ITEM # 3

COMMUTER CONNECTIONS TRANSPORTATION DEMAND MANAGEMENT EVALUATION PROJECT

TRANSPORTATION EMISSION REDUCTION MEASURES (TERMS) REVISED EVALUATION FRAMEWORK 2005 – 2008

Prepared for:

Metropolitan Washington Council of Governments
777 North Capitol Street, NE, Suite 300
Washington DC 20002-4239

Prepared by:

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

In conjunction with:

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

April 27, 2007

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.
- InfoExpress Kiosks – Involves self-service electronic kiosks located in the District of Columbia and in northern Virginia that offer information on commute options and allow for remote submittal of ridematch and GRH registration applications.

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 other TERMs.

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 2005 through June 2008 (FY 06-08). 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.

Three 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), and the third for July 2002 through June 2005 (2002-2005). The evaluation framework presented in this document builds on the framework used in the 2002-2005 analysis. Minor changes were made to the

TERM evaluation framework for 2005-2008 to address consolidation of some TERMs, such as the integration of the Employer Outreach for Bicycling into the Employer Outreach TERM and the integration of the Software Upgrades component of the Integrated Rideshare TERM into the Commuter Operations Center. Additionally, impacts for the InfoExpress Kiosk component of the Integrated Rideshare TERM now will be analyzed and measured separately.

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), and Particulate Matter ($PM_{2.5}$)
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, kiosk users, 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 and $PM_{2.5}$ 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.

This page intentionally left blank.

TABLE OF CONTENTS

TABLE OF CONTENTS (CON'T)

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.
- InfoExpress Kiosks – Involves self-service electronic kiosks located in the District of Columbia and in northern Virginia that offer information on commute options and allow for remote submittal of ridematch and GRH registration applications.

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 other TERMs.

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 2005 through June 2008 (FYs 06-08). 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 three previous evaluation framework documents developed in 1997 and 2001 to evaluate results and progress toward goals during the periods January 1997 through June 1999,[1] July 1999 through June 2002[2], and July 2002 through June 2005[3] respectively. The evaluation

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

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. These activities are 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 six 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.

Section 4 discusses evaluation components specific to each TERM. The Employer Outreach method now includes a bicycling element, the InfoExpress Kiosk TERM is now a separate TERM, and the Software Upgrade component of the Integrated Rideshare TERM has been combined with the Commuter Operations Center. Thus, methods are described in this evaluation framework for six Commuter Connections components – five TERMS and the Commuter Operations Center.

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. Finally, Section 7 presents recommendations for the evaluation schedule, responsibilities, and reporting of results to maintain and utilize information produced through the evaluation process.

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 a program. The valuation is not performed solely for the purpose of documentation or reporting. Rather, if guides future decision-making about funding priorities, reinforces program users' participation, highlights desirable program enhancements, and defines the benefits of programs in relation to those of others. The evaluation activities have been tailored to support decision-making; activities that do not support decision-making have not been undertaken in the evaluation process.

For these reasons, there are clear and specific objectives for the evaluation of the TERMs. The evaluation has been proceeding for the past seven year with primary objectives of providing useful information to the following groups that need or desire evaluation information:

- Providing information to regional policy-makers 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.

- For both regional policy-makers and TERM program staff, helping 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 five TERMs.[4]

- Providing information to program funders on the effectiveness and cost effectiveness of the TERMs being implemented via the Commuter Connections program.

- Providing information to Commuter Connections staff and program partners on potential program enhancements to increase effectiveness and efficiency.

[4] 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 relay the benefits of the TERMs in ways that are most meaningful to policy-makers and funders.

- Providing information to employers and commuters, the consumers of program services, on the collective, regional impacts of individual participation. Evaluation information can also be useful in showing employers the types of trip reduction strategies that may be most cost effective.

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.

- The evaluation framework covers all current Commuter Connections TERMs, but assures that the impacts of each TERM can be separated from one another to avoid double counting.

Separating Impacts of Program Elements

- It is also important to separate the impacts of various 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 important for the Mass Marketing TERM as impacts on commuters and air quality will be distributed to the advertising campaign or to other service components, such as the Commuter Operations Center or Guaranteed Ride Home, for example, that are promoted by Mass Marketing efforts.

- 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 and by identifying some "indirect" impacts of other commuter assistance measures implemented in the region, such as the Mass Marketing effort.

Accounting for Prior Mode and Access Mode

- Prior mode is an important variable in this evaluation; a shift of a commuter to an alternative mode does not always mean the commuter reduced a vehicle trip. 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 the travel mode carpoolers, vanpoolers, and transit riders use to travel from home to Park & Ride lots, to other places where they meet their rideshare partners, or to the bus stop or train station, if they do not walk or are not picked up at home. Access mode is less important for evaluating 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, from an air quality standpoint, a commuter who drives alone to the meeting point still makes a vehicle trip and accumulates some drive alone VMT, which must be subtracted from the total numbers of vehicle trips reduced and VMT reduced in the air quality analysis.

Refining Assumptions Used in the Evaluation

- Experience gained during past evaluation periods helped refine the assumptions and calculation steps developed for each TERM in this evaluation framework. Additionally, NOx and VOC emissions factors will be updated to reflect factors that will apply in 2008. The specific revisions included in this 2005-2008 evaluation framework update are presented later in this report for each TERM. The most significant potential refinement might involve the Employer Outreach TERM. During the last two evaluation periods, the US Environmental Protection Agency's COMMUTER Model (version 2.0) has been used to estimate the impact of employer services programs. During this evaluation period, a new model, the CUTR Worksite Trip Reduction Model developed by the Center for Urban Transportation Research (CUTR) at the University of South Florida, will be evaluated to assess whether it might be a more robust and accurate tool for estimating the mode shift impacts of employer program enhancements.

Including PM Reductions

- Due to the new emission standards that include $PM_{2.5}$, the TERM evaluation will both set PM targets from 2008 and estimate PM reductions as part of the triennial evaluation report. PM is divided into two components, direct $PM_{2.5}$ reductions and NOx precursors.

Specific Evaluation Issues for Individual TERMs

In general, the TERM analysis approaches documented in the 2005 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 H, as excerpted from the 2005 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.

- Guaranteed Ride Home (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to ridesharing, transit, and bike/walk. However, since past evaluation results show that a sizeable portion of GRH applicants were ridesharing before they applied for GRH benefits, the TERM analysis also explores benefits from the continuation and expansion of existing ridesharing arrangements. Thus, the evaluation process outlined here will estimate the influence of GRH availability on both mode shifts and frequency/duration 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. During this evaluation period, the COMMUTER Model v. 2.0 will be compared to the CUTR Worksite Trip Reduction Model to assess which would be better for this analysis and the preferred model used to evaluate the Employer Outreach TERM. Additionally, employer bicycle programs, which were evaluated separately from other Employer Outreach services in 2005, will be evaluated using the preferred model, along with the survey data from the regional "bike-to-work day" used to estimate travel and emission impacts from this event.

- Mass Marketing – The critical issues for this TERM are documenting and attributing changes in attitudes and behavior to the mass marketing campaign. Two types of impacts will be measured, "direct" impacts, for commuters who cite the regional marketing campaign as the reason for their commuting change and "referred" impacts 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. It also requires careful attribution of impacts to Mass Marketing or other TERMs, as appropriate.

- InfoExpress Kiosks – In the 2002-2005 framework, the InfoExpress Kiosk TERM was one of two components of the Integrated Rideshare TERM. It is now a separate TERM, with goals established for the TERM. The analysis of this TERM will use State of Commute survey information to identify changes in commute behavior related to the use of information kiosks. The kiosk evaluation will assess impacts only through January 31, 2007, the end date of the program.

- Commuter Operations Center (COC) – The evaluation of COC activities will now include the impacts of Software Upgrades, improved transit information, that were previously included in the Integrated Rideshare TERM.

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 work to measure changes in travel attitudes over time, including: commute frustration levels and attitudes toward a range of possible alternatives to driving alone. This information is currently captured in the State of the Commute survey and will now be tracked over time as more general population surveys are conducted.

PROGRAM PARTICIPATION, UTILIZATION AND SATISFACTION

These performance measures gauge program output, that is, 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, kiosk users, 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 all groups using its services: employers, commuters, GRH users, teleworkers, and kiosk users, for example.

PROGRAM IMPACTS

Program impact measures estimate the results of the programs implemented and are needed to assess the 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 purpose 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. While less of a factor in congestion relief than trips reduced, VMT reduced is important to an 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. In past evaluations the primary pollutants of concern for the TERMs included in this framework were Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), which are both ozone precursors. The 2005-2008 evaluation also will estimate impacts for particulate matter (PM). PM is divided into two components, direct PM2.5 emission, and NOx precursors. PM emission reduction goals will be added to the evaluation framework when 2008 emission factors are developed. Daily reductions of NOx and VOC and $PM_{2.5}$, expressed in terms of tons per day reduced, are the air quality performance measures of greatest interest to this evaluation process.

- 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.

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 five TERMs and for the Commuter Operations Center.

The TERMs included are:

1 Maryland and Virginia Telework
2 Guaranteed Ride Home
3 Employer Outreach
4 Mass Marketing
5 InfoExpress Kiosks
6 Commuter Operations Center

For each TERM, the following information is provided:

- TERM description
- Goals defined by TPB for the TERM for 2008
- 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 2005 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 NOx and VOC reductions)
- Regional fuel economy data in average miles per gallon consumed (to calculate energy saving)
- Program costs (to derive cost effectiveness)

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 2002-2005

- Eliminate Separate Credit for MWTCs – In the 2002-2005 evaluation, the TERM analysis included credit for Commuter Connections assistance to the Metropolitan Washington Telework Centers. This component has been eliminated from the analysis, as Commuter Connections has largely eliminated this support. However, credit for telecenter users who obtained telework information from Commuter Connections will continue to be counted.

Stated Goals for 2008

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 2008:

- Maintain 31,854 teleworkers
- Reduce 11,830 daily vehicle trips
- Reduce 241,209 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 – Early 2007
- Commuter Connections Telework assistance survey – Early 2008

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.

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 2002-2005

- No changes

Stated Goals

COG/TPB defined the following regional goals for GRH for 2008:

- 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 commuters who request GRH information
- 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 GRH database
• One-time GRH exception users	Commuter Connections 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 – spring 2007

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.

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 2002-2005

- Eliminate Credit for Metrochek Employers not in ACT! Database – In the 2002-2005 evaluation, a separate calculation was performed to estimate impacts for employers that were not participating in Employer Outreach but that did offer Metrochek/Smart Benefits through the program administered by the Washington Metropolitan Area Transit Authority (WMATA). This credit will not be included in the 2005-2008 calculation.

- Incorporate Credit from Employer Outreach for Bicycling – In the 2002-2005 evaluation, a separate credit was estimated for impacts related to bicycle support implemented by employers participating in Employer Outreach (Employer Outreach for Bicycling TERM). In the 2005-2008 evaluation, this credit will be captured in the Employer Outreach TERM. This will not result in a loss of benefits, since the Employer Outreach for Bicycling credit was subtracted from the Employer Outreach TERM credit in 2002-2005 to avoid double counting these credits.

Stated Goals

COG/TPB has defined the following regional goals for Employer Outreach for 2008:

- Achieve 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

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)
- Number of employees at worksites with commuter assistance programs
- 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 (incl. bicycle)	ACT! database
• Employer characteristics	ACT! database
• Level of commuter assistance program at worksite	ACT! database
• Starting Average Vehicle Ridership (AVR)	Employee baseline surveys
• Ending AVR (estimated)	EPA COMMUTER or CUTR WTR Model
• Average travel distance	SOC survey

Proposed timing of data collection

- ACT! database – ongoing
- Employee baseline surveys – ongoing
- SOC survey – Early 2007

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 both the 1999-2002 and 2002-2005 evaluations. For the 2005-2008 TERM analysis, a new model will be evaluated to assess its use for this TERM. The CUTR Worksite Trip Reduction (WTR) Model will be assessed to gauge

whether it is a more robust tool for evaluating changes to employer programs. Based on the results of that assessment, the COMMUTER v. 2.0 or CUTR WTR Model will be used for the 2005-2008 evaluation period.

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 also is now included with the Mass Marketing TERM. 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 2002-2005

- Calculate Both "Direct" and "Referred" Impacts – In the 2002-2005 TERM framework, it was assumed that credits would be calculated only for commuters who were directly influenced by the Mass Marketing TERM to change modes. In the 2005 TERM analysis, however, a second credit was estimated for a share of GRH and ridematching applications that were generated by referrals from Mass Marketing ad campaigns to the GRH program and Commuter Operations Center. Both credits will be included in the 2005-2008 evaluation framework.

- Incorporate Bike to Work Day – In the 2002-2005 evaluation, impacts from Bike-to-Work Day were captured in the Employer Outreach for Bicycling TERM. In 2005-2008, this credit will be included in the Mass Marketing TERM.

Stated Goals

COG has defined the following regional goals for Mass Marketing for 2008:

- Encourage 11,023 commuters to switch modes
- Reduce 7,759 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 prorated 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?
- Ask commuters who contact CC about referral source.
- 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 – Early 2007
- CC Applicant Placement survey – 2005
- GRH Applicant survey – Spring 2007
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2007

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.

INFOEXPRESS KIOSKS

Program Description

This TERM focuses on the information delivery system for commuters. It involves self-service electronic kiosks located in the District of Columbia and in northern Virginia that offer information on commute options and allow for remote submittal of ridematch and GRH registration applications.

TERM Evaluation Changes Since 2002-2005

- None

Stated Goals

The following goals were defined for the InfoExpress Kiosk program for 2008:

Reduce 1,778 daily vehicle trips
Reduce 46,755 daily vehicle miles of travel
Reduce 0.0233 daily tons of NOx
Reduce 0.0130 daily tons of VOC

Nature of Evaluation

The kiosk population of interest includes regional commuters who can be directly identified as having used an InfoExpress Kiosk to obtain transportation information. Evaluation of the kiosk users is more difficult than for other TERMS, because the anonymous and self-service nature of kiosks makes it difficult to follow-up with these users. To assess impacts for those users who obtain traveler information using kiosks, the evaluation will rely on the SOC survey. A sufficient number of survey respondents used kiosks (based on the 2001 and 2004 SOC surveys) to enable kiosk analysis from this source and we anticipate a similar use incidence in 2007. From these data, a placement rate and VTR factor will be developed for this population.

Performance Measures

The following performance measures are proposed:

Participation, Utilization, and Satisfaction Measures:

- Number of users who access transportation information through a kiosk
- Number of users who submit a ridematch application to Commuter Operations Center
- Number of users who obtain transit schedules or maps
- Kiosk user placement rate (percent of users who shift to an alternative mode)

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 performance measures for the InfoExpress Kiosks. Each data source is described in Section 5.

Data Needs	*Data Source*
• Kiosk users	SOC survey
• Applications submitted to CC via kiosks	Commuter Connections database
• Kiosk users' placement rate	SOC survey
• Kiosk VTR Factor, average travel distance	SOC survey

Proposed timing of data collection

- Commuter Connections database – ongoing
- SOC survey – Early 2007

This TERM overlaps with the Commuter Operations Center for rideshare applicants who submit their applications via a kiosk. Double counting of impacts is avoided by estimating kiosk impact for these rideshare applicants and subtracting this credit from the impacts calculated for the Commuter Operations Center.

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 or one of the information kiosks described earlier.

TERM Evaluation Changes Since 2002-2005

- Incorporate Software Upgrades – In the 2002-2005 evaluation, the Integrated Rideshare TERM included a Software Upgrade component. This component integrated information on transit service options, Park & Ride locations, and telecenter locations into the Commuter Connections Ridematch Software System (information provided to all matchlist recipients). This component has now been incorporated into the Commuter Operations Center.

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

Software Upgrades (additional to Basic COC)
- Reduce 2,370 daily vehicle trips
- Reduce 62,339 daily vehicle miles of travel
- Reduce 0.031daily tons of NOx
- Reduce 0.017daily 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, InfoExpress Kiosks, and any other TERM that overlaps with the COC. The balance of impacts equals the impacts of the COC.

The Software Upgrade component is directed to a subset of Commuter Connections clients; applicants who remember receiving transit and/or Park and Ride 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 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 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

Software Upgrades – Participation, Utilization, and Satisfaction Measures:

- Number of applicants who remember receiving transit/P&R information on ridematch letter or email
- Number of applicants who contact a transit agency or use P&R 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 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
Software Upgrades	
• Database applicants	Commuter Connections database
• Applicants who remember receiving transit and Park & Ride information	CC Applicant Placement survey
• Software Upgrade placement rate	CC Applicant Placement survey
• Software Upgrade 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 (2005)
- SOC survey – early 2007

Double counting is avoided by subtracting the credit assigned to the 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 available from ongoing monitoring activities of Commuter Connections and its partners in the form of application records, GRH registration forms, etc. The other basic source of travel impact and attitudinal information comes from periodic surveys of applicants, service users, or the public-at-large. All the surveys proposed for 2005-2008 have been used in past years; all with be reviewed and modified as needed for the 2005-2008 evaluation. The data sources and surveys can be divided into three groups as follows:

Ongoing Monitoring

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

Existing/Ongoing Surveys

- Commuter Connections applicant Placement Rate survey (completed in FY 2006)
- 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) or CUTR Worksite Trip Reduction Model

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 and Reporting Activities
Use of the Data

Evaluation Activity/Tool	Applicable TERM	Use of Data
Ongoing Monitoring		
• ACT! Employer Contact Database	Employer Outreach	TERM tracking, conformity analysis
• Telework employer contact and assistance records	MD and VA Telework	TERM tracking, conformity analysis
• Bike to Work Day participant records	BTW component of Mass Marketing	TERM tracking, conformity analysis
• Commuter Connections Applicant Database	COC, Mass Marketing	TERM tracking, conformity analysis
Existing/Ongoing Surveys		
• Commuter Connections Applicant Placement Rate Survey	COC, Mass Marketing	TERM tracking, conformity analysis
• State of the Commute Survey	MD and VA Telework, Kiosks, Mass Marketing	Commute trend analysis, conformity analysis
• GRH Applicant Survey	GRH	Conformity analysis
• Bike-to-Work Participant Survey	BTW component of Mass Marketing	TERM tracking, conformity analysis
• Employee Commute Surveys	Employer Outreach	TERM tracking, conformity analysis
• Telework assisted employer follow-up survey	MD and VA Telework	TERM tracking, conformity analysis
Analysis Tools		
• COMMUTER or WTR Model	Employer Outreach	Conformity analysis
Evaluation Results Reporting		
• CC quarterly “Report Card”	All TERMs	TERM tracking
• CC Program Annual Report	All TERMs	TERM tracking
• TERM Analysis Report	All TERMs	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 and kiosk "hits"). 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.

Commuter Operations Center Activity Tracking – Ongoing tracking of telephone and internet information requests, GRH registration, and ridematching applications received for processing. *(Used for GRH, InfoExpress Kiosk, and Mass Marketing TERMs, and Commuter Operations Center)*

- 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)*

  Telework Assistance Records – 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 and the employer for which they work. *(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.

- 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. These surveys have been used to derive placement rates and other evaluation factors needed to calculate program impacts. The surveys also assess users' perceptions of and satisfaction with the services provided. Through 2005, this survey was

conducted annually, at the same time each year in the fall. Only one placement survey will be included in the 2005-2008 evaluation period. This was conducted in November 2005 for FY 2006.

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.

Results of the survey conducted during this evaluation period were presented in a survey report. [6] 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)*

- 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. *(Used for GRH TERM).*

- 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 and 2004 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 InfoExpress Kiosk use and teleworking, two TERMs that have 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.

  The State of the Commute survey is a triennial survey and will be conducted in early 2007. *(Used for Maryland and Virginia Telework, InfoExpress Kiosk, 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)*

[6] Fiscal Year 2006 Applicant Database Annual Placement Survey Report, Applications Received During July-September 2005 (November, 2005 Survey), April 30, 2006.

- 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 2005-2008 evaluation period, the predictive model used as part of the Employer Outreach TERM method will be evaluated against a new model available developed by the Center for Urban Transportation Research (CUTR) at the University of South Florida. The evaluation will be conducted in 2007 and presented to COG with a recommendation. The selected model will be used as part of the Employer Outreach TERM analysis and included in the Analysis Report.

- EPA COMMUTER Model v 2.0 – This model estimates the change in mode split at an employer worksite or group of worksites based on changes to employer-provided support services, incentives, and transportation services. It is based on a logit mode choice model and experiential data on employer support services. This model was used in the 1999-2002 and 2002-2005 TERM analyses.

- CUTR Worksite Trip Reduction Model – The CUTR Worksite Trip Reduction Model is built upon empirical evidence from thousands of employer TDM plans from around the U.S. It estimates changes in commute behavior in a very different manner than the other two models (the FHWA TDM Evaluation Model and version 1 of the COMMUTER Model) that were used for the Employer Outreach analysis in past TERM analyses and can evaluate a greater number of employer programs.

As part of the evaluation framework development process, the team will assess this new tool and compare it to the EPA Commuter Model, in terms of ease of use, comparative rigor, range of measures that can be evaluated, and format for reporting results. As was done during the switch to the COMMUTER model in the 1999-2002 evaluation, the team will again evaluate a sample set of employers with both the EPA COMMUTER Model v 2.0 and CUTR Worksite Trip Reduction Model to attain a comparative assessment on the same data set and recommend the best tool for the TERM analysis.

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 are included in Appendices C through H:

- Appendix C – Maryland and Virginia Telework
- Appendix D – Guaranteed Ride Home
- Appendix E – Employer Outreach
- Appendix F – Mass Marketing
- Appendix G – InfoExpress Kiosks
- Appendix H – Commuter Operations Center

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.

- 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.

- Finally, the number of InfoExpress Kiosk users in total and those requesting specific follow-on information should be tracked. Using the results of the SOC survey, placement rates and VTR factors will be estimated for regional kiosk users.
- Commuters participating in Bike-to-Work Day should be tracked to determine the total number of participants

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 information, 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. 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 below. 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, Kiosk users, 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, kiosks, 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 1.7569 gm/trip = 787 gm = 24,640 VMT x 0.1856 gm/VMT = 4,573 gm = (787 gm + 4,573 gm) / 907,185 gm/ton = 0.0059 tons VOC reduced
NOx	= 448 trips x 0.6291 gm/trip = 310 gm = 24,640 VMT x 0.4287 gm/VMT = 10,563 gm = (310 gm + 10,563 gm) / 907,185 gm/ton = 0.012 tons NOx reduced
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 = 294,100 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
= $718 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 separate 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 a commuter reduces also depends on the number of days per week that he or she now uses the alternative mode, compared to the number of days he or she 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 2008, the 2005-2008 TERM Analysis target year, the emission factors[7] are:

Emission Factors	NOx	VOC
• Trip end *(grams per one-way vehicle trip)*	0.6291	1.7569
• Running *(grams per mile)*	0.4287	0.1856

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 and NOx reduced for our example in Figure 1:

VOC = 448 trips x 1.7569 g/trip = 787 g
= 24,640 VMT x 0.1856 g/VMT = 4,573 g
= (787 gm + 4,573 g) / 907,185 g/ton

= 0.0059 daily tons VOC reduced

NOx = 448 trips x 0.6291 g/trip = 310 g
= 24,640 VMT x 0.4287 g/VMT = 10,563 g
= (310 g + 10,563 g) / 907,185 g/ton

= 0.012 daily tons NOx reduced

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:

[7] 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.

- Energy savings are based on a national average fuel consumption factor of 23.8 miles per gallon (2006 data, US EPA)
- 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 16.4 cents per mile in 2006, the most recent period for which AAA prepared cost estimates.

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)	= 294,100 gallons saved per year
Commuter cost saving ($)	= 28,000 VMT x $0.164/mile
Daily saving	= $4,592 per day
Annual saving (250 work days)	= $1,148,000 saved per year
Annual saving per commuter (based on 1,600 placements)	= $718 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 2006 should be credited against the cost of the program in 2006, 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 2005 TERM Analysis Report, which forms the basis of this evaluation framework. The actual 2005-2008 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 RECOMMENDED 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 four categories, with various recommended schedules as described in Table 2. The first column shows the evaluation activity, including surveys and on-going tracking activities. 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, activity and evaluation reports also are recommended 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.

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
Proposed 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

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 below 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
SAMPLE CALCULATIONS OF MARYLAND AND VIRGINIA TELEWORK IMPACTS

Populations of Interest		
All regional teleworkers (TW)	318,130	(from SOC survey)
Employees at worksites assisted by CC	265,250	(from TW assistance survey)
Telework Placement Rates		
Directly assisted TW	6.4%	(% of TW assisted by CC, from SOC survey)
Assisted worksites	3.4%	(% of new TW at sites, from TW assistance survey)
Placements		
Mixed home and TC based		
Directly assisted TW	20,505	(regional TW x directly assisted placement rate)
TW at CC asst. sites	9,018	(employees at assisted sites x asst site placement rate)
Total assisted TW	**29,524**	
Breakdown of placements by Location (home-based and telecenter-based)		
% Home-based TW	95%	(from SOC survey)
% telecenter-based TW	5%	(from SOC survey)
HB TW	28,048	(total assisted TW x % HB TW)
Telecenter-based TW	1,476	(total assisted TW x % TC-based TW)
Daily Vehicle Trips Reduced		
VTR Factors		
Home-based factor	0.38	(from SOC survey)
Telecenter-based factor	0.26	(from SOC survey)
Home-based VT reduced	10,793	(HB TW x HB VTR factor)
Telecenter-based VT reduced	380	(TC-based TW x TC VTR factor)
Total Daily Vehicle Trips Reduced	**11,173**	

Appendix C, continued

Daily VMT Reduced

Ave one-way trip distance (mi)		
Home-based TW	19.2	(SOC survey)
Telecenter reductions (TC days)		
VMT reduction – telecenter days	12.0	(SOC survey)
Ave. days/wk at TC	1.2	(SOC survey)
VMT reduction – home TC days	38.4	(SOC survey)
Ave. days/wk at home	1.0	(SOC survey)
Total weekly VMT reduction	52.8	(TC days x TC mi)+(home days x home mi)
Daily reduction per teleworker	10.6	
VMT reductions on TC days		
Home-based VMT reduced	207,219	(HB VT reduced x ave trip distance)
Non MWTC VMT reduced	15,593	(TC TW x daily miles reduced)
Total Daily VMT Reduced	**222,812**	

Daily Emissions Reduced

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	11,173	0.9905			11,067	0.0122
• Running (40 mph)			222,812	0.6995	155,416	0.1713
Total NOx reduced (tons)						**0.1835**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	11,173	2.3454			26,205	0.0288
• Running (40mph)			222,812	0.2717	60,367	0.0665
Total VOC reduced (tons)						**0.0953**

APPENDIX D
SAMPLE CALCULATIONS OF GUARANTEED RIDE HOME IMPACTS

Populations of Interest		
GRH registrants	26,702	(GRH database)
One-time exceptions	550	(GRH database)
Total GRH base	**27,252**	
Within MSA	22,919	
Outside MSA	4,333	
GRH Placement Rates (continued rates only)		
Within MSA placement rate	50.5%	(GRH survey)
Outside MSA placement rate	51.8%	(GRH survey)
Placements (continued only)		
Within MSA	**11,574**	(Within MSA base x within MSA placement rate)
Outside MSA	**2,245**	(Outside MSA base x outside MSA placement rate)
Daily Vehicle Trips Reduced		
VTR Factors (continued only)		
Within MSA	0.91	(GRH survey)
Outside MSA	0.81	(GRH survey)
VT Reduced (continued only)		
Within MSA	**10,532**	**(**Within MSA placements x within MSA VTR factor)
Outside MSA	**1,818**	(Outside MSA placements x outside MSA VTR factor**)**
Daily VMT Reduced		
Ave one-way trip distance (mi)		
Within MSA	28.2	(from GRH survey)
Outside MSA	28.2	(discounted from actual 52.0 miles from GRH survey)
VMT reduced		
Within MSA	297,014	(Within MSA VT reduced x trip distance)
Outside MSA	51,270	(Outside MSA VT reduced x trip distance)
Total Daily VMT Reduced	**348,283**	

Appendix D, continued

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

Inside MSA		
Non-SOV access percentage	40%	(GRH survey)
SOV access distance (mi)	5.3	(GRH survey)

Outside MSA – not applicable – all access outside MSA

VT Reduction

No SOV access	6,031	(VT x non-SOV access %)
Total VT for AQ analysis	**6,031**	

VMT Reduction

No SOV access	170,075	(VT x SOV % x trip distance)
With SOV access	144,715	(VT x SOV % x (trip distance – access distance)
Total VMT for AQ analysis	**314,790**	

Daily Emissions Reduced

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	6,031	0.9905			5,974	0.0066
• Running (40 mph)			314,790	0.6995	220,196	0.2427
Total NOx reduced (tons)						**0.2493**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	6,031	2.3454			14,145	0.0156
• Running (40 mph)			314,790	0.2717	85,528	0.0943
Total VOC reduced (tons)						**0.1099**

Correction for Overlap with MM TERM

Total GRH apps FY 03, 04, 05	27,252	
New GRH apps FY 04, 05	13,884	42%
Estimated MM share of new GRH	8%	
Estimated MM share of GRH impact	3%	

	GRH base	**MM**	**Net GRH**
Placements	13,819	563	13,255
VT reduced	12,350	503	11,847
VMT reduced	348,283	14,195	334,088
NOx reduced (T)	0.249	0.010	0.239
VOC reduced (T)	0.110	0.004	0.105

APPENDIX E
SAMPLE CALCULATION OF EMPLOYER OUTREACH

Populations of Interest		
Sites 100+ with Level 3-4 program	373	(ACT! database)
Sites <100 with Level 3-4 program	443	(ACT! database)
Employees at L3-4 sites	217,913	(ACT! database)
Total TERM base employees	**217,913**	
Average Vehicle Occupancy (AVO)		
Starting (pre-program)	1.37	(employee survey data)
Ending (with program)	1.70	(COMMUTER model runs)
Daily person trips		
Starting (pre-program)	435,826	(total employees x 2 one-way trips per day)
Ending (with program)	435,826	(total employees x 2 one-way trips per day)
Daily vehicle trips		
Starting (pre-program)	318,156	(total employees / starting AVO)
Ending (with program)	255,758	(total employees / ending AVO)
Total Daily Vehicle Trips Red.	**62,398**	(starting vehicle trips – ending vehicle trips)
Daily VMT Reduced		
One-way trip dist (mi)	16.5	(SOC survey, regional average)
Total Daily VMT Reduced	**1,029,567**	**(**vehicle trips reduced x average trip distance)
Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)		
Non-SOV access percentage	71%	(from SOC survey)
SOV access distance (mi)	3.1	(from SOC survey)
VT Reduction		
No SOV access (cont)	44,303	(VT reduced x non-SOV access %)
Total VT for AQ analysis	**44,303**	
VMT Reduction		
No SOV access	730,993	(VT reduced x SOV % x trip distance)
With SOV access	242,479	(VT reduced x SOV % x (trip dist – access dist)
Total VMT for AQ analysis	**973,471**	

Appendix E, continued

Daily Emissions Reduced

NOx reduced	Trips	05 Emis. Factor	VMT	05 Emis. Factor	Tot gm	Tot ton
• Cold start	44,303	0.9905			43,882	0.0484
• Running (40 mph)			973,471	0.6995	680,943	0.7506
Total NOx reduced (tons)						**0.7990**

VOC reduced	Trips	05 Emis. Factor	VMT	05 Emis. Factor	Tot gm	Tot ton
• Cold start	44,303	2.3454			103,907	0.1145
• Running (40 mph)			973,471	0.2717	264,492	0.2916
Total VOC reduced (tons)						**0.4061**

Correction for TRC TERMs

	EO base	TRC	Net EO
Vehicle Trips Reduced	62,398	1,585	60,813
VMT Reduced (miles)	1,029,567	26,153	1,003,414
NOx Reduced (tons)	0.799	0.022	0.777
VOC Reduced (tons)	0.406	0.012	0.394

APPENDIX F

SAMPLE CALCULATION OF MASS MARKETING IMPACTS

PART 1
Populations of Interest – commuters influenced by ads to contact CC
New CC apps (does not include re-apply or follow-up)

FY 2003	0	(no MM credit for FY 2003)
FY 2004	19,656	(CC database)
FY 2005	15,077	(CC database)
Total applicants	**34,733**	

Commuters influenced by ads to contact CC	15%	(COC – monthly applicant analysis)
New apps 04-05 as % of total	24%	(new apps FY04, 05 / total CC apps)
% all apps influenced by ads	3.6%	

CC Impacts – FY 03-05	**Total**	**MM Share**
CC placements	55,336	2,011
CC Vehicle trips reduced	13,466	489
CC VMT reduced	402,019	14,614

CC Impacts – FY 03-05 – Discounted for AQ Analysis

	Total	**MM Share**
CC Vehicle trips reduced	6,874	250
CC VMT reduced	362,916	12,192

Daily Emissions Reduced – Part I

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	250	0.9905			247	0.0003
• Running (40 mph)			13,192	0.6995	9,228	0.0102
Total NOx reduced (tons)						**0.0105**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	250	2.3454			586	0.0006
• Running (40 mph)			13,192	0.2717	3,584	0.0040
Total VOC reduced (tons)						**0.0046**

Appendix F, continued

PART 2
Populations of Interest – commuters influenced by ads to change mode – no contact CC

Total commuters in region	2,422,811	(SOC and Mini-HH surveys)
• % recall commute message	39%	(SOC and Mini-HH)
• % chg to alt mode after ads	1.0%	(SOC and Mini-HH)
• % chg influenced by ad	85%	(SOC and Mini-HH)
Placements – no contact with CC	**7,785**	(COC – monthly applicant analysis)
Placement Rates		
Continued placement rate	56%	(SOC and Mini-HH)
Temporary placement rate	44%	(SOC and Mini-HH)
Placements		
Continued placements	4,360	(Placements x continued placement rate)
Temporary placements	3,426	(Placements x temporary placement rate)
Daily Vehicle Trips Reduced		
VTR Factors		
Continued VTR factor	1.25	(SOC and Mini-HH)
Temporary VTR factor	1.00	(SOC and Mini-HH)
Continued VT reduced	5,450	(Continued placements x continued VTR factor)
Temporary VT reduced	856	(Temporary placements x temporary VTR factor x 0.25 discount for temporary use)
Total Daily Vehicle Trips Reduced	**6,306**	
Daily VMT Reduced		
• Ave one-way trip dist (mi)	16.5	(SOC and Mini-HH)
Total Daily VMT Reduced	**104,052**	
Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)		
Non-SOV access percentage	71%	(from CC placement survey)
SOV access distance (mi)	3.1	(from CC placement survey)
VT Reduction		
• No SOV access	4,477	(VT x non-SOV access %)
Total VT for AQ analysis	**4,477**	
VMT Reduction		
• No SOV access	73,877	(VT x SOV % x trip distance)
• With SOV access	24,506	(VT x SOV % x (trip dist – access dist)
Total VMT for AQ analysis	**98,383**	

Appendix F, continued

PART 2 (cont.)
Daily Emissions Reduced

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	4,477	0.9905			4,435	0.0049
• Running (40 mph)			98,383	0.6995	68,819	0.0759
Total NOx reduced (tons)						**0.0808**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	4,477	2.3454			10,501	0.0116
• Running (40 mph)			98,383	0.2717	26,731	0.0295
Total VOC reduced (tons)						**0.0411**

PART 3 – GRH Credit
From GRH Analysis

Total GRH apps FY 03, 04, 05	27,252	
New GRH apps FY 04, 05	13,884	51%
Estimated MM share of new GRH	8%	
Estimated MM share of GRH impact	4%	

	GRH base	**MM**
Placements	13,819	563
VT reduced	12,350	403
VMT reduced	348,283	14,195
NOx reduced (T)	0.249	0.010
VOC reduced (T)	0.110	0.004

PART 4 – Bike-to-Work Day Event

Participants' riding percentage and frequency

• Number of riders	5,738	(BTWD registration data, 2002, 2003, 2004)
• % biking to work before event	78%	(BTWD survey)
• Ave days riding before event	2.4	(BTWD survey)
• % part. Start/incr biking	20%	(BTWD survey)
• Ave days riding after event	1.4	(BTWD survey)
• % new riders still Bk winter	72%	(BTWD survey)
• Weekly bike days during winter	1.1	(BTWD survey)

Appendix F, continued

PART 4 (cont.)

New Bike Days

New wkly bike days summer	1,607	(riders x % new after event x ave days summer)
New wkly bike days winter	909	(riders x % new riders x still ride winter x ave days)
• Total new bike days summer	44,986	(wkly summer days x 28 wks – Apr-Oct)
• Total new bike days winter	19,996	(wkly winter days x 22 wks – Nov-Mar)
Total new bike days-year	64,982	(summer bk days + winter bk days)
New bike trips - year	129,963	(annual bike days x 2)

New Bike Trips and VT Reduction

Ave new daily bk trips	520	(Annual new bike trips / 250)
% DA/RS on non-bike days	41%	(BTWD survey)
Daily vehicle trips reduced	213	(daily new bike trips x DA %
BTWD Daily Vehicle Trips Reduced	**213**	

Daily VMT Reduced

• Ave trip distance (mi)	10.0	(BTWD survey)
BTWD Daily VMT Reduced	**2,131**	(vehicle trips reduced x average trip distance)

Total – PART 1, PART 2, PART 3 and PART 4

	CCContacts	NoContact	GRH	BTW	Total MM
Placements	2,011	7,785	563	520*	10,880
VT reduced	489	6,306	503	213	7,512
VMT reduced	14,614	104,052	14,195	2,131	134,992
NOx reduced (T)	0.010	0.081	0.010	0.002	0.103
VOC reduced (T)	0.005	0.041	0.004	0.001	0.051

* new bicycle trips per day

APPENDIX G
SAMPLE CALCULATION OF INFOEXPRESS KIOSK IMPACTS

Populations of Interest – Regional Commuters who used Kiosks to obtain commute information

Regional kiosk users	22,612	(SOC survey)

Kiosk Placement Rates

Continued placement rate	1.6%	(SOC survey)
Temporary placement rate	16.5%	(SOC survey)

Placements

Continued placements	353	(Kiosk users x continued placement rate)
Temporary placements	3,741	(Kiosk users x temporary placement rate)
Total placements	**4,094**	

Daily Vehicle Trips Reduced

VTR Factors

Continued VTR factor	1.60	
Temporary VTR factor	1.49	(from SOC survey)
Continued VT reduced	565	
Temporary VT reduced	2,741	(Temporary placements x temporary VTR factor x .49 discount for temporary use)
Total Daily Vehicle Trips Reduced	**3,306**	

Daily VMT Reduced

Continued one-way trip dist (mi)	22.1	
Temp trip dist (mi)	22.1	(from SOC survey)
Continued VMT reduced	12,482	
Temp VMT reduced	60,576	(Temp VT reduced x Temp trip distance)
Total Daily VMT Reduced	**73,058**	

Daily Emissions Reduced

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	3,306	0.9905			3,274	0.0036
• Running (40 mph)			73,058	0.6995	51,104	0.0563
Total NOx reduced (tons)						**0.0599**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	3,306	2.3454			7,753	0.0085
• Running (40 mph)			73,058	0.2717	19,850	0.0219
Total VOC reduced (tons)						**0.0304**

APPENDIX H
SAMPLE CALCULATION OF COMMUTER OPERATIONS CENTER IMPACTS

Populations of Interest – Commuter Connections Rideshare Applicants

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

FY 2003	40,125	(CC database)	
FY 2004		46,888	(CC database)
FY 2005		56,313	(CC database)
Total assisted commuters		**143,326**	

Within MSA (84%)	120,393
Outside MSA (16%	22,919

COC Placement Rates	**In MSA**	**Out MSA**
Continued rate	25.2%	24.3%
Temporary rate	13.6%	13.6%
Total	38.7%	37.9%

Placements

Continued	30,337	5,533	(Apps x cont. rate)
Temporary	16,366	3,101	(Apps x temporary rate)
Total placements		**55,336**	

Daily Vehicle Trips Reduced

VTR Factors

Continued	0.33	0.47	
Temporary	0.38	0.42	
Temporary discount	10.5%	10.5%	
Continued trips reduced	10,075	2,596	(Placements x cont. VTR factor)
Temporary trips reduced	657	138	(Placements x temp. VTR factor)
Total VT reduced	**13,466**		

Daily VMT Reduced

Ave one-way trip distance (mi)

Continued	29.9	29.9	(Actual Outside dist. 54.4 miles)
Temporary	28.6	28.6	(Actual Outside dist. 57.9 miles)
Continued VT reduced	301,593	77,713	(Vehicle trips x ave distance)
Temporary VT reduced	18,769	3,944	

Total VMT Reduced **402,019**

Appendix H, continued

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

	In MSA	Out MSA	
Non-SOV access % - cont/temp	39%	0%	(CC placement survey)
SOV access dist (mi) – cont/temp	5.9	0.0	(CC placement survey)
VT Reduction			
No SOV access (cont + temp)	4,139	2,734	(VT x non-SOV access %)
Total VT for AQ analysis	**6,874**		
VMT Reduction			
No SOV access (cont + temp)	123,572	81,657	(VT x SOV % x (dist – access dist))
SOV access (cont + temp)	157,688	0	
Total VMT for AQ analysis	**362,916**		

Daily Emissions Reduced

NOx reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	6,874	0.9905			6,808	0.0075
• Running (40 mph)			362,916	0.6995	253,860	0.2798
Total NOx reduced (tons)						**0.2873**

VOC reduced	**Trips**	**05 Emis. Factor**	**VMT**	**05 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	6,874	2.3454			16,122	0.0178
• Running (40 mph)			362,916	0.2717	98,604	0.1087
Total VOC reduced (tons)						**0.1265**

Correction for Overlap with GRH, Kiosks and MM TERMs

	COC base	**MM**	**Kiosk**	**GRH**	**Net COC**
Placements	55,336	2,011	318	3,040	35,322
Vehicle Trips Reduced	13,466	489	77	740	7,406
VMT Reduced (miles)	402,019	14,614	2,310	22,082	189,097
NOx Reduced (tons)	0.287	0.010	0.0017	0.016	0.149
VOC Reduced (tons)	0.126	0.005	0.0007	0.007	0.069

Notes:
MM influenced commuters – from MM analysis, Appendix F
Kiosk – 0.7% 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 H, continued

Daily Emissions Reduced

NOx reduced	**Trips**	**02 Emis. Factor**	**VMT**	**02 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	20,416	1.1835			24,162	0.0266
• Running (35mph)			402,190	1.2075	730,992	0.5353
Total NOx reduced (tons)						**0.5619**

VOC reduced	**Trips**	**02 Emis. Factor**	**VMT**	**02 Emis. Factor**	**Tot gm**	**Tot ton**
• Cold start	20,416	3.202			65,371	0.0721
• Running (35mph)			402,190	0.4885	196,470	0.2166
Total VOC reduced (tons)						**0.2887**

APPENDIX I
COMMUTER CONNECTIONS TERM EVALUATION SCHEDULE

Measure line(s)	**Data Collection** FY Completion		**Dead-** Activity
Telework 2007	State of the Commute	June 2007 (Draft Report) June 2008 (Final Report)	FY07 & 08
	Employer Survey	January 2008 FY08	
Employer Outreach	Database Information Analysis From ACT!	December 2007	FY08
GRH	In-depth GRH applicant Survey	June 2007 (Final Report)	FY07
Commuter Operations Center	Placement Rate Study ***(survey completed)***	July – September 2005 3rd Quarter Survey by Oct/Nov 2005	FY06
Marketing	State of the Commute	June 2007 (Draft Report) June 2008 (Final Report)	FY07 & 08
Bike To Work Day	2007 Participant Survey	Nov/Dec 2007 (Draft Report) June 2008 (Final Report)	FY08
InfoExpress Kiosk	2007 State of the Commute	June 2007 (Draft Report) June 2008 (Final Report)	FY07 & 08
ALL	Regional State of the Commute Survey	June 2007 (Draft Report) June 2008 (Final Report)	FY07 & 08
ALL	2005 TERM Analysis Report ***(completed)***	January 2006	FY06
ALL	2006 - 2008 TERM Analysis Report	June 2008 (Draft Report) January 2009 (Final Report)	FY08 & 09
ALL	TDM Evaluation	December 2006 FY07	

Framework Methodology

FY06 = July 1, 2005 – June 30, 2006
FY07 = July 1, 2006 – June 30, 2007
FY08 = July 1, 2007 – June 30, 2008
FY09= July 1, 2008 – June 30, 2009

APPENDIX J
GLOSSARY OF ACRONYMS

ACT	-	Association for Commuter Transportation
AVR	-	Average Vehicle Ridership
CC	-	Commuter Connections
CCWP	-	Commuter Connections Work Program
COC	-	Commuter Operations Center
COG	-	Council of Governments
DDOT	-	District of Columbia Department of Transportation
DTP	-	Department of Transportation Planning
ECO	-	Employee Commute Options
FHWA	-	Federal Highway Administration
GIS	-	Geographic Information System
GRH	-	Guaranteed Ride Home
HOV(s)	-	High Occupancy Vehicle(s)
ITAC	-	International Telework Association & Council
MATAC	-	Mid-Atlantic Teleworking Advisory Council
MTA	-	Maryland Transit Administration
MDOT	-	Maryland Department of Transportation
MWAQC	-	Metropolitan Washington Air Quality Committee
MWCOG	-	Metropolitan Washington Council of Governments
MWTRC	-	Metropolitan Telework Resource Center
NO_X	-	Nitrogen Oxides
OPA	-	Office of Public Affairs
P & R	-	Park and Ride
PM	-	Particulate Matter
PRTC	-	Potomac & Rappahannock Transportation Commission
SOC	-	State of the Commute
SOV	-	Single Occupant Vehicle
TAHG	-	Telework Ad-Hoc Group
TCM	-	Transportation Control Measure
TDM	-	Transportation Demand Management
TERM	-	Transportation Emission Reduction Measure
TIP	-	Transportation Improvement Program
TMA	-	Transportation Management Association

Appendix J (cont.)

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
WMTC	-	Washington Metropolitan Telework Centers