	-	Single Occupant Vehicle
TDM	-	Transportation Demand Management
TERM	-	Transportation Emission Reduction Measure
TIP	-	Transportation Improvement Program
TMA	-	Transportation Management Association
TMO	-	Transportation Management Organization
TPB	-	Transportation Planning Board
VDOT	-	Virginia Department of Transportation
VDRPT	-	Virginia Department of Rail & Public Transportation
VMT	-	Vehicle Miles Traveled
VOC	-	Volatile Organic Compounds
VRE	-	Virginia Railway Express
VT	-	Vehicle Trips
VTR	-	Vehicle Trip Reduction
WMATA	-	Washington Metropolitan Area Transit Authority