ITEM #2

COMMUTER CONNECTIONS TRANSPORTATION DEMAND MANAGEMENT EVALUATION PROJECT

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

Prepared for:

National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments
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Washington, DC 20002-4290

Prepared by:

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In conjunction with:

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

December 15, 2009

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EXECUTIVE SUMMARY

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

- Maryland and Virginia Telework – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.
- Employer Outreach – Provides regional outreach to encourage large, private-sector employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and improved in-house trip reduction programs.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute.
- ~~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 2008 through June 20011 (FY 09-11). These impacts then will be compared against the goals established for each TERM by COG's National Capital Region Transportation Planning Board (TPB), the region's designated Metropolitan Planning Organization (MPO). The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

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

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

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

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

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

1) Vehicle trips reduced
2) Vehicle miles of travel (VMT) reduced
3) Emissions reduced: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), Particulate Matter ($PM_{2.5}$), and Carbon Dioxide (CO_2) and other associated greenhouse gases
4) Energy reduction (fuel saving)
5) Consumer saving (commuting cost saving)
6) Cost effectiveness, in terms of cost per benefit obtained (e.g., cost per trip reduced)

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

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

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

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

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

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

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

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

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SECTION 1 OVERVIEW

This report provides a framework and methodology for evaluating the transportation and air quality impacts of four 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.
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Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all 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 2008 through June 2011 (FYs 09-11). Second, it guides COG's future evaluation efforts to assess the effectiveness and cost effectiveness of the TERMs. The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group. The framework describes an overall evaluation process for the program and specific evaluation techniques for each TERM.

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

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

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

This evaluation framework report is organized into eight 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 of TERMs, Maryland and Virginia Telework, Guaranteed Ride Home, Employer Outreach / Employer Outreach for Bicycling, and Mass Marketing. This section also presents evaluation activities relevant for the Commuter Operations Center (COC) and the Software Upgrade component of the Integrated Rideshare TERM, which was combined with the COC in the 2005-2008 evaluation period.

Section 5 describes the data sources and data collection tools to be used to collect evaluation data. The next section, Section 6, outlines the method to calculate travel, air quality, energy, and consumer cost impacts of the TERMs. Section 7 presents recommendations for the evaluation schedule and responsibilities. Two additional sections were added to the evaluation framework for this evaluation period. Section 8 describes methods and tools to report Commuter Connections' evaluation results to various stakeholder audiences. Section 9 presents _____.

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

SECTION 2 EVALUATION OBJECTIVES AND ISSUES

PURPOSE OF THE EVALUATION

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

EVALUATION OBJECTIVES

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

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

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

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

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

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

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

EVALUATION ISSUES

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

Purpose of the Evaluation

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

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

Separating Impacts of Program Elements

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

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

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

Accounting for Prior Mode and Access Mode

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

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

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

Updating Calculation Factors and Assumptions Used in the Evaluation

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

- The 2008 TERM Analysis estimated reductions in Carbon Dioxide (CO_2), the primary greenhouse gas. This new emission calculation was added to the evaluation to provide data for regional climate change mitigation assessments.

Specific Evaluation Issues for Individual TERMs

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

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

- Guaranteed Ride Home (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to alternative modes. Because past evaluation results showed that a sizeable portion of GRH applicants were ridesharing before they registered for GRH, the TERM analysis also ex-

plores benefits from the continuation and expansion of existing ridesharing arrangements. Thus, the evaluation for GRH will estimate the influence of GRH availability on both mode shifts and frequency of ridesharing. Enhancements made over the past several evaluation periods include discounting of VMT reductions made outside the COG non-attainment area and the derivation of one placement rate for both GRH applicants and one-time exemptions.

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

  Additionally, the 2008-2001 methodology will distinguish between "new" impacts and "continuing" impacts. New impacts include impacts from employers that joined the program on or after July 1, 2008 and employers that were involved in Employer Outreach before July 1, 2008 but that enhanced their commute assistance services after that date. Continuing impacts include those from employers that joined before July 1, 2008 and made no changes since that date. These impacts are considered part of the new Employer Outreach baseline. Impacts from program reductions will be "back-filled" from new or expanded programs instituted on or after July 1, 2008.
- Mass Marketing – The critical issue for this TERM is attributing changes in attitudes and behavior to the mass marketing campaign versus another TERM. Two types of impacts are possible for Mass Marketing: "direct" impacts generated by commuters who cite the regional marketing campaign as the reason for their commuting change and "referred" impacts that are generated when advertising encourages commuters to submit rideshare and GRH applications. This is explained further in Section 4. The evaluation will be accomplished using a variety of data sources, including the State-of-the-Commuter survey and COC tracking data.

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

- Integrated Rideshare – Software Upgrades – Impacts for this TERM component will continue to be evaluated as part of the Commuter Operations Center (COC).

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

SECTION 3 PERFORMANCE MEASURES

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

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

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

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

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

AWARENESS AND ATTITUDES

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

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

PROGRAM PARTICIPATION, UTILIZATION AND SATISFACTION

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

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

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

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

PROGRAM IMPACTS

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

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

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

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

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

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

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

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

SECTION 4 EVALUATION COMPONENTS FOR INDIVIDUAL TERMS

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

The TERMs included are:

- Maryland and Virginia Telework
- Guaranteed Ride Home
- Employer Outreach
- Mass Marketing
- ~~InfoExpress Kiosks~~
- Commuter Operations Center

For each TERM, the following information is provided:

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

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

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

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

4-A MARYLAND AND VIRGINIA TELEWORK

Program Description

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

TERM Evaluation Changes Since 2005-2008

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

Stated Goals

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

- Maintain _____ teleworkers
- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

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 2010
- Commuter Connections Telework assistance survey – Early 2011

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

4-B GUARANTEED RIDE HOME TERM

Program Description

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

TERM Evaluation Changes Since 2005-2008

- No changes

Stated Goals

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

- Maintain ____ GRH applicants
- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

Nature of Evaluation

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

Two populations are of interest for the GRH TERM evaluation:

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

Performance Measures

The following performance measures are used for GRH:

Participation, Utilization, and Satisfaction Measures:

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

Program Impact Measures

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

Data Needs and Sources

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

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

Proposed timing of data collection

- Commuter Connections GRH database – ongoing
- GRH Applicant surveys – spring 2010

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

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

4-C EMPLOYER OUTREACH TERM

Program Description

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

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

TERM Evaluation Changes Since 2005-2008

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

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

- Apply Batch Methodology for COMMUTER Model Runs – Evaluations conducted prior to 2008 classified employers into categories based on their commute program services and applied factors derived from the COMMUTER Model to groups of employers with similar programs. The 2008 TERM Analysis applied an improved method, in which the COMMUTER model was run in a batch format that allowed each employer's program components to be modeled separately. The analysis thus calculated trip reduction for each employer individually. This will not change the results of the analysis, but will enable Commuter Connections to define individual employers' contributions to the impacts, should Commuter Connections or local jurisdictions choose to do so.

Stated Goals

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

- Achieve ____ total employers; ____ without bicycle support and __ with bicycle support
- Achieve ____ new or expanded employers; ____ without bicycle support and __ with bicycle support
- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

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

Program Impact Measures:

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

Data Needs and Sources

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

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

Proposed timing of data collection

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

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

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

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

In 2008, COG completed a new Household Travel Survey, collecting data that will be used to revise the regional travel models. This is expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If COG adopts new coefficients during the 2008-2011 evaluation period for the regional model, the coefficients used in the COMMUTER Model v. 2.0 will be updated to be consistent with the new coefficients. The consulting team will also assess any other modifications to other parameters and default factors, such as average trip length, vehicle occupancy, employment characteristics, etc., and will update these parameters as needed for the 2011 TERM Analysis.

4-D MASS MARKETING TERM

Program Description

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

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

TERM Evaluation Changes Since 2005-2008

- None

Stated Goals

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

- Encourage _____ commuters to switch modes
- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

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?
- 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 2010
- CC Applicant Placement survey – November 2008
- GRH Applicant survey – Spring 2010
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2010

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

~~INFOEXPRESS KIOSKS - DELETED~~

4-E COMMUTER OPERATIONS CENTER

Program Description

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

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

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

TERM Evaluation Changes Since 2005-2008

- None

Stated Goals

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

Commuter Operations Center (basic services)

- Register _____ commuters
- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

Integrated Rideshare-Software Upgrades (additional to Basic COC)

- Reduce _____ daily vehicle trips
- Reduce _____ daily miles of travel
- Reduce _____ daily tons of NOx
- Reduce _____ daily tons of VOC
- Reduce _____ daily tons of $PM_{2.5}$
- Reduce _____ daily tons of CO_2

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 effective-

ness 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 Integrated Rideshare-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 ride-matching 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

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

Proposed timing of data collection

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

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

SECTION 5 DESCRIPTION OF DATA SOURCES

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

Ongoing Monitoring

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

Existing/Ongoing Surveys

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

Analysis Tools

- EPA COMMUTER Model (v 2.0)

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

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

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

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

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

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

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

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

EXISTING/ONGOING SURVEYS

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

- 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 2008-2011 evaluation period. This was conducted in November 2008 for FY 2009.

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)*

In past TERM evaluations, interviews for the GRH survey have been conducted via telephone. But in 2008, Commuter Connections transitioned to an online ridematching and GRH system. This will facilitate the use of the internet for some data collection. A pilot internet GRH survey was conducted as a companion to the 2007 GRH survey to test the potential of this method. The pilot documented that the results for the telephone and Internet samples were not statistically different in any variable that was important to the TERM analysis and that either an internet alone or an internet / telephone combination would be a valid option.

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

- 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, 2004, and 2007 State of the Commute Surveys.

  SOC survey data also are used to estimate the impacts of TERMs that have a possible influence on the population-at-large. Specifically, the survey generates information on teleworking, a TERM that

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

has broad application and for which it is not possible to identify all users from any Commuter Connections database. The survey also is used to assess awareness and penetration of the regional GRH program.

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

The State of the Commute survey is a triennial survey and will be conducted in early 2010. *(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)*

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

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

ANALYSIS TOOLS

~~During the 2008-2011 evaluation period, the 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.~~

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

SECTION 6 BASIC METHOD FOR CALCULATING PROGRAM IMPACTS

This section presents the methodology for calculating and quantifying the travel, air quality, energy and commuter cost impacts of the TERMs. Following are the basic calculation steps common to all TERMs (except Employer Outreach, which uses a modeled method and Mass Marketing, which uses information from the State of the Commute and COC activity tracking to assess mode change due to the campaign). Specific examples of the evaluation calculations and unique methodological elements for each TERM 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, EO employees
2. Calculate placement rate (from commute survey data)	= Proportion of commuters who made a travel change as a result of the TERM
3. Estimate number of "placements"	= Population base x placement rate
4. Estimate VTR factor (from commute survey data)	= Average daily vehicle trips reduced per placement
5. Estimate vehicle trips (VT) reduced	
- GRH, COC, Telework, MM	= placements x VTR factor
- Employer Outreach	= Modeled method
6. Estimate VMT reduced	= Vehicle trips reduced x avg. trip length
7. Adjust VT and VMT for SOV access	
- Adjusted vehicle trips reduced	= Total vehicle trips – SOV access trips
- Adjusted VMT reduced	= Total VMT – SOV access VMT
8. Estimate emissions reduced	= Vehicle trips x "trip end" emission factors = VMT x "running" emission factor
9. Estimate energy and commuter savings	= VMT reduced x average fuel consumption = VMT reduced x average vehicle operating cost
10. Estimate cost-effectiveness	= total annual TERM budget ÷ annual emissions reduced by TERM

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

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

1.	Estimate TERM "population base"	= 8,000 commuters
2.	Calculate placement rate	= 20%
3.	Estimate number of "placements"	= 8,000 x 0.2 =1,600 commuters placed
4.	Estimate VTR factor	= 0.7 daily vehicle trips reduced per placement
5.	Estimate vehicle trips (VT) reduced	= 1,600 x 0.7 trips reduced per placement = 1,120 daily vehicle trips reduced
6.	Estimate VMT reduced	= 1,120 vehicle trips reduced x 25 miles/trip = 28,000 daily VMT reduced
7.	Adjust VT and VMT for SOV access	(assume 60% of placements have SOV access and drive 5 miles to meeting point)
	- Adjusted vehicle trips reduced	= 1,120 trips – 0.6 x 1,120 = 1,120 - 672 = 448 vehicle trips (without SOV access)
	- Adjusted VMT reduced	= 28,000 VMT – (0.6 x 1,120 x 5 miles) = 28,000 – 3,360 = 24,640 VMT
8.	Estimate emissions reduced VOC	= 448 trips x 1.7569 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
	PM2.5 NOx precursors	= 448 trips x 0.6652 gm/trip = 298 gm = 24,640 VMT x 0.4038 gm/VMT = 9,950 gm = (298 gm + 9,950 gm) / 907,185 gm/ton = 0.011 tons NOx reduced

PM2.5	= 448 trips x 0.0 gm/trip = 0 gm = 24,640 VMT x 0.0115 gm/VMT = 2,464 gm = (0 gm + 2,464 gm) / 907,185 gm/ton = 0.003 tons PM2.5 reduced
CO2	= 448 trips x 0.0 gm/trip = 0 gm = 24,640 VMT x 455.7 gm/VMT = 11,228,448 gm = (0 gm + 11,228,448 gm) / 907,185 gm/ton = 12.4 tons CO2 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 2011, the 2008-2011 TERM Analysis target year, the emission factors[7] are:

Emission Factors	NOx	VOC	PM2.5 NOx	PM2.5	CO2
• Trip end *(gm / one-way vehicle trip)*					
• Running *(gm / mile)*					

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:

[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.

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

PM2.5 NOx = 448 trips x 0.6652 gm/trip = 298 gm
= 24,640 VMT x 0.4038 gm/VMT = 9,950 gm
= (298 gm + 9,950 gm) / 907,185 gm/ton
= 0.011 daily tons NOx reduced

PM2.5 = 448 trips x 0.0 gm/trip = 0 gm
= 24,640 VMT x 0.0115 gm/VMT = 2,464 gm
= (0 gm + 2,464 gm) / 907,185 gm/ton
= 0.003 daily tons NOx reduced

PM2.5 = 448 trips x 0.0 gm/trip = 0 gm
= 24,640 VMT x 0.0115 gm/VMT = 2,464 gm
= (0 gm + 2,464 gm) / 907,185 gm/ton
= 0.003 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:

- 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 G.

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

SECTION 7 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 Activities
Proposed Frequency and Responsibility

Evaluation Activity/Tool	**Frequency**	**Responsibility**
Ongoing Monitoring		
• ACT! employer contact database	Ongoing	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

CC – Commuter Connections

SECTION 8 REPORTING AND COMMUNICATION OF EVALUATION RESULTS

SECTION 9 REGIONAL ISSUES AND FUTURE PERFORMANCE INDICATORS

LIST OF APPENDICES