Transportation Demand Management (TDM)
Program Elements
DRAFT Revised Evaluation Framework
FY 2021 – FY 2023

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Transportation Demand Management (TDM) Program Elements DRAFT Revised Evaluation Framework FY 2021 – FY 2023

Prepared for:

Metropolitan Washington Council of Governments
777 North Capitol Street, NE, Suite 300
Washington, DC 20002-4290

Prepared by:

LDA Consulting

In association with:

Eric N. Schreffler, Transportation Consultant
Center for Urban Transportation Research (University of South Florida)
and
WBA Research, Inc.

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ABSTRACT

Transportation Demand Management (TDM) Program Elements: Revised Evaluation Framework FY 2021 – FY 2023
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ABOUT COMMUTER CONNECTIONS
Commuter Connections, a program of the National Capital Region Transportation Planning Board at the Metropolitan Washington Council of Governments (COG), promotes bicycling to work, ridesharing, and other alternatives to drive alone commuting, provides ridematching for carpools and vanpools, incentive programs for alternative commuting, and offers the free Guaranteed Ride Home program. Commuter Connections is funded by the District of Columbia, Maryland, Virginia and U.S. Department of Transportation.

CREDITS
Prepared by LDA Consulting in association with Eric N. Schreffler, Transportation Consultant; Center for Urban Transportation Research (University of South Florida); and WBA Research, Inc.

Authors:
Nicholas Ramfos, Director, Transportation Operations Programs, COG
Lori Diggins, Principal, LDA Consulting.

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Executive Summary

Overview of the Evaluation Framework

The Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in concert with program partners, is responsible for implementing a package of Transportation Demand Management (TDM) program elements in the metropolitan Washington region. The objective of these elements is to improve the travel experience of regional commuters and support regional efforts to meet air quality goals and mitigate growth in vehicle miles traveled. The four TDM program elements covered by this evaluation framework include:

- **Maryland and Virginia Telework Assistance** – The Maryland portion of this element provides information and assistance to Maryland commuters and employers to further in-home and co-working/telecenter-based telework programs. The Virginia portion provides assistance to employers and employees participating in the Telework!VA (TWVA) program.
- **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 for commuters who use alternative modes.
- **Employer Outreach** – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites. This program element includes the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling component also is part of this analysis.
- **Mass Marketing** – Involves a large-scale, comprehensive media campaign to inform commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various incentive programs and special promotional events also are part of this program element.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and other information on travel services through telephone and internet assistance to commuters. The COC supports each of the four program elements described above.

Note that the TDM program elements included in the Commuter Connections evaluation framework do not encompass all the TDM activities currently ongoing in the Washington metropolitan region. Many other organizations, such as states and local jurisdictions, transportation management associations, transit agencies, vanpool vendors, other transportation service providers, employers, commercial and residential building operators, and other organizations also offer services that perform similar functions to the TDM program elements implemented by Commuter Connections. The impacts of these other TDM services are not addressed in this framework, but certainly are expected to provide travel and air quality benefits to the region and personal benefits to the commuters who use them.

This report provides a framework and methodology for evaluating the transportation and air quality impacts of these TDM program elements. This methodology and numerous data collection tools described in this report have been developed to estimate impacts of these elements for the period from July 2020 through June 2023 (FY 2021 – FY 2023). These impacts then will be compared against the goals estab-

lished for each element by COG's National Capital Region Transportation Planning Board (TPB), the region's designated Metropolitan Planning Organization (MPO). The TDM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

When the TDM program elements were first implemented, Commuter Connections elected to undertake significant evaluation for each element. The objective of the evaluation process is to provide timely and meaningful information on the performance of each element to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TDM program partners; and employers and commuters who comprise Commuter Connections' clients.

Eight previous evaluation frameworks have been prepared, for the following time periods:

- January 1997 through June 1999 (FY 1997 – FY 1999)
- July 1999 through June 2002 (FY 2000 – FY 2002)
- July 2002 through June 2005 (FY 2003 – FY 2005)
- July 2005 through June 2008 (FY 2006 – FY 2008)
- July 2008 through June 2011 (FY 2009 – FY 2011)
- July 2011 through June 2014 (FY 2012 – FY 2014)
- July 2014 through June 2017 (FY 2015 – FY 2017)
- July 2018 through June 2020 (FY 2018 – FY 2020)

Impact Performance Measures and Calculation of Impacts

The evaluation framework presented in this document builds on the framework used in the FY 2018 – FY 2020 analysis. Several updates have been made in the FY 2021 – FY 2023 TDM evaluation framework to reflect methodologies that were applied in the 2020 TDM analysis. These are described later in this document.

The evaluation process outlined in this framework applies several types of performance measures to allow for both on-going estimation of program effectiveness and for annual and triennial evaluations. Measures reflecting commuters' and users' awareness, participation, and satisfaction with the program, and their attitudes related to transportation options are examined to track program recognition and output, and program service quality. Measures documenting shifts to alternative modes following use of TDM program elements are reported to assess the effectiveness of the elements in motivating travel behavior change. Performance data is collected through surveys of users of each program and documented in the survey reports.

Program impact measures are used to quantify five key outcome results:

- Vehicle trips reduced
- Vehicle miles of travel (VMT) reduced
- Emissions reduced: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), and Carbon Dioxide (CO_2) and other associated greenhouse gases[1]
- Energy reduction (fuel saving)
- Consumer saving (commuting cost saving)

[1] In previous TDM evaluations, emissions reductions also were calculated for particulate matter: PM2.5 and PM2.5 NOx precursors. Reductions for these emissions will not be calculated for the FY 2021 – FY 2023 evaluation because the MWCOG region is in attainment for these pollutants. Thus, reductions in the pollutants are no longer relevant for the regional conformity analysis.

To compute these impacts, the evaluation process uses several multiplier factors derived from surveys of Commuter Connections' program applicants and/or the public-at-large. These factors include:

- Placement rate (percentage of commuters who shift to alternative modes)
- Vehicle trip reduction (VTR) factor (average daily trips reduced for each commuter placed in a non-drive alone "alternative" mode)
- Average commute trip distance
- Drive alone access percentage (proportion of rideshare and transit users who drive alone to 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 TDM program element.

1) Estimate commuter population "base" for the TDM program element (e.g., all commuters, GRH applicants, rideshare matching applicants, Employer Outreach employees, etc.)
2) Derive "placement rate" – Percentage of commuters in the population base who made a travel change after using the TDM program element
3) Estimate the number of new alternative mode placements – Multiply placement rate by the population base for the evaluation period
4) Derive vehicle trip reduction (VTR) factor for new placements – Average daily vehicle trips reduced per placement
5) Estimate vehicle trips reduced – Multiply number of placements by the VTR factor
6) Estimate vehicle miles traveled (VMT) reduced – Multiply number of vehicle trips reduced by average commute distance
7) Adjust vehicle trips and VMT for access mode – Discount vehicle trips reduced and VMT reduced to account for commuters who drive alone to meet rideshare modes and transit
8) Estimate NOx, VOC, and 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 and societal cost savings – Multiply VMT reduced by fuel efficiency and vehicle operating cost factors and by societal benefit cost factors

The calculations outlined above have been embedded into a spreadsheet used by Commuter Connections and its partners to track results on a quarterly basis. A 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 element are completed. At the end of the three-year evaluation period, a TDM Analysis Report is prepared to summarize placements; reductions in vehicle trips, VMT, and emissions; and progress toward goals in each of these performance measures 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 others with an interest in regional transportation to help inform regional transportation plans and initiatives.

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Table of Contents

Table of Contents (continued)

Section 1 Overview

This report provides a framework and methodology for evaluating transportation and air quality impacts of four Transportation Demand Management (TDM) program elements in the metropolitan Washington region. The objective of these elements is to improve the travel experience of regional commuters and support regional efforts to meet air quality goals and mitigate growth in vehicle miles traveled. The four TDM program elements covered by this evaluation framework include:

- **Maryland and Virginia Telework Assistance** – The Maryland portion of this TDM program element provides information and assistance to Maryland commuters and employers to further in-home and co-working/telecenter-based teleworking. The Virginia portion provides assistance to employers and employees participating in the Telework!VA (TWVA) program.
- **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 for commuters who use alternative modes.
- **Employer Outreach** – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites. Includes the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling component also is part of this analysis.
- **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. Various incentive programs and special promotional events also are part of this TDM program element.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and information on other travel services through telephone and internet assistance to commuters. The COC supports all the elements described above.

Note that the TDM program elements in the Commuter Connections evaluation framework do not encompass all the TDM activities currently ongoing in the Washington metropolitan region. Many other organizations, such as states and local jurisdictions; transportation management associations; transit agencies, vanpool vendors, and other transportation service providers; employers, commercial and residential building operators, and other public and private organizations also offer services that perform similar functions to the TDM program elements implemented by Commuter Connections. The impacts of these other TDM services are not addressed in this framework, but certainly are assumed to provide travel and air quality benefits to the region and personal benefits to the commuters who use them.

The evaluation defined in this framework serves two purposes. First, it assesses Commuter Connections' progress in supporting the transportation and air quality goals established by COG's National Capital Region Transportation Planning Board (TPB) for the TDM program elements for the period July 2020

through June 2023 (FY20-FY23). Second, it guides COG's assessment of the use and effectiveness of each program element for future program planning purposes. The TDM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

This report represents an update to the most recent of eight previous evaluation framework documents developed to evaluate results and progress toward goals during previous three-year time periods:

- January 1997 through June 1999[2]
- July 1999 through June 2002[3]
- July 2002 through June 2005[4]
- July 2005 through June 2008[5]
- July 2008 through June 2011[6]
- July 2011 through June 2014[7]
- July 2014 through June 2017[8]
- July 2017 through June 2018[9]

The upcoming evaluation will quantify the impacts of the four TDM program elements, results that will be used to support regional transportation and air quality planning and congestion management efforts.

This evaluation framework report is organized into eight sections:

- Section 1 presents the framework overview.
- Section 2 defines evaluation objectives and issues guiding the process.
- Section 3 enumerates performance measures used to assess program effectiveness.
- Section 4 discusses evaluation components specific to each TDM program element, and to the Commuter Operations Center (COC) and the Software Upgrade component of Integrated Rideshare, which was combined with the COC in a previous evaluation period.
- Section 5 describes the data sources and data collection tools used to collect analysis data.
- Section 6 outlines the method to compute travel, air quality, energy, and consumer cost impacts of the TDM program elements.
- Section 7 describes tools currently used to report Commuter Connections' evaluation results to various stakeholder audiences.
- Section 8 outlines the evaluation schedule and responsibilities.

[2] Commuter Connections Transportation Demand Management Evaluation Project: Transportation Control Measures Evaluation Framework, June 30, 1997.
[3] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 1999-2002, MWCOG, March 20, 2001.
[4] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2002-2005, MWCOG, March 16, 2004.
[5] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2005-2008, MWCOG, May 15, 2007.
[6] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2008-2011, MWCOG, May 18, 2010.
[7] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2012-2014, MWCOG, May 21, 2013.
[8] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2015-2017, MWCOG, March 15, 2016.
[9] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Demand Management (TDM) Program Elements Revised Evaluation Framework 2018-2020, MWCOG, March 19, 2019.

Section 2 Evaluation Objectives and Issues

Objectives of the Evaluation and Emphasis Areas for FY 2021 – FY 2023

The objective of the evaluation process is to provide timely and meaningful information on the performance of TDM program elements to document transportation and emission impacts, identify program enhancements that support effective program outreach and service delivery, and guide decisions on future funding priorities. This information includes travel and air quality impacts, such as reductions in vehicle trips, vehicle miles of travel, and emissions generated by use of Commuter Connections' TDM program elements, as well as data on commuters' travel patterns, opportunities, constraints, and attitudes.

Regional Goals and New Technologies/New Modes – The information described above has been collected and reported by Commuter Connections through all previous triennial evaluations. Other topics have been added as the evaluation has evolved to address regional and/or programmatic questions, refine Commuter Connections messaging and outreach, and identify TDM program changes and new services that can attract new users. Two topics that were added to the evaluation in the FY 2018 – FY 2020 framework remain of interest for the FY2021 – FY2023 evaluation; these are the contribution of Commuter Connections' TDM program elements to regional transportation-related societal goals and how the availability and use of new technologies and new mode options can influence commute decisions.

Coronavirus Pandemic Impact on Travel – One regionally-significant topic that will be important to the FY 2021 – FY 2023 TDM evaluation is the effect of the coronavirus pandemic on regional travel. The most obvious impact is the dramatic increase in telework during the pandemic; some telework growth is likely to be reversed when the pandemic ends, but recent surveys suggest that telework will retain some gains. The pandemic appears to have sparked other travel changes as well, such as reduced use of transit and new interest in walking and bicycling to name just two.

Illustration by Golden Cos-

Since the pandemic began in early 2020, Commuter Connections has included pandemic-related questions in several surveys, offering a real-time view of how commuters and employers were adjusting work locations and mode use choices as the pandemic progressed. Commuter Connections surveys such as the State of the Commute survey and Guaranteed Ride Home survey, that will be conducted during 2022 and 2023, will provide additional insights into changing commuting patterns.

Equity in Access to and Delivery of Services – An additional MWCOG initiative that is relevant for the evaluation framework is the focus on equity in access to and delivery of transportation services. The MWCOG Board of Directions affirmed that equity would be "woven into COG's Region Forward Vision to ensure a more prosperous, accessible, livable, sustainable, and equitable future for all area residents and throughout COG's analyses, procurement, programs, and priorities."[10] Further, The COG Transportation Planning Board identified Equity Emphasis Areas (EEAs) across the region to help assess equity of impacts of transportation planning projects.

[10] https://www.mwcog.org/about-us/cog-board-and-priorities/equity/

Commuter Connections undertakes numerous outreach and assistance activities to ensure equity in service delivery and service access. For example, Commuter Connections offers multiple method by which commuters can receive information and assistance, including a regional call center, Internet website, mobile applications, and jurisdiction-based partners. Additionally, Commuter connections translates marketing and information materials into numerous languages and targets program marketing to residents of Equity Emphasis Areas and essential workers.

All surveys conducted for the Commuter Connections evaluation collect demographic data and some geographic data and past evaluations have reported data on access, awareness, and use of Commuter Connections services by geographic and demographic sub-populations. These ongoing efforts to examine service equity will continue in the FY 2021 – FY 2023 evaluation, with one additional element to the State of the Commute Survey. The 2022 survey will append census block group information to respondents' survey data. The use of block group is disaggregated enough to allow examination of service access and use in EEAs, while sufficiently aggregated to protect respondents' privacy.

Evaluation Framework Emphasis Areas for FY 2021 – FY 2023

- Define evaluation methods for all Commuter Connections TDM program elements, reflecting methods applied in the **2020 TDM analysis**.
- Collect and share TDM program data to **document TDM contribution to the region** and support regional and local planning.
- Collect data to examine commuters' attitudes toward and use of **new technologies and new mode options** and influence on commute decisions.
- Collect data for regional analysis of **coronavirus pandemic travel changes**
- Collect and report data on **equity of service access, delivery, and use**

Key Audiences

Key audiences for the evaluation results include decision-makers such as the TPB and other regional policy makers; COG program funders; COG/TPB staff; Commuter Connections program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients. Specific information relevant to each group includes:

- Regional policy-makers – Impacts and cost-effectiveness of TDM program elements in contributing to regional goals for reducing congestion, enhancing transportation system performance, improving air quality, reducing energy consumption, and improving mobility and accessibility.
- Program funders – Impacts and cost-effectiveness of the TDM program elements implemented via the Commuter Connections program.
- Regional and local transportation planners and TDM program staff – Regional commute trends and attitudes and the collective impact of Commuter Connections programs on regional traffic and air quality. The 2021–2023 evaluation will continue to collect travel pattern data that Commuter Connections can provide for regional and local jurisdiction analyses on regional transportation system performance measurement. The evaluation also will compile evaluation data to assist program managers to report TDM program benefits in ways meaningful to policy-makers and funders.

- COG TPB staff and Commuter Connections program partners – Program enhancements that will increase service effectiveness and efficiency of service delivery, attract additional commuters to alternative modes, and contribute to improved performance of the transportation network.
- Employers and commuters – Collective, regional impacts of individual participation, benefits for employers that support commute programs, and personal benefits received by commuters who use alternative modes. Evaluation information also can be useful to educate employers about feasible and effective trip reduction strategies for their specific worksite conditions.

Evaluation Principles and Issues

Several overarching principles and issues apply to evaluation of the TDM program elements and the Commuter Operations Center. They are presented here to emphasize the underlying foundation of the evaluation process.

Document Progress Toward TDM Goals and Support Program Management

- The evaluation uses common, quantitative performance measures for all TDM program elements to allow for comparisons among program elements and between program elements and other strategies that could be implemented to address congestion and air quality concerns. These common performance measures are enumerated in Section 3.
- The evaluation framework allows for quarterly projection of benefits as a program management information tool. While assessment of travel and air quality benefits is the key purpose of the evaluation, the process also provides information to support administration of Commuter Connections TDM program elements.
- The evaluation process follows industry-accepted evaluation techniques, is rigorous, ongoing, resource efficient, unobtrusive for Commuter Connections partners, and is compatible with regional, state, and national practices.

- The evaluation framework addresses collection of data to assist MWCOG to integrate Commuter Connections' TDM program elements into its response to the FAST Act federal performance-based planning requirements and the regional congestion management process.[11]

Separating Impacts of Program Elements

- The evaluation separates the impacts of individual Commuter Connections TDM program elements and applies discount factors to avoid overestimating benefits when a commuter uses more than one

[11] MWCOG has been required since passage of the 2005 SAFETEA-LU federal legislation to undertake a Congestion Management Process (CMP). The current FAST Act fully maintains the CMP requirements with additional options. The National Capital Region's CMP Technical Report describes the region's activities to monitor and evaluate transportation system performance and defines congestion management strategies the region will implement. The Commuter Connections' TDM Program elements are included among the strategies described. The current CMP for the National Capital Region was documented in the 2018 Congestion Management Process (CMP) Technical Report, National Capital Region Transportation Planning Board, MWCOG, September 7, 2018. The document is available at: https://www.mwcog.org/documents/2016/09/09/congestion-management-process-cmp-technical-report-congestion-management-process/

Commuter Connections service. For example, carpools might be formed as a joint result of ride-matching and GRH. These impacts must either be credited to one of the two program elements or divided between them in proportion to their respective influences in encouraging the change. Program benefits are not necessarily additive.

- Similarly, the evaluation separates the impacts of Commuter Operations Center "basic" services from the impacts of the other TDM program elements. The method for attributing impacts to a specific element or service is discussed in Section 6. This is especially relevant for the Mass Marketing program element, because its impacts can be "direct," meaning the marketing alone motivated an alternative mode shift, or "referred," where the marketing influenced commuters to use another Commuter Connections program, such as GRH or ridematching. In such cases, the travel and air quality impacts will be assigned to the element or to the Commuter Operations Center, based on their respective influences.
- When possible, the evaluation recognizes and attempts to address possible influence of exogenous factors, such as the extent of congestion, work and home locations, economic factors, fuel prices, and other factors on travel behavior and mode choice. The regional State of the Commute survey and other service user surveys that explore commuters' reasons for choosing their travel modes can help gauge the relative importance of TDM program elements, among the many factors that can influence travel behavior, in commuters' use of a new travel mode.

Accounting for Prior Mode and Access Mode

- Prior mode is an important variable in the 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) the commuter shifts from driving alone to an alternative mode, 2) an alternative mode commuter increases the frequency of use of alternative modes, or 3) the commuter shifts to a higher-occupancy mode (e.g., from carpool to vanpool or vanpool to transit). Section 6 describes the development of the vehicle trip reduction (VTR) factor used to convert the number of alternative modes placements into the number of vehicle trips reduced, taking into account various types of before-after alternative mode combinations.
- For emission reduction evaluation purposes, the evaluation also accounts for the access mode of carpoolers, vanpoolers, and transit riders, that is, how commuters who use these modes travel from home to Park & Ride lots, bus stops, train stations, or other places where they meet rideshare partners or board a bus or train. Access mode is a minor issue in the evaluation of VMT reduction, because access trips generally account for a small portion of the total miles between home and work and the alternative mode generally is used for the most congested and longest portion of the trip. However, commuters who drive alone to the meeting point still make a vehicle trip and accumulate some drive-alone miles, which must be subtracted from the vehicle trips reduced and VMT reduced in the emissions analysis.

Updating Calculation Factors and Assumptions Used in the Evaluation

- The TDM evaluation methodology applies calculation factors developed from surveys and other research conducted during the evaluation period. Revisions will be incorporated in the FY 2021 – FY 2023 evaluation as noted later in this report for each element. Additionally, regional emissions factors will be updated to reflect factors that will apply in 2023.

Apply Life-cycle Assessment to Mode Shifts to Capture the Full Duration of Benefits for TDM Impacts

- In Commuter Connections evaluations prior to 2017, mode shifts motivated by TDM program elements during an evaluation period were not carried over to the next evaluation cycle. But numerous surveys conducted for past TDM program analyses suggested that commuters who made mode shifts continued using the new modes for more than three years, so some additional impacts could be retained from one 3-year evaluation cycle to the next. To address this opportunity, in 2016, Commuter Connections conducted a new "Retention Rate" survey to estimate the share of past service users who continued to use alternative modes during the current cycle.

  The survey interviewed Commuter Connections online system users and GRH users who last participated in these programs prior to the start of the FY 2017 – FY 2020 evaluation period. Users were asked about their current modes, how long they had used the modes, and what Commuter Connections services they received. Commuters who were still using alternative modes were asked if and how Commuter Connections services influenced them to continue to use alternative modes. These survey data were used to develop "retained" placement rates and other factors for the GRH TERM and for the Commuter Operations Center and the 2017 TDM analysis calculated "retained" impact credits for each of these program elements.

  Commuter Connections conducted a second Retention Rate survey in February 2021, following the same method as for the 2017 survey. Results from this survey will be used to update the multiplier factors for GRH and for the Commuter Operations Center for the 2023 analysis. Section 5 provides additional details on the Retention Rate survey.

Specific Evaluation Issues for Individual TDM Program Elements

In general, the analysis approaches documented in the 2020 TDM Analysis Report are used as the basis for the evaluation methods described in this framework. A sample of the calculations are included in Appendices D through I, as excerpted from the 2020 TDM Analysis Report.

- ***Maryland and Virginia Telework Assistance*** – The Telework program element is comprised of resources to help employers, commuters, and program partners initiate and expand telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to telework, the mode on non-telework days, and mode and travel distance to telework locations other than home. Impacts for the Maryland component of the element are estimated from the State of the Commute survey and from surveys conducted with Maryland employers that received telework information or assistance from Commuter Connections. Impacts for the Virginia portion of the element are estimated from baseline and follow-up surveys of employees at Virginia worksites of employers participating in the Telework!VA (TWVA) program. These survey data are collected by the Virginia Department of Rail and Public Transportation.

  Note that the calculated telework impacts do not include all telework in the region; only impacts that can be tied to a service provided by Commuter Connections or a CC partner organization and services that are provided under this TDM program element. Additionally, Commuter Connections and its program partners also offer some telework assistance under the Employer Outreach program element and the Commuter Operations Center. These impacts are calculated separately from those for Maryland and Virginia Telework Assistance for the commuter and employer target telework populations and assigned to either Employer Outreach or the Commuter Operations Center. Appendix C defines the assignment of telework impacts for commuters and employers, depending on their location (District of Columbia, Maryland, Virginia) and the telework assistance services they received.

- ***Guaranteed Ride Home*** (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to alternative modes and to encourage commuters who were ridesharing before they registered for GRH to continue or expand their use of these modes. The evaluation for GRH will gauge the influence of GRH availability on both mode shifts and frequency of ridesharing. The 2021–2023 methodology includes the "retained" component, described above, for registrants who ended their participation in GRH prior to the start of the current evaluation period but who are continuing to use alternative modes to commute.

- ***Employer Outreach (EO)*** – The EO evaluation applies a two-faceted approach employing empirical data on employer programs and modeled impacts. The empirical data come from the regional ACT! database of employer contacts, which includes information on TDM strategies implemented by employers at their worksite. The EPA COMMUTER model (v 2.0) applies these empirical data to project the likely change in employee commuting behavior for given changes in the employer's program.

  The COMMUTER Model uses time and cost coefficients that are compatible with coefficients used by MWCOG in regional transportation modeling. In 2007, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. During 2010-2012, MWCOG developed a new travel model used for regional transportation planning and forecasting. To ensure consistency with the new regional model, MWCOG modeling staff reviewed the COMMUTER Model cost and time coefficients that were used in the 2011 evaluation. They concluded that no further coefficient adjustments were needed for the 2014 or 2017 TDM analyses to be consistent with the new regional model.

  MWCOG continues to update the regional model and in 2020, the research team reviewed regional model guidance documents to determine if any updates might necessitate a change in the COMMUTER model coefficients to remain compatible with the regional approach. The review identified changes to enhance the efficiency and speed of model operation, but no modifications that would affect the validity of the current cost COMMUTER Model coefficients. Thus, the research team concluded that no additional COMMUTER model adjustments were needed for the 2020 evaluation.

  In 2020, the research team also examined several other models to determine if any other options would be as reliable and efficient as the COMMUTER model for the Employer Outreach analysis. This review found that none of the alternative models offered both the capability to analyze the wide range of TDM strategy combinations that were implemented by EO employers as well as the capability to analyze efficiently impacts for individual employers. Thus, the project team used the COMMUTER Model for the FY 2017 – FY 2020 EO calculation. The team is currently expanding this review. If a new tool appears likely to be more accurate than the COMMUTER Model, with similar ease and capabilities, it will replace the COMMUTER Model for the 2023 analysis.

  The 2021-2023 methodology also will distinguish three types of employer impacts: maintained, new, and expanded. The EO program element has been in effect for many years. Beginning with the 2008 analysis, new goals were established for the overall program and for new program activity during each new evaluation period. The evaluation now calculates impacts for three employer groups:

  - Maintained impacts: employers that joined EO before the start of the evaluation period (e.g., July 1, 2020), continued in the program, but made no changes since that date.
  - New impacts: employers that joined the EO program during the current evaluation period.
  - Expanded impacts: employers that were involved in EO before July 1, 2020, but that expanded their commute assistance services after that date.

The evaluation also includes impacts for employers that participated in the program during the most recent past evaluation period (2018-2020) but dropped out of EO before the start of the new period. Impacts that would have been credited for these employers would have to be replaced or "back-filled" by new/expanded impacts.

Finally, employer bicycle programs, which were evaluated separately from other Employer Outreach services prior to 2008, under the Employer Outreach for Bicycling component, are now addressed within the broad Employer Outreach program element. But the contribution of these bicycle programs will continue to be calculated and reported separately.

- ***Mass Marketing*** – The critical issue for this program element is attributing changes in attitudes and behavior to the mass marketing campaign versus another TDM program element. The following types of impacts are evaluated for Mass Marketing:

  1) "*Direct marketing" impacts* generated by commuters who cite regional Commuter Connections advertising messages as an influence on their commuting change
  2) "*Referred marketing" impacts* that are generated when advertising encourages commuters to submit rideshare and GRH applications
  3) *Event impacts* generated from mode shifts related to special event programs, such as the Bike to Work Day and Car Free Day events
  4) *Incentive impacts* generated by shifts to alternative modes by commuters who receive 'Pool Rewards carpool start-up and vanpool start-up/continuation incentives, Flextime Rewards incentive for shifting travel out of the peak period, and incenTrip rewards for alternative mode trips logged using the mobile application
  5) *Dynamic ridematch impacts* generated by shifts to carpool by commuters who use the CarpoolNow dynamic ridematch mobile application

  Most of these components were addressed in the 2018-2020 TDM evaluation, but new calculations will be added to Mass Marketing for the 2021-2023 evaluation for two incentive programs, Flextime Rewards and IncenTrip and the CarpoolNow "dynamic ridematch" component. The November 2020 Applicant Placement survey interviewed users of these programs, allowing the derivation of impact multiplier factors for the TDM analysis. Section 4 presents additional information on the data sources for this analysis.

- ***Commuter Operations Center and Integrated Rideshare–Software Upgrades*** – Impacts for the Commuter Operations Center (COC) will be evaluated as in the 2020 TDM analysis. Integrated Rideshare-Software Upgrades will continue to be evaluated as part of the COC under the Integrated Rideshare program element. However, their impacts will be calculated and reported as a sub-set of the Commuter Operations Center.

  The 2021-2023 methodology for the Commuter Operations Center also will continue two components that were added to the methodology in the 2017 TDM analysis. First, it will include the "retained" component, described above, for online system applicants who received services before the start of the current evaluation period but who are continuing to use alternative modes to commute. Second, the COC methodology will incorporate impacts from Commuter Connections-assisted telework that occurs outside of the telework components of the Maryland and Virginia Telework Assistance program element. Appendix C describes the assignment of these telework impacts.

Section 4 elaborates on the evaluation activities and issues for individual TDM program elements.

Section 3 Performance Measures

Performance Measures by Category

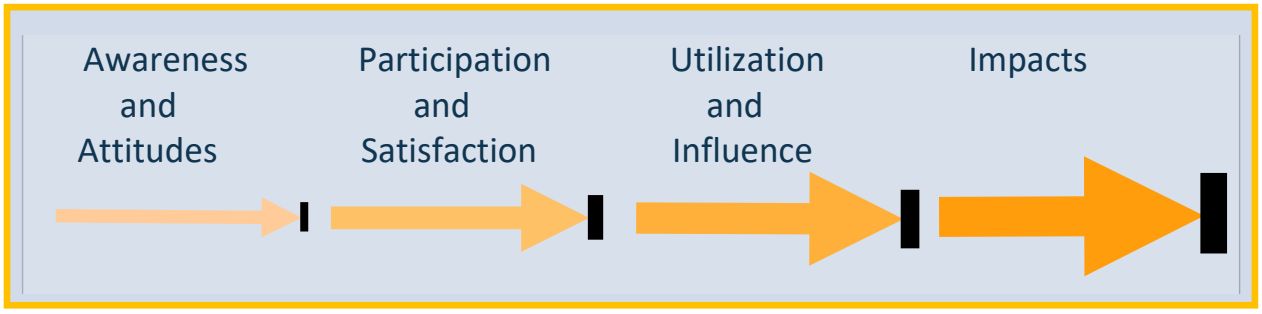
Previous Commuter Connections TDM program evaluation frameworks established performance measures for each TDM program element. Performance measures assess the extent to which the program is meeting the program objectives, in particular the travel and emission targets set by the TPB, but also customer-focused performance related to service awareness, service use, and user satisfaction.

Most Americans have been conditioned to "*think auto first*." Changing this mindset requires that commuters go through an educational process supported by positive experiences before they permanently adopt the desired behavior. The classic social marketing model outlines this multi-step transformation:

- Awareness – Build initial awareness of the concept
- Familiarity – Increase appreciation and understanding of options
- Consideration/Trial – Try an option and have a favorable experience
- Desired behavior – Adopt the behavior in everyday living

The Commuter Connections evaluation framework adapts this model for a seven-step approach to TDM program evaluation, with each step representing one component on a "continuum" of results (Figure 1). The first five categories represent steps necessary for social behavioral change. The sixth category refers to assessment of the factors influencing or motivating the behavioral changes. The final category includes indicators related to the external impacts resulting from behavior changes. For a TDM program, the impacts are typically travel and environmental changes, but can include other personal or social impacts also, such as enhanced quality of life, personal travel savings, and other indicators.

Figure 1: TDM Performance Continuum



Awareness and Attitudes

Awareness measures assess the degree to which commuters know about the Commuter Connections program and its services. While not a direct measure of program impacts, awareness is a required precursor to use of the services. Awareness has assumed a larger role in recent evaluation periods because it is a primary objective of the Mass Marketing program element. A related type of measure is commuters' ***attitudes***, their personal feelings about their commute experience, commute travel mode options available in the region, and their willingness to consider and try new modes of travel.

- ***Awareness*** – Program awareness will be assessed by the proportion of residents and commuters who recognize the Commuter Connections "branding" and who are aware of transportation infrastructure, alternative modes, and commuter assistance services available to them. Awareness will be assessed by questions in the State of the Commute (SOC) survey and/or other surveys of the public at large.
- ***Attitudes*** – One goal of the Mass Marketing program element is to address commuters' frustration with increasing congestion. The evaluation will document travel attitudes over time, including commute ease and commute satisfaction, the extent of recent shifts to alternative modes, and the reasons and influences for those shifts. This information is currently captured in the SOC survey and will continue to be tracked as more general population surveys are conducted.

Program Participation and Satisfaction

Participation refers to indicators related to use of TDM services by targeted populations, for example, the numbers of matchlist requests, GRH applicants, and bicyclists who register for Bike-to-Work Day, and the number of employers that participate in Employer Outreach. Participation data measure program outputs and are needed to compute program impacts. An expanded definition of participation can include the share of commuters who take actions with commute information they are provided, for example, contacting other commuters on a matchlist or asking an employer for permission to telework.

Satisfaction measures commuters' satisfaction with various features of TDM services and the efficiency of service delivery, for example, the speed with which requests are fulfilled and users' impression of the usefulness of the services. These measures are not necessarily correlated to participation or travel change but are important to determine future staffing and funding needs, increase commuter referrals, and identify program improvements.

- ***Program Participation*** – Program participation will be assessed by the number of clients or customers who request individual Commuter Connections TDM program services and the number who are assisted. Participation could include the numbers of new employer who participate in Employer Outreach services, new and re-registering GRH applicants, online TDM information system users, telework employer sites, etc. A primary participation measure is generally the *number of applicants or users*, but other measures, specific to individual TDM program elements, also are described in Section 4. These measures are typically tracked through internal databases by Commuter Connections staff who administer each TDM program element.
- ***Program and Service Satisfaction*** – A primarily qualitative set of performance measures is suggested to assess client satisfaction and determine how well services are meeting customers' needs and expectations. Satisfaction of various customer groups is examined through questions in user surveys (e.g., GRH survey, applicant placement survey, employer satisfaction survey).

Mode Utilization and Influence

Utilization refers to new and expanded use of alternative modes motivated by use of TDM program element services, for example, the percentage of GRH registrants who shift from driving alone to an alternative mode to be eligible for GRH. Data on mode shifts is assessed through user surveys that document current mode use and modes used before receiving TDM services.

- ***Alternative Mode Placements*** – The measure of "placements" is defined as the number of commuters who shift to (i.e., are "placed" in) alternative mode arrangements following use of the Commuter Connections services. These commuters could be new carpoolers, vanpoolers, transit riders, bicyclists/walkers, or teleworkers, as well as commuters who increase use of these modes.

Influence measures examine the role that TDM program elements play in motivating behavior changes, relative to other factors that influenced the changes. Influence is typically assessed through user surveys, which ask service users who made a travel change what motivated the change, how or how much the service assisted or influenced the change, and how likely they would have been to make the same change if the service was not available.

Program Impacts

Program impacts reflect the travel, air quality, energy, and commuter cost saving benefits of the TDM program elements. The impact measures and targets set for 2020 were established by Commuter Connections following the 2017 TDM analysis and remain at the same levels for the 2023 TDM analysis. They reflect both past trends and proposed future resources and efforts by Commuter Connections and program partner staffs. This section describes several performance measures to be assessed for each element and for the program as a whole. Other performance measures specific to each element are listed in Section 4. Impact measure goals also are detailed for each element in Section 4.

- ***Vehicle Trips Reduced*** – The number of vehicle trips reduced is a travel impact measure. It defines the number of daily vehicle trips that alternative mode placements remove from the road during their commutes. This is a primary indicator of congestion relief through reduction in travel delay, increase in travel speed, reduction in travel time, and improvement of roadway service levels. In essence, trip reduction equates to a roadway capacity increase, by freeing up roadway space for additional vehicles. It also is a primary input (trip end emissions) to the air quality analysis.

  Vehicle trip reduction is computed using a *vehicle trip reduction (VTR) factor*, defined as the average number of vehicle trips reduced per day by an alternative mode placement. The VTR factor accounts for shifts from drive alone to alternative modes, shifts among alternative modes (e.g., from carpool to vanpool and from transit to carpool), increases in the days per week that a commuter uses an alternative mode, and changes in carpool and vanpool occupancy. Shifts from alternative modes to drive alone are not included, because these changes are not motivated by commuters' contact with Commuter Connections. Appendix A presents an example of the calculation of VTR factor.

- ***Vehicle Miles of Travel (VMT) Reduced*** – VMT reduced, a second travel impact measure, assesses the total daily miles of vehicle travel removed by mode shifts. VMT reduction is important to the air quality and energy evaluation, but also is relevant to any assessments of the roadway system performance impacts.

- ***Emissions Reduced*** – Emissions reduced measures the decrease in mobile source emissions resulting from reductions in vehicle trips or VMT. From the start of the TDM evaluations, the primary pollutants of concern were Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), both of which are ozone precursors. Emissions for these two pollutants will be assessed in the 2023 evaluation. The 2008 TDM Analysis added calculation of impacts for particulate matter (PM) and for Carbon Dioxide (CO2), the primary greenhouse gas. Carbon Dioxide/Greenhouse gas emissions also will be assessed in the 2023 evaluation, but PM emissions will not be calculated in 2023 because the MWCOG region is in attainment for these pollutants. Thus, reductions in the pollutants are no longer relevant for the regional conformity analysis.

- ***Energy Saving*** – Energy saving, resulting when commuters reduce VMT, is defined as the reduction in the number of gallons of gasoline consumed.

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

Societal Benefit Cost Savings

An analysis component added to the 2017 and 2020 TDM analyses was calculation of the societal benefit cost savings generated by Commuter Connections TDM program vehicle trip and VMT impacts. The benefits include cost savings for reductions in air pollution, greenhouse gases, and noise pollution, reduced hours of travel delay, gallons of fuel saved, and reduced vehicle crashes.

The 2020 analysis, which is summarized in Appendix J, applies benefit "unit conversion" and unit cost multipliers to translate VMT reduction impacts into units of benefits and daily cost savings for each benefit and for all societal benefits combined. For most benefits, the method used to derive the units of benefit and the unit cost factors were obtained from the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS™) model developed by the Center for Urban Transportation Research (CUTR). The societal benefits cost savings calculation also will be prepared for the 2023 TDM Analysis.

Future Review and Updates to Performance Measures

The impact measures described above were developed primarily to report the performance of TDM program elements as compared with regional goals set for them by COG's National Capital Region Transportation Planning Board (TPB) for air quality conformity determination. In 2015, air quality data compiled by COG indicated that the region was meeting federal standards for ground-level ozone and PM2.5 fine particulate matter. With this achievement, the TPB eliminated the conformity-related emission targets set for the Commuter Connections TDM program elements.

Visualize 2045 Aspirational Initiatives

1. Bring jobs and housing closer together
2. Expand bus rapid transit regionwide
3. Move more people on Metrorail
4. Increase TW and other options for commuting
5. Expand express highway network
6. Improve walk/bike access to transit
7. Complete National Capital Trail

This administrative change did not eliminate, however, COG's commitment to TDM strategies. The November 2016 conformity analysis referenced the continued role of the Commuter Connections TDM strategies to the region; the Chair of COG's Air Quality Committee wrote, "We urge TPB's continued investment in … travel demand management strategies to continue to mitigate future growth in vehicle emissions."[12]

In the *Visualize 2045* long-range transportation plan approved in October 2018, the TPB reiterated the important regional role of the Commuter Connections program and of the transportation options that Commuter Connections promotes and encourages. The report stated that "Commuter Connections is the major demand management component of the TPB's congestion management process and it helps support regional air quality goals" and noted that one goal in the *2014 Regional Transportation Priorities Plan (RTPP)* was to "provide a comprehensive range of transportation options," which would be expected to help "protect and enhance the environment, promote energy conservation, and improve quality of life."[13] Further, the *Visualize 2045* plan, which includes aspirational initiatives that go beyond fiscal constraints, spelled out a "call to action" for policies, programs, and projects that "better manage peak

[12] Metropolitan Washington Council of Governments. Air Quality Conformity Analysis of the 2016 CLRP Amendments and FY2017-2022 TIP, November 2016. http://www1.mwcog.org/clrp/resources/2016/ConformityReportFull.pdf

[13] National Capital Region Transportation Planning Board. Visualize 2045: A Long-Range Transportation Plan for the National Capital Region, October 17, 2018, page 89-90.

period travel demand, reduce single occupant travel, make transit more viable and affordable, and enhance existing infrastructure.[14]

The regional planning documents cited above suggest that while the regulatory focus on Commuter Connections TDM program impacts has lessened, the specific performance measures established for the TDM program elements remain as valid as when they were initially set. But the TDM program elements do offer other benefits to the Washington region, in the societal objectives noted above. Documenting and communicating the type and magnitude of these benefits will demonstrate the broad value of Commuter Connections programs to the community and reinforce the value of program investments.

Documenting these contributions also will support the regional response to the federally-mandated, Performance-based planning and programming (PBPP) process required of states and MPOs.[15] Under this requirement, MWCOG must track a variety of performance indicators related to transportation system performance. Two indicators of particular relevance for Commuter Connections include annual per capital hours of peak hour excessive roadway delay and percent of non-single occupant vehicle travel. Commuter Connections already will continue to address these indicators through various data collection and analysis activities in the TDM evaluation as part of the 2018-2020 evaluation. The team will identify ways that Commuter Connections can provide useful data to support MWCOG's regional response.

Two indicators of particular relevance for Commuter Connections include annual per capital hours of peak hour excessive roadway delay and percent of non-single occupant vehicle travel. Commuter Connections already will continue to address these indicators through various data collection and analysis activities in the TDM evaluation as part of the 2018-2020 evaluation. The team will identify ways that Commuter Connections can provide useful data to support MWCOG's regional response.

The SOC and user surveys conducted throughout the evaluation period offer immediate opportunities for Commuter Connections to collect data related to system performance and other regional, societal benefits of TDM programs as well as data on other emerging transportation issues. For example, the 2013 and 2016 SOC and GRH surveys included questions about the primary roadways that commuters used for their trip to work and the time they typically arrive at work. The 2016 SOC survey also included questions to explore how residents' perceptions of transportation satisfaction are related to the availability and quality of transportation services. The 2019 SOC survey is expected to retain many of these questions and add new inquiries on the role of technology in influencing commute mode choice, commuters' use of transportation network companies and shared-mode transportation services, current and past use of transit service for commuting, and other issues related to transportation system performance.

[14] Ibid, page 34.

[15] Federal Register, Vol. 81, No. 103, Friday, May 27, 2016, page 34051, Section B.1.

Section 4 Evaluation of Individual TDM Program Elements

Sections 2 and 3 stated the objectives and issues guiding the evaluation process and presented several common performance measures that will be used for all TDM program elements. This section details the specific evaluation approach for each of the TDM program elements.

The TDM program elements included are:

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

For each element, the following information is provided:

- TDM program element description
- Evaluation methodology changes since FY 2018-FY 2020
- Goals established for the element for 2023
- Nature of the evaluation
- Performance measures recommended for the element
- Data needed to estimate impacts and recommended data sources

Section 5 of this report provides a more detailed description of the surveys and other data sources referenced in this section. Section 8 presents a schedule for the collection of data and defines the party responsible for collecting the data. Included in the appendices are examples of how travel and emission impacts are calculated for each TDM program element. These are excerpted from the 2020 TDM Analysis Report to provide real examples of how the calculations were performed in the most recent evaluation period. These calculation methods form the basis for the refinements included in this evaluation framework.

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

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

4-A Maryland and Virginia Telework Assistance

Program Description

The Maryland and Virginia Telework Assistance program element is comprised of resources to help employers, commuters, and program partners initiate and expand telework programs. This program element has two components, one focused on telework among Maryland employers and commuters and a second for the Telework!VA program in Virginia.

- In the Maryland component, Commuter Connections, working with numerous partners in Maryland, assists employers to establish worksite telework programs and arrangements and provides telework information to individual commuters. This component estimates the impact of telework among commuters who work or live in Maryland that is attributable to Commuter Connections' telework assistance.
- The Virginia component of the element encompasses impacts of the Telework!VA (TWVA) program offered to employer worksites in Virginia. The program, jointly funded and administered by the Virginia Departments of Rail and Public Transportation (DRPT) and Transportation (VDOT), provides financial incentives and program development assistance to participating Virginia employers to establish and expand worksite telework programs.

The evaluation will count Commuter Connections-assisted telework not described above through either the Employer Outreach TDM program element or the Commuter Operations Center.[16] Appendix C details the assignment of Commuter Connections assisted telework to these other program elements.

Evaluation Methodology Changes Since FY 2021 – FY 2023

- No changes since 2018-2020

Stated Goals

The purpose of the Telework program element is to increase the number of full-time or part-time home-based and telework center-based teleworkers.

[16] The Telework program element includes all Maryland residents, regardless of their work location, residents of the District of Columbia and Virginia who work in Maryland, and District of Columbia and Virginia residents who work at a TWVA-participating worksite. Commuter Connections also provides telework information to commuters who live and/or work outside Maryland and who work for employers that do not participate in TW!VA; impacts of this assistance are included in the Commuter Operations Center impacts.

Commuter Connections established five goals for the ***Maryland portion*** of this element for 2023:

- Maintain 31,854 teleworkers
- Reduce 11,830 daily vehicle trips
- Reduce 241,209 daily miles of travel
- Reduce 0.122 daily tons of NOx
- Reduce 0.072 daily tons of VOC

The goals for the ***TWVA portion*** of this element were established by the Virginia Department of Transportation and the Virginia Department of Rail and Public Transportation:

- Increase telework by 1,500 teleworkers at TWVA worksites
- Reduce 500 daily vehicle trips
- Reduce 9,000 daily miles of travel
- Reduce 0.0027 daily tons of NOx
- Reduce 0.0021 daily tons of VOC

Nature of Evaluation

The three populations of interest for this element include:

1 (Maryland) – Teleworkers who live and/or work in Maryland who are influenced by Telework services/assistance they receive from Commuter Connections/MWCOG to begin teleworking
2 (Maryland) – Telework employees at Maryland worksites that are assisted by Commuter Connections
3 (Virginia) – Telework employees at Virginia worksites that participate in the Telework!VA program

1 (Maryland) – For the first population, the evaluation determines the number of teleworkers who live or work in Maryland who were influenced or assisted by the Telework program element services to begin teleworking and the travel impacts of their teleworking. Data for this component come from the State of the Commute survey:

- Number of Maryland teleworkers and their frequency of teleworking
- Telework locations – the mix between home-based and non-home-based telework
- Teleworkers' commute modes and commute distance on non-telework days
- Teleworkers' travel patterns to telework locations outside the home
- Sources of information teleworkers had used to learn about telework

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

2 (Maryland) – For the second population, the evaluation defines the portion of teleworking influenced by the Telework program element through telework assistance to Maryland employers. This analysis uses data from a survey of telework-assisted Maryland employers to determine:

- Percentage of Maryland employers with telework programs before and after receiving telework assistance
- Percentage of teleworkers at assisted Maryland worksites before and after the employer received assistance

To calculate the share of Maryland-based telework attributable to the Telework program element, the evaluation will define the telework universe among Maryland commuters, and examine employers' and

commuters' sources of information for telework and the value of that information or assistance in their starting or expanding telework programs.

3 (Virginia) – The evaluation for the third population is similar to that for the second population; the evaluation estimates the portion of teleworking influenced by direct TWVA assistance to participating Virginia employers. This analysis compares data from baseline and follow-up surveys of teleworkers at TWVA-assisted worksites to determine the percentage of teleworkers at assisted sites before and after telework assistance is provided. The comparison of the before and after survey data will reflect the increase in telework resulting from TWVA assistance.

Performance Measures

Performance measures recommended to evaluate the Maryland and Virginia Telework Assistance program element include:

Maryland Component – Participation, Satisfaction, and Utilization Measures:

- Number of Maryland employers that receive telework assistance from Commuter Connections
- Number of Maryland employers that implement/expand telework programs after receiving assistance
- Number of Maryland commuters who receive telework information from Commuter Connections
- Number of Maryland commuters who begin teleworking after receiving assistance – home-based and non-home based
- Maryland telework placement rate
- Average weekly frequency of teleworking

Virginia Component – Participation, Satisfaction, and Utilization Measures:

- Number of Virginia employers that receive telework assistance through TWVA
- Number of commuters at TWVA worksites who begin teleworking after TWVA assistance is provided
- Number of new home-based TWVA teleworkers
- TWVA placement rate
- Average weekly frequency of teleworking

Program Impact Measures (Maryland and Virginia):

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to assess impacts of this program element. Each data source is described in Section 5.

Maryland Component	
Data Need	*Data Source*
• Home-based teleworkers	State of the Commute (SOC) survey
• Non-home-based teleworkers	SOC survey
• Telework frequency (average 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
• Telework at assisted employers' worksites	MD-TW assistance survey

Virginia Component/TWVA	
Data Need	*Data Source*
• Home-based teleworkers (before/since assistance)	TWVA baseline/follow-up surveys
• Telework frequency (average days/week)	TWVA baseline/follow-up surveys
• Percent drive-alone on non-telework days	TWVA baseline/follow-up surveys
• Travel distance on non-telework days	TWVA baseline/follow-up surveys

Proposed timing of data collection:

- SOC survey – January-April 2022
- Commuter Connections Telework assistance survey – Early 2023
- TWVA baseline surveys – ongoing through February 2023
- TWVA follow-up surveys – ongoing through February 2023

To avoid double counting benefits, the employers included in the Maryland and Virginia Telework Assistance program element will be cross-referenced against employers that participate in the Employer Outreach program element. The telework impacts for any employers that participate in both programs will be subtracted from their impacts in the Employer Outreach program element, but non-telework impacts for these employers will continue to be included in Employer Outreach.

4-B Guaranteed Ride Home

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.

Evaluation Methodology Changes Since FY 2018 – FY 2020

- No changes since 2018-2020

Stated Goals

Commuter Connections established the following regional goals for ***GRH*** for 2023:

- Maintain 18,496 GRH applicants
- Reduce 6,296 daily vehicle trips
- Reduce 177,568 daily vehicle miles of travel
- Reduce 0.089 daily tons of NOx
- Reduce 0.048 daily tons of VOC

Nature of Evaluation

GRH is intended to encourage drive-alone commuters to shift to alternative modes. Additionally, GRH is expected to help maintain existing alternative mode arrangements and increase frequency of alternative mode use. The evaluation estimates 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 increase use of the modes.

The GRH program element evaluation for 2021-2023 will determine impacts for three commuter groups:

- Commuters who were registered for/participating in GRH at any time during the three-year evaluation period, even if they were no longer registered at the end of the period
- Commuters who did not register for GRH but took a "one-time exception" trip during the three-year evaluation period
- Commuters who participated in GRH prior to the evaluation period, but who are continuing to use alternative modes

Performance Measures

The following performance measures are used for GRH:

Participation, Satisfaction, and Utilization Measures:

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

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

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

Data Need	*Data Source*
• GRH applicants	GRH database/archived GRH database
• One-time GRH exception users	GRH database/archived GRH database
• GRH placement rate	GRH Applicant survey
• GRH VTR factor	GRH Applicant survey
• Average travel distance (trip length)	GRH Applicant survey
• GRH retained placement rate	CC Retention Rate survey
• GRH retained VTR Factor and average travel distance	CC Retention Rate survey

Proposed timing of data collection:

- Commuter Connections GRH database – ongoing
- CC Retention Rate survey – February 2021 (next survey scheduled for FY 2026)
- GRH Applicant survey – April-May 2022
- GRH Trip Customer Satisfaction Survey – ongoing

Two subgroups are identified for GRH. The first sub-group includes participants who both live and work in any of the 15 jurisdictions in the Washington, DC-MD-VA ozone National Ambient Air Quality Standard (NAAQS) nonattainment area (NAA).[17] The second population includes participants who work in the NAA but live outside it. Placement rates, VTR factors (average trips reduced per placement), and travel distances will be derived for each of the two sub-groups ("Within NAA" and "Outside NAA"). This distinction is made because applicants who live outside the NAA travel a portion of their VMT outside the NAA. The average VMT for "Outside NAA" applicants will be discounted to include only the portion of the VMT reduction that occurs within the NAA.

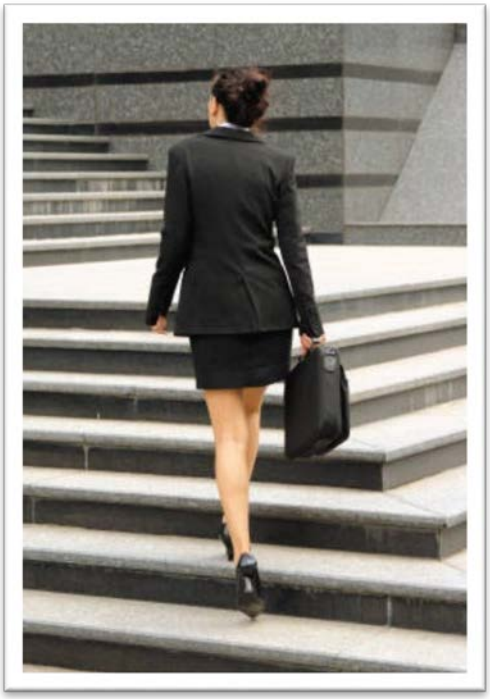
[17] The 15 jurisdictions included in the Washington, DC-MD-VA NAAQS nonattainment area (NAA) are: District of Columbia, Calvert County (MD), Charles County (MD), Frederick County (MD), Montgomery County (MD), Prince George's County (MD), Arlington County (VA), Fairfax County (VA), Loudoun County (VA), Prince William County (VA), City of Alexandria (VA), City of Fairfax (VA), City of Falls Church (VA), City of Manassas (VA), and City of Manassas Park (VA).

The GRH analysis also includes steps to avoid credit double-counting from overlap with two other TDM program elements. Overlap occurs between GRH and the Commuter Operations Center because some GRH applicants also obtain ridematch lists, transit information, or other commute assistance information. The COC impacts are discounted to account for this overlap. GRH results also will be adjusted to assign a portion of the GRH impacts to the Mass Marketing program element to recognize that some GRH applicants will be influenced to apply for GRH by hearing a Mass Marketing advertisement.

4-C Employer Outreach

Program Description

The Employer Outreach program element is designed to encourage employers to implement new commute assistance programs and to expand the services they offer in existing programs. In this element, 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:



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

Evaluation Methodology Changes Since FY 2018 – FY 2020

- No changes currently defined, however, the research team is reviewing predictive models as possible substitutes for the COMMUTER Model to calculate vehicle trips and VMT reduction. If a new tool appears more accurate than the COMMUTER Model, with similar ease and capabilities, it will replace the COMMUTER Model for the 2023 analysis.

Stated Goals

Commuter Connections has set the following regional participation an impact goals for ***Employer Outreach*** for 2023:

Participation Goals

- Overall – 2,031 total participating employers
- Employers with bike services[18] – 590 participating employers
- Employers without bike services – 1,441 participating employers

Impact Goals – Employer Outreach Overall (Non-bicycle plus Bicycle services)

- Reduce 90,776 daily vehicle trips
- Reduce 1,533,161 daily vehicle miles of travel
- Reduce 0.617 daily tons of NOx
- Reduce 0.385 daily tons of VOC

[18] Bike services include bike lockers, racks, or other storage; showers/personal lockers for bicyclists use; financial incentives for bicyclists, provision of free or discounted bikeshare memberships; sponsorship of bikeshare stations; and commuter rider support services such as bike "buddies" and assistance finding safe bike commute routes.

Impact Goals – Employer Outreach Non-bicycle services

- Reduce 90,372 daily vehicle trips
- Reduce 1,530,740 daily vehicle miles of travel
- Reduce 0.6154 daily tons of NOx
- Reduce 0.3835 daily tons of VOC

Impact Goals – Employer Outreach for Bicycling

- Reduce 404 daily vehicle trips
- Reduce 2,421 daily vehicle miles of travel
- Reduce 0.0016 daily tons of NOx
- Reduce 0.0015 daily tons of VOC

Nature of Evaluation

Employer Outreach is aimed at increasing the number of private employers implementing worksite commuter assistance programs, but Employer Outreach is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes.

Two primary evaluation questions are thus important. First, how many employers start or expand commuter assistance programs? And second, how many employees use alternative modes in response to new employer-sponsored services at the worksite? The populations of interest for this element are:

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

Differentiating New and Maintained Impacts – When the Employer Outreach program element was adopted, the TPB established a goal that was to be achieved by June 2005 and evaluations conducted through June 2005 compared impacts against this goal. Beginning with the 2008 Analysis, the Employer Outreach goals 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, 2011, 2014, 2017, and 2020 TDM analyses created two categories of Employer Outreach impacts: "maintained" impacts and "new/expanded" impacts.

In 2018, the Employer Outreach goals were again re-set, to reflect the 2017 impacts as a new starting point, again with goals for maintained and new/expanded impacts. These goals have been continued into the 2021-2023 evaluation cycle. For the 2023 analysis, maintained impacts will include those from employers that joined EO before July 1, 2020, the start of the 2021-2023 evaluation period and made no changes since that date. These impacts are considered part of the 2021-2023 baseline for EO. New impacts will include those from employers that joined the EO program after June 30, 2020. Expanded impacts will include those for employers that were involved in EO before the start of the evaluation period but expanded their commute services since June 30, 2020. Additionally, impacts from program reductions will be "back-filled" from new or expanded programs.

Apply Batch Methodology for COMMUTER Model (v2.0) Runs – The TDM analysis runs the COMMUTER Model (v2.0) in a batch format that allows each employer's program to be modeled separately and that calculates trip reduction for each employer individually. This method will enable Commuter Connections to determine individual employers' contributions to the impacts, should Commuter Connections or local jurisdictions choose to do so.

Employer Outreach for Bicycling – In the 2002 and 2005 TDM evaluations, bicycle programs offered by employers were evaluated separately from other Employer Outreach services under the Employer Outreach for Bicycling (EOB) program element. EOB was later incorporated into the overall EO element and will be addressed similarly in the 2023 evaluation. However, the contribution of these bicycle programs to the overall EO impact will continue to be measured and reported separately. The Employer Outreach for Bicycling component also will include employers' support for bikesharing programs, particularly for employers that offer Bikeshare Corporate accounts to employees.

Performance Measures:

The following performance measures are recommended for Employer Outreach:

Participation, Satisfaction, and Utilization Measures:

- Number of employer clients (employers with commuter assistance programs and employers with bicycle programs) – total and new/expanded
- Number of employees at client worksites (worksites with commuter assistance programs and bicycle programs) – total and new/expanded
- 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:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

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

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

Proposed timing of data collection

- ACT! database – ongoing
- Employee baseline surveys – ongoing; data to be compiled in Fall 2022
- SOC survey – January-April 2022

Use of COMMUTER Model as an Analysis Tool

The Employer Outreach program element is the only TDM program element for which placement rates and VTR factors are not directly used to determine the number of new participants, vehicle trips reduced, or VMT reduced. This is because sufficient employee survey data are not available to assess employees' post-program travel behavior. These missing evaluation elements are modeled using the EPA COMMUTER Model (v2.0). To determine impacts, employers' starting mode shares and commuter assistance program strategies are input into the COMMUTER Model (v2.0) and the model projects "after" mode split and average vehicle ridership, that is, with the program in place. The TDM analysis used this model in past evaluations.

Consistency of the COMMUTER Model with MWCOG Regional Model – The COMMUTER Model uses time and cost coefficients that are compatible with coefficients used by MWCOG in regional transportation modeling. In 2007, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. During 2010-2012, MWCOG developed a new regional travel model used for regional transportation planning and forecasting. To ensure that the COMMUTER Model was consistent with the new regional model, MWCOG modeling staff reviewed the COMMUTER Model cost and time coefficients that had been used in the 2011 evaluation. They concluded that no further coefficient adjustments were needed for the 2014 or 2017 TDM analyses to be consistent with the new regional model.

MWCOG continues to use this regional model and to add updates as the model evolves. In 2020, the research team reviewed regional model guidance documents prepared by MWCOG to determine if any regional model updates might indicate a needed change in the COMMUTER model coefficients to remain compatible with the regional approach. The review identified numerous model modifications, but none that would affect the validity of the current coefficients for the COMMUTER Model. Most changes were affected the efficiency and speed of model operation, rather than the model results. The few changes that altered the model results primarily adjusted assumptions related to bike and walk access to transit in suburban areas. As these changes were not cost related, the research team concluded that no additional COMMUTER model adjustments were needed for the 2020 evaluation.

Review of Other Possible Models for Employer Outreach Analysis – In 2020, the research team examined several other models to determine if any other options would be as reliable and efficient as the COMMUTER model for the Employer Outreach analysis. This review found that none of the alternative models offered both the capability to analyze the wide range of TDM strategy combinations that were implemented by EO employers as well as the capability to analyze efficiently impacts for individual employers. The research team previously developed a technique to run the COMMUTER model for large numbers of individual employers in "batch" mode, allowing an independent impact analysis for each employer, in a highly efficient process. Without this capability, it would be cumbersome to analyze the large number of employers in the EO analysis. Thus, the project team used the COMMUTER Model for the FY 2017 – FY 2020 EO calculation, with the revised coefficients referenced above. The team is currently expanding this review. If a new tool appears likely to be more accurate than the COMMUTER Model, with similar ease and capabilities, it will replace the COMMUTER Model for the 2023 analysis.

Adjust Default Baseline Mode Splits – One required input for the COMMUTER Model analysis is the baseline "pre-commute program" mode split. If a worksite has conducted a survey, the actual mode split from that survey will be the baseline for that worksite, regardless of when the survey was conducted. This has been the protocol for the calculation from the start of the evaluation framework and will not

change. Many employers in the ACT! Database have not conducted an employee survey, however, and a proxy or default baseline mode split must be defined for these employers.

Default baseline mode splits will be calculated following the method used in the 2020 analysis, as the average of mode splits of worksites in the ACT! database that have conducted baseline surveys. Worksites will be aggregated into six groups by the primary work type (office or non-office) and the transit service level (low, moderate, or high) in the area around the worksite. For each of the six combinations of these two variables, for example, non-office employers with high transit or office employers with moderate transit, an average mode split will be derived from the survey data of worksites that had conducted commuter surveys.

In evaluations prior to 2020, the default baseline mode splits were derived from all employee surveys conducted since 1997. Because the commuting environment has changed markedly since that time, the baseline mode splits for new employers could be expected to be different from those of employers that joined Employer Services many years earlier. Thus, in the 2020 evaluation, the default mode splits for worksites that have not conducted an employee commute survey were based on the averages of employee surveys conducted in 2006 or later. The 2023 evaluation will follow this protocol.

4-D Mass Marketing

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, television, social media, direct mail, transit advertising, 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.

Four other marketing-related programs and events have been added to the evaluation of this program element since it was first implemented:

- Bike to Work Day – FY 2005-08 evaluation
- 'Pool Rewards carpool incentive program – FY 2008-11 evaluation
- Car-Free Day event – FY 2012-14 evaluation
- 'Pool Rewards vanpool incentive program -FY 2015-2017 evaluation

The objectives of the Mass Marketing program element are to:

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

Evaluation Methodology Changes Since FY 2018 – FY 2020

- Revise methodology for incentive component (IncenTrip mobile application, Flextime Rewards incentive, and CarpoolNow mobile application) to use impact multipliers derived from the Commuter Connection Online Placement Survey.

Stated Goals

Commuter Connections has established the following regional goals for ***Mass Marketing*** for2023:

- Encourage 23,168 commuters to switch modes
- Reduce 10,809 daily vehicle trips
- Reduce 181,932 daily vehicle miles of travel
- Reduce 0.085 daily tons of NOx
- Reduce 0.025 daily tons of VOC

Nature of Evaluation

The Mass Marketing program element has numerous populations of interest:

1) All commuters in the Commuter Connections air quality non-attainment 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 regional special events (e.g., Bike-to-Work Day, Car Free Day)
4) Commuters who participate in Commuter Connections incentive programs ('Pool Rewards carpool/vanpool incentive program, Flextime Rewards incentive program, and/or incenTrip rewards mobile application)
5) Commuters who register with the CarpoolNow dynamic ridematch mobile application

The Mass Marketing element presents two challenges not encountered in most of the other program elements. First, it is more difficult to assess the influence of a strategy, such as a marketing campaign, that is applied to the general commuting public, than it is to identify and track known participants in a registration-based program such as GRH. Second, when commuters who changed travel behavior can be identified, it is still necessary to identify what motivated their change. The critical issue for this element is attributing changes in attitudes and behavior – to the mass marketing campaign, another program element, or to some other outside influence.

Type of Changes Addressed – The Mass Marketing evaluation method examines impacts from several components, which are assessed separately in five categories of changes.

1 – *"Directly influenced"* changes – These are mode shifts that are made when Mass Marketing ads directly 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 recent mode changes 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 determine the incidence of mode shifting in the region and the motivation for the shift. If a mode shift is attributed to a Mass Marketing campaign message, the associated vehicle trip, VMT, and emissions reductions can be credited to the campaign. Note that this calculation needs to correct for double counting with commuters who also cite influence of other program elements on their travel change.

2 – "R*eferred"* changes – These are mode shifts that occur when a commuter is influenced by an ad to contact Commuter Connections, such as when a commuter hears a radio ad for GRH and registers for the program. Under the evaluation method, any mode change the commuter makes in response to GRH would be defined through the GRH assessment, but a portion of the influence for that change would be credited to Mass Marketing, which provided the information about GRH.

Referred influences are best assessed by tracking changes in the volume of GRH and Commuter Operations Center information and services requests. A comparison of the volumes of requests received during periods of media activity to periods without media activity can provide a likely change in requests as a result of the ads. A pro-rated share of the impacts of these other program element impacts then can be assigned to Mass Marketing.

3 – "S*pecial event*" changes – These are changes such as would occur following a Bike to Work Day or Car Free Day event. Special events are typically short-term. For example, both Bike to Work Day and Car Free Day are one-day events. But the influence of these events can be ongoing; their purpose is to introduce commuters to a new travel option, with the goal that some will continue using the new mode after the event or benefit period ends. Impacts for events will be calculated using data from post-event participant surveys that identify changes in commuters' travel during the event, but also ongoing use of the mode in the months after the event.

4 – "*Incentive program*" changes – These are generated from commuters' participation in programs such as the 'Pool Rewards, Flextime Rewards, and/or incenTrip incentive programs. Incentive programs offer a financial motivation to switch to an alternative mode. Some incentives provide the benefit for a short-term, start-up period; 'Pool Rewards offers incentives to new carpoolers for a 3-month enrollment period. Others, such as 'Pool Rewards for vanpools, provide an on-going monthly incentive. Flextime Rewards offers an incentive to registered commuters who travel to/from work outside the peak commuting period on days when traffic is disrupted by an accident or other roadway incident. incenTrip provides incentives for using and logging alternative mode commute trips. As with special event programs, incentive program can encourage both short-term and long-term impacts, if commuters continue using the new mode after the benefit period ends.

Impacts for the carpool component of the 'Pool Rewards incentive will be calculated using data from a post-enrollment participant survey that identify changes in commuters' travel during the program and ongoing use of the mode in the months after the incentive period. Impacts for the vanpool component of 'Pool Rewards will be estimated using pre-vanpool mode information provided in program applications and trip information provided through vanpool logs.

Impacts for the Flextime Rewards and incenTrip incentives will be estimated using multiplier factors derived from the applicant placement survey. New modules were added to the November 2020 survey to examine use of the programs and commute mode changes of registered users. The Flextime Rewards program applies only to commute trips, so all trips made under this program could be included in the TDM analysis. Trips made using IncenTrip can be for commute and/or non-commute purposes, thus, the applicant placement survey module for this program examined frequency of program use for both trip purposes and the impact multiplier factors derived for IncenTrip will include only commute trip impacts.

5 – "*Dynamic ridematch*" changes – This component includes impacts from the CarpoolNow mobile application. In this application, registered users can request a ride (participate as a passenger) or a rider (participate as a driver) for a one-time carpool arrangement. Because each request is for a single trip, the impact of a commuter's participation could be limited. However, as with events and incentives, the influence of the service could be ongoing either by repeated use of the service or by encouraging commuters to seek more permanent carpool arrangements with commuters they meet through the service. The component also includes a driver financial incentive to encourage more commuters to offer rides.

The impacts for this service will be analyzed using data from the 2020 applicant placement survey. In the CarpoolNow module, registered users were asked about frequency of use of the service for commuting and non-commuting, successful one-time carpool trips formation, and formation of ongoing carpools for commuting.

Performance Measures

The following performance measures are proposed for the Mass Marketing program element:

Direct/Referred Impacts – Participation, Satisfaction, and Utilization 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)
- 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)

Special Events – Participation, Satisfaction, and Utilization Measures:

- Number of riders participating in Bike to Work
- Participants' frequency of bike commuting before and after the Bike to Work Day event
- Number of commuters participating in Car Free Day
- Participants' frequency of alternative mode use before and after Car Free Day
- Commuters' satisfaction with events – Bike to Work Day, Car Free Day

Incentive Programs – Participation, Satisfaction, and Utilization Measures:

- Number of commuters participating in 'Pool Rewards
- Participants' frequency of alternative mode use before, during, and after 'Pool Rewards
- Number of commuters participating in Flextime Rewards
- Participants' frequency of peak period travel before and during Flextime Rewards and share of trips with time shifts, mode shifts, and trip elimination (telework)
- Number of commuters participating in incenTrip
- Participants' frequency of alternative mode use before and during incenTrip enrollment
- Share of incenTrip trips made for commute vs non-commute
- Commuters' satisfaction with incentive programs – 'Pool Rewards, Flextime Rewards, incenTrip

Dynamic Ridematch Programs – Participation, Satisfaction, and Utilization Measures:

- Number of commuters participating in CarpoolNow
- Participants' frequency of carpool use before and during CarpoolNow enrollment
- Share of new carpool trips made for commuting
- Commuters' satisfaction with incentive programs – 'Pool Rewards, Flextime Rewards, incenTrip

Program Impact Measures (all components):

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

Advertising Campaign	
Data Needs	*Data Source*
• Regional commuters aware of ads / messages	SOC survey
• Percentage of commuters who make alternative mode changes after ads	SOC survey
• Influence of ads on mode change	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 CC Online Placement Survey

Bike to Work Day (BTWD)	
Data Needs	*Data Source*
• Number of BTWD participants	BTWD survey
• Bike use before, during, and after event	BTWD survey
• Average travel distance	BTWD survey

Car Free Day (CFD)	
Data Needs	*Data Source*
• Number of CFD participants	CFD database
• Alternative mode use before, during, and after event	CFD database
• Average travel distance	CFD database or SOC survey

'Pool Rewards	
Data Needs	*Data Source*
• Number of carpool/vanpool 'PR participants	'PR database
• Carpool use before, during, and after enrollment	'PR database and 'PR survey
• Vanpool use before and during enrollment	'PR log database
• Average travel distance, carpool/vanpool	'PR database

Flextime Rewards (FR)	
Data Needs	*Data Source*
• Number of FR participants	Flextime Rewards database
• Peak period trips adjusted	CC Online Placement Survey
• Average travel distance	CC Online Placement Survey

incenTrip (IT)	
Data Needs	*Data Source*
• Number of IT participants	incenTrip database
• Non-SOV modes for commuting before/after use	CC Online Placement survey
• Average travel distance	CC Online Placement survey
• IT share of commute trips	CC Online Placement survey

CarpoolNow (CPN)	
Data Needs	*Data Source*
• Number of CPN participants	CarpoolNow database
• Carpool use before and since enrollment	CC Online Placement survey
• Average travel distance	CC Online Placement survey
• CPN share of commute trips	CC Online Placement survey

Proposed timing of data collection

- SOC survey – January-April 2022
- CC Online Placement survey – November 2020 (next survey scheduled for November 2023)
- GRH Applicant survey – April-May 2022
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2022
- 'Pool Rewards program mode use – Ongoing
- Car Free Day event feedback – November 2022
- Flextime Rewards service use – Ongoing
- incenTrip service use – Ongoing
- CarpoolNow service use – Ongoing

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

4-E Commuter Operations Center

Program Description

Since 1974, COG has offered basic commute information and assistance, such as regional ridematching database, to commuters living and/or working in the Washington metropolitan region. Prior to 1997, when Commuter Connections was established, these services were provided by COG's RideFinders program. Because these services were available when the other TDM program elements were developed, the Center was designated as an ongoing program. It is also part of the region's congestion management process.

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.

Basic Commuter Operations Center Services – 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 route and walking information. Commuters obtain services and information primarily through the Commuter Connections website, but also can call a toll-free telephone number or contact a local partner assistance program for personal assistance from a commuter services representative.

Integrated Rideshare-Software Upgrades – Included within the Commuter Operations Center program is the Integrated Rideshare-Software Upgrades Project. When it began, Integrated Rideshare provided improvements to the quality and delivery of alternative mode information. In particular, Commuter Connections added transit, park and ride, telecenter/co-working center, and bicycling information to carpool/vanpool ridematch lists to inform commuters of the range of travel options that were available. Since 2008, when Commuter Connections introduced its updated web-based TDM system, these additional services have been available on a self-service basis through the online information system. These services represent upgrades to the original ridematching services, so their impacts are captured under the Commuter Operations Center, but are reported separately.[19]

Evaluation Methodology Changes Since FY 2018 – FY 2020

- No changes since 2018-2020

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

Stated Goals

Commuter Connections set the following goals for the ***Commuter Operations Center (basic services)*** for 2023:

- Register/assist 91,609 commuters
- Reduce 24,425 daily vehicle trips
- Reduce 512,637 daily vehicle miles of travel
- Reduce 0.241 daily tons of NOx
- Reduce 0.115 daily tons of VOC

Commuter Connections set the following goals for ***Integrated Rideshare-Software Upgrades*** for 2023:

- Assist 4,681 commuters
- Reduce 2,379 daily vehicle trips
- Reduce 66,442 daily vehicle miles of travel
- Reduce 0.028 daily tons of NOx
- Reduce 0.011 daily tons of VOC

Nature of Evaluation

The primary components of the ***Commuter Operations Center*** are ridematching and commute information assistance provided to commuters to help them plan their commutes. Since some Commuter Connections ridematching and information services were available in 1997 when the first new TDM program elements were developed, this evaluation component seeks to credit the COC with any increases in effectiveness due to program enhancements not covered by other TDM program elements. Thus, the basic approach is to determine the total impacts for Commuter Operations Center services as if they stood alone, then subtract the portion of impacts that overlaps with GRH, Mass Marketing, and any other Commuter Connections TDM program element. The balance is credited to the COC.

The ***Integrated Rideshare Software Upgrade*** component is directed to a subset of Commuter Connections clients; applicants who remember receiving transit and/or Park and Ride, telecenter/co-working locations, and bicycling information along with other ridematching information from the Commuter Operations Center. This program is aimed at improving the quality and availability of commute information and encouraging commuters to try transit, bicycling, and telework, even if they did not have these options in mind when they contacted Commuter Connections.

Integration of transit and Park & Ride, telecenter/co-working locations, and bicycling information into the computer system will be evaluated through the applicant placement rate survey, described in Section 5. From this survey, a separate placement rate can be derived for those who shifted to an alternative mode after receiving transit or Park & Ride, telework, and bicycling information.

Performance Measures

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

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

- Number of commuters who use the online information system
- Distribution of services accessed (e.g., ridematch, transit, bicycle, telework)
- Online system placement rate
- Applicant satisfaction with online service

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

- Number of applicants who remember receiving or accessing transit, P&R, telework, or bicycle information through the online system
- Number of applicants who use transit, P&R, telework, or bicycle information that was received but not specifically requested
- 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):

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily 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.

Commuter Operations Center (Basic)	
Data Needs	*Data Source*
• Commuter Connections (CC) online system users	CC online system database
• COC placement rate	CC Online Placement survey
• COC VTR Factor and average travel distance	CC Online Placement survey
• COC retained placement rate	CC Retention Rate survey
• COC retained VTR Factor and average travel distance	CC Retention Rate survey
• Vehicle trips/VMT assigned to other program elements	Results of other element evaluations

Integrated Rideshare–Software Upgrades (IR-SU)	
Data Needs	*Data Source*
• Database applicants	CC Online system database
• Applicants who remember receiving transit, P&R, bicycle information	CC Online Placement survey
• IR-SU placement rate	CC Online Placement survey
• IR-SU VTR Factor and average travel distance	CC Online Placement survey

Proposed timing of data collection

- Commuter Connections database – ongoing
- CC Online Placement survey – November 2020 (next survey scheduled for November 2023)
- CC Retention Rate survey – February 2021 (next survey scheduled for FY 2026)

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 Descriptions 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 of the surveys proposed for FY21-FY23 have been used in past years. Previously-administered surveys will be reviewed and modified as needed for the 2023 evaluation. The data sources and surveys can be divided into two groups, Ongoing monitoring and resident and user surveys:

Commuter Connections TDM Evaluation Data Sources and Surveys

Ongoing Monitoring

- Commuter Connections GRH registrant database and archived GRH database (GRH)
- ACT! Employer Contact database (Employer Outreach and Telework)
- Commuter Operations Center activity tracking (Mass Marketing)
- Bike to Work Day participant records (Mass Marketing)
- Car Free Day participant records (Mass Marketing)
- 'Pool Rewards registrant database (Mass Marketing)
- Flextime Reward registrant database (Mass Marketing)
- incenTrip registrant database (Mass Marketing)
- CarpoolNow registrant database (Mass Marketing)
- Commuter Connections online information user database (COC, IR SU)

Resident and User Surveys

- Maryland Telework assisted employer follow-up survey
- State of the Commute survey
- GRH registrant survey
- Employee commute surveys (voluntarily administered by employers)
- Commuter Connections online assistance placement rate survey (November 2014)
- Bike-to-Work Day participant survey
- Retention rate survey
- Telework!VA baseline/follow-up surveys (conducted by VDRPT/VDOT)
- 'Pool Rewards registrant survey
- Car Free Day participant survey

Each data source, survey, and analysis tool is described below, noting the TDM program element or elements 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, TDM program element tracking, monitors use of and user satisfaction with the elements. The second purpose, impact analysis, refers to the calculation of transportation, air quality, energy, and cost impacts of the element. This evaluation framework document deals primarily with the second of the purposes.

Table 1
Data Collection Activities
Applicable TDM Program Elements and Uses of the Data

Evaluation Activity/Tool	Applicable Element	Use of Data
Ongoing Monitoring		
• GRH registrant / archived database	Guaranteed Ride Home	TDM element tracking, impact analysis
• ACT! Employer Outreach & Telework Contact Database	Employer Outreach & Telework	TDM element tracking, impact analysis
• COC website and call volume tracking	Mass Marketing (Secondary – COC, GRH)	TDM element tracking, impact analysis
• Documentation of media/marketing activities	Mass Marketing	Impact analysis
• Bike to Work Day participant records	Mass Marketing (BTW component)	TDM element tracking, impact analysis
• Car Free Day participant records	Mass Marketing (CFD component)	TDM element tracking, impact analysis
• 'Pool Rewards participant records	Mass Marketing ('PR component)	TDM element tracking, impact analysis
• Flextime Rewards participant records	Mass Marketing (FR component)	TDM element tracking, impact analysis
• incenTrip participants records	Mass Marketing (IT component)	TDM element tracking, impact analysis
• CarpoolNow participant records	Mass Marketing (CPN component)	TDM element tracking, impact analysis
• CC online information system user database	COC, Integrated Rideshare-Software Upgrades (Secondary – Mass Marketing)	TDM element tracking, impact analysis
Resident and User Surveys		
• Maryland Telework assisted employer survey	Telework	TDM element tracking, impact analysis
• State of the Commute survey	Telework, Mass Marketing	Commute trends, impact analysis
• GRH registrant survey	Guaranteed Ride Home	Impact analysis
• Employee commute surveys (employer- administered)	Employer Outreach	Impact analysis
• CC online system user placement rate survey	COC, Integrated Rideshare-Software Upgrades and Mass Marketing	Program satisfaction, impact analysis
• Retention Rate survey	Guaranteed Ride Home and COC	Impact analysis
• Bike-to-Work participant survey	Mass Marketing (BTW component)	Program satisfaction, impact analysis
• Car Free Day participant survey	Mass Marketing (Car-Free Day component)	Impact analysis
• 'Pool Rewards participant survey	Mass Marketing ('Pool Rewards component)	Impact analysis
• Telework! VA baseline/follow-up surveys (conducted by VDRPT/VDOT)	Telework	TDM element tracking, impact analysis

Ongoing Monitoring

Program activity and utilization tracking is an ongoing function already performed by Commuter Connections 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 ride-match applications, tracked by individual program element.

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 measure travel, air quality, energy and consumer savings benefits for the quarter. This tool is used primarily by COG/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 7.

- **GRH Registrant / Archived Database** – Ongoing tracking of registered and one-time exception GRH users. Database includes contact information, mode at time of registration, and GRH uses. *(Used for GRH program element.)*
- **ACT! Employer Client Database** – Tracks the number of employers participating in Employer Outreach Program and the commuter assistance services they offer in worksite programs, including Telework. 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., number of employees, location, transit accessibility) and on the strategies (e.g., transit subsidies, GRH, preferential parking, teleworking) that the employer offers. *(Used for Employer Outreach and Telework program elements)*
- **Documentation of Commuter Connections Media / Marketing Activities** – Ongoing tracking of the dates and types of media activities (media buys, direct mail, Internet outreach, etc.) and the number and time distribution of telephone and Internet information requests made to Commuter Connections. Maintained/compiled by Commuter Connections staff, staff of GRH online system vendor, and COG marketing consultant. *(Used for Mass Marketing program element; secondary use for GRH program element and Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project)*
- **Bike-to-Work Day Registration Records** – Provides contact information on commuters who register to participate in Bike-to-Work Day. *(Used for Mass Marketing program element)*
- **Car Free Day Pledge Records** – Provides information on commuters who register to participate in Car Free Day. Data include contact information, mode used prior to CFD, and mode registrant pledges to use on CFD. *(Used for Mass Marketing program element)*
- **'Pool Rewards Registrant Records** – Provides information on commuters who register to participate in 'Pool Rewards carpool and vanpool incentive program. Data include contact information, mode used for commuting prior to registration, and carpool and vanpool days recorded during the enrollment period. Data on the vanpool use and travel patterns are used directly to calculate vanpool impacts. Data from the carpool program are used in combination with data from a follow-up survey of program participants to estimate impacts of the carpool component. *(Used for Mass Marketing program element)*

- **Flextime Rewards Registrant Records** – Provides information on commuters who register to participate in Flextime Rewards incentive program. Data include contact information, typical commuting time (departure/arrival), mode used for commuting prior to registration, and trips shifted/eliminated by day/time. *(Used for Mass Marketing program element)*
- **incenTrip Registrant Records** – Provides information on commuters who register for incenTrip rewards program. Data include contact information, trips made by day/time, mode used for each trip, and travel distance. *(Used for Mass Marketing program element)*
- **CarpoolNow Registrant Records** – Provides information on commuters who register to participate in CarpoolNow dynamic ridematch program. Data include contact information, trips requested/offered, and trips accepted by day/time, travel distance, and driver incentives provided. *(Used for Mass Marketing program element)*
- **Commuter Connections Online Information System Database** – Ongoing tracking of commuters who establish accounts for the online information system and counts of non-registered users. Includes contact information for account holders. *(Used for Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project; secondary use for GRH and Mass Marketing program elements)*

Resident and User Surveys

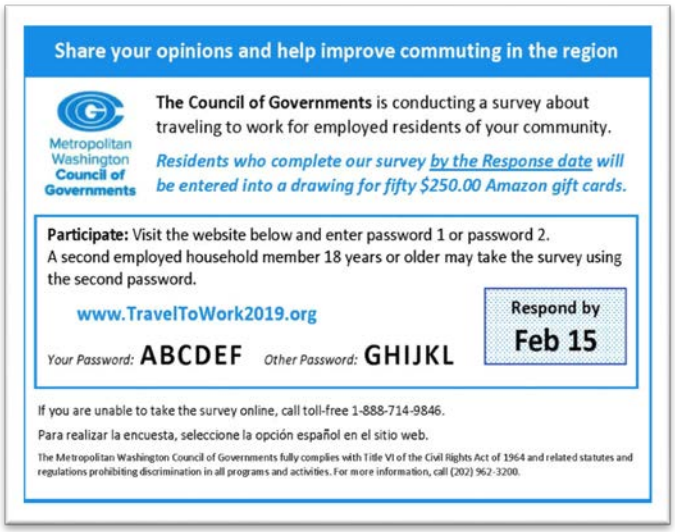
Several surveys are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction. These surveys also provide program impact data. Some of the surveys, such as the online system user placement survey and GRH Survey, also provide information used by Commuter Connections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

- **Maryland Telework Assisted Employer Survey** – Sent to employers in Maryland 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 the approximate number of employees who were teleworking before the employer received assistance and after assistance. This information is used to estimate the number of teleworkers who were indirectly influenced by Commuter Connections Telework Assistance. *(Used for Telework program element)*
- **TW!VA surveys** – Administered to employees who work at worksites participating in the Telework! VA (TW!VA) program. A baseline survey, administered before telework assistance is provided, is used to establish the percentage of employees who telework prior to the program implementation and their telework characteristics. A follow-up survey conducted six to eight months later determines the percentage of new teleworkers, their telework frequency, and modes used to travel to the worksite on non-telework days. *(Used for Telework program element)*
- **State of the Commute Survey** – The SOC survey, a random sample survey of employed adults in the Washington metro region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance. The survey also examines awareness and attitudes about commuting and awareness and use of transportation services, such as HOV lanes and public transportation, that are available to commuters in the region. To this end, it will be compared to data from past State of the Commute surveys (2001, 2004, 2007, 2010, 2013, 2016, and 2019).

  SOC survey data also are used to assess the impacts of TDM program elements that have a possible influence on the population-at-large. Specifically, the survey generates information for the Mass Marketing and Telework program elements, both of which have broad application and for which it is

not possible to identify all users from any Commuter Connections database. The survey also is used to assess awareness of the regional GRH program.

Next, by querying respondents about their attitudes about alternative modes and reasons for choosing or not choosing alternative modes, the survey also suggests how commuter service programs and marketing efforts influence commuting behavior in the region. In this way, it helps to establish the influence of the Mass Marketing advertising messages on mode switching and use of Commuter Connections services, provides opinion research data that could contribute to assessment of broad social and personal benefits of commute programs, and offers an opportunity to test concepts for new services.



The SOC survey is a triennial survey and will be conducted in early 2022. The survey will be conducted via Internet, with a random sample of households in each of the 11 MWCOG jurisdictions receiving a postcard invitation specifying the survey website link. The card will provide two unique passwords, allowing up to two adult household members to participate in the survey. *(Used for Telework and Mass Marketing program elements)*

- **GRH Applicant Survey** – Commuters who registered with the GRH program or used 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. The survey also will include questions to gauge users' satisfaction with GRH services. 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.

  As was done in the past four GRH surveys, the 2022 GRH survey will be conducted by a combination of Internet and telephone methods. COG's online TDM system database vendor has programmed the GRH questionnaires for online application. This tool will be used to survey applicants who provided an email address and have a current GRH account. To ensure that all GRH registrants are included in the survey, past registrants who provided an email address will be surveyed by web-based survey administered through a consultant server. Telephone interviews will be conducted with GRH respondents who did not provide an email address. The data from these methods will be combined for analysis of the GRH survey and used to calculate impacts for the GRH program element.

- **Employee Commute Surveys** – Some employers conduct baseline surveys of employees' commute patterns before the worksite begins to offer commuter assistance programs. Commuter Connections staff makes the results of these surveys available to the research team through an employee survey database. *(Used for Employer Outreach program element)*

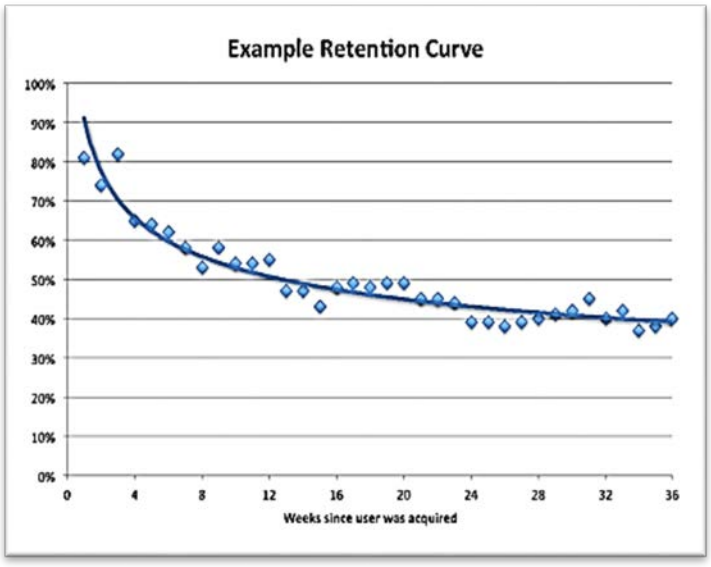
- **Commuter Connections Online System User Placement Rate Survey** – Since May 1997, Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center and users' perceptions of and satisfaction with the services provided. Data from the applicant placement surveys are used primarily to derive placement rates and

VTR factors for the Commuter Operations Center, Integrated Rideshare Software Upgrades, and for the Mass Marketing program element (referred impacts and incentive programs).

A new component of the November 2020 survey was to collect data on use of the Flextime Rewards, incenTrip, and CarpoolNow components of Mass Marketing. The survey included follow-up questions about use of and commute travel changes resulting from these services. These data will be used to estimate placement rates and VTR factors for the incentive programs as well as facilitate determination of overlap among these and other Commuter Connections TDM program elements, information needed to allocate impact credits to program elements.

The placement survey conducted in November 2020 will be used in the 2021-2023 evaluation period. Results of the survey conducted during this evaluation period were presented in a survey report finalized in May 2021.[20] 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. *(Used for the Commuter Operations Center (Basic), and Software Upgrades; secondary use for Mass Marketing and GRH program elements)*

- **Retention Rate Survey** – In Commuter Connections evaluations prior to 2017, mode shifts motivated by TDM program elements during an evaluation period were not carried over to the next evaluation cycle. But numerous surveys conducted for past TDM program analyses suggested that commuters who made mode shifts continued using the new modes for more than three years, so some additional impacts could be retained from one 3-year evaluation cycle to the next. To address this opportunity, in 2016, Commuter Connections conducted a new "Retention Rate" survey to estimate the share of past service users who continued to use alternative modes during the current cycle.



The survey interviewed Commuter Connections online system users and GRH users who last participated in these programs prior to the start of the FY 2017 – FY 2020 evaluation period. Users were asked about their current modes, how long they had used the modes, and what Commuter Connections services they received. Commuters who were still using alternative modes were asked if and how Commuter Connections services influenced them to continue to use alternative modes. These survey data were used to develop "retained" placement rates and other factors for the GRH TERM and for the Commuter Operations Center and the 2017 TDM analysis calculated "retained" impact credits for each of these program elements.

[20] Fiscal Year 2021 Applicant Database Annual Placement Survey Report, Technical Survey Report (November-December 2020 Survey), May 18, 2021.
https://www.mwcog.org/file.aspx?D=T5PMIJY96D9vtQTY6W7Qrx5X57zJ9pFmYr2owOy3yfQ%3d&A=QizXllXx1rmrAq3al13rwq6xvTvayoQq3FD9yvMxjNQ%3d

Commuter Connections conducted a second Retention Rate survey in February 2021, following the same method as for the 2017 survey. Results from this survey will be used to update the multiplier factors for GRH and for the Commuter Operations Center for the 2023 analysis. Section 5 provides additional details on the Retention Rate survey. *(Used for Commuter Operations Center (Basic) and for GRH program element)*

- **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. The survey also collects data on participant satisfaction with the event, data that is shared with other organizations that sponsor and promote the event. *(Used for Mass Marketing program element)*

- **Car Free Day Participant Survey** – This survey is conducted among commuters who register for the Car Free Day (CFD) event. In a similar fashion to the Bike to Work Day survey, it compares modes pledged and used on the event day for work and non-work trips, commuters' usual commute mode at the time of the survey, and frequency of non-SOV modes used for commute travel following the event. The survey also collects data on participant satisfaction with the event, data that is shared with other organizations that sponsor and promote the event. *(Used for Mass Marketing program element)*

- **'Pool Rewards Participant Survey** – Registered participants in the 'Pool Rewards carpool incentive program are surveyed after they complete their 3-month enrollment period. Carpoolers participating in 'Pool Rewards log their carpool trips during the enrollment period, thus the focus on the survey is to determine the share of participants who continue to carpool after the incentive ends. The survey also collects data on participant satisfaction with the program. *(Used for Mass Marketing program element)*

Analysis Tools

The EPA COMMUTER model (v 2.0), which the research team has used to estimate impacts for the Employer Outreach program element, predicts likely change in employee commuting behavior for reported changes in an employer's commute assistance program. The COMMUTER Model uses time and cost coefficients that are compatible with coefficients used by MWCOG in regional transportation modeling. In 2007, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes.

During 2010-2012, MWCOG developed a new travel model used for regional transportation planning and forecasting. To ensure consistency with the new regional model, MWCOG modeling staff reviewed the COMMUTER Model cost and time coefficients that were used in the 2011 evaluation. They concluded that no further coefficient adjustments were needed for the 2014 or 2017 TDM analyses to be consistent with the new regional model.

MWCOG continues to update the regional model and in 2020, the research team reviewed regional model guidance documents to determine if any updates might necessitate a change in the COMMUTER model coefficients to remain compatible with the regional approach. The review identified changes to enhance the efficiency and speed of model operation, but no modifications that would affect the validity of the current cost COMMUTER Model coefficients. Thus, the research team concluded that no additional COMMUTER model adjustments were needed for the 2020 evaluation.

In 2020, the research team also examined several other models to determine if any other options would be as reliable and efficient as the COMMUTER model for the Employer Outreach analysis. This review found that none of the alternative models offered both the capability to analyze the wide range of TDM strategy combinations that were implemented by EO employers as well as the capability to analyze efficiently impacts for individual employers. Thus, the project team used the COMMUTER Model for the FY 2017 – FY 2020 EO calculation. The team is currently expanding this review. If a new tool appears likely to be more accurate than the COMMUTER Model, with similar ease and capabilities, it will replace the COMMUTER Model for the 2023 analysis.

Section 6 Basic Method for Calculating Program Impacts

This section presents the methodology for calculating and quantifying the travel, emissions, energy and commuter cost impacts of the TDM program elements. Following are the basic calculation steps that apply a series of multiplier factors to the participation count for the program element. This method is consistent across program elements, with two exceptions. Employer Outreach uses a modeled method applied to known commute services offered at worksites. And Mass Marketing uses information from the State of the Commute and COC activity tracking to assess mode change due to Mass Marketing advertising campaign activities. Specific examples of the evaluation calculations and unique methodological elements for each TDM program element are presented in Appendices D through I:

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

Documenting Program Participation and Utilization

The evaluation of program impacts requires first an accurate documentation of the participation of employers and commuters in each TDM program element. The calculation methodology begins with consistent and continuous tracking of the number of participants or users of each element:

- **Employers participating in Telework activities** – Track participation in Commuter Connections' Maryland telework programs through telework contact records maintained by Commuter Connections and in the regional ACT! Employer Outreach database. 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 Maryland employer telework follow-up survey. Participation for the Telework! VA program will be tracked by the Virginia Department of Rail and Public Transportation (DRPT) and the Virginia Department of Transportation (VDOT).

- **GRH registrants and one-time exception users** – Track separately from Commuter Connections online system applicants. A GRH placement rate and VTR factor will be developed from the 2022 GRH survey for registrants who participated in GRH during the evaluation period. Also retain information on commuters who participated in GRH and whose registration expired prior to the start of the evaluation period; placement rates and VTR factors will be derived for these commuters though the 2021 Retention Rate survey.

- **Employers participating in Employer Outreach** – Track details about the employer size (number of employees), geographic location, transit access, and commute assistance services offered at the worksite.

- **Commuters participating in Bike-to-Work Day, Car Free Day, and other one-time special events/programs** – Track the total number of commuters who register to participate and number of actual participants, if different from the registration count.

- **Commuters participating in 'Pool Rewards carpools and vanpools** – Track counts of participants, starting mode, pool occupants, and total carpool and vanpool days during the incentive period.

- **Commuters participating in Flextime Rewards** – Track counts of participants, number and locations of trips shifted/eliminated on roadway incident days.
- **Commuters participating in incenTrip** – Track counts of participants, trips taken by location, mode and by day/time of day.
- **Commuters participating in CarpoolNow** – Track counts of participants, rides/riders requested and accepted by location and day/time of day.
- **Commuters who request or access Commuter Connections assistance through online information system** – Track number of participants, dates of assistance/requests, and type of information requested (e.g. ridematching, transit information, telework assistance, bicycle information, etc.). Using the results of the online system user 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 program element but now part of the COC section in this report. Also retain information on commuters who received services from the online system prior to the evaluation period; placement rates and VTR factors will be derived for these commuters though the Retention Rate survey.

The purpose of this tracking process is to determine the "population base" that will be used to quantify impacts and then to credit those impacts to the program element from which they were derived. Other program information, in addition to participation and utilization, also could 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 program element, into a form that allows for the calculation of impacts. This is accomplished with a simple spreadsheet that includes the factors discussed below.

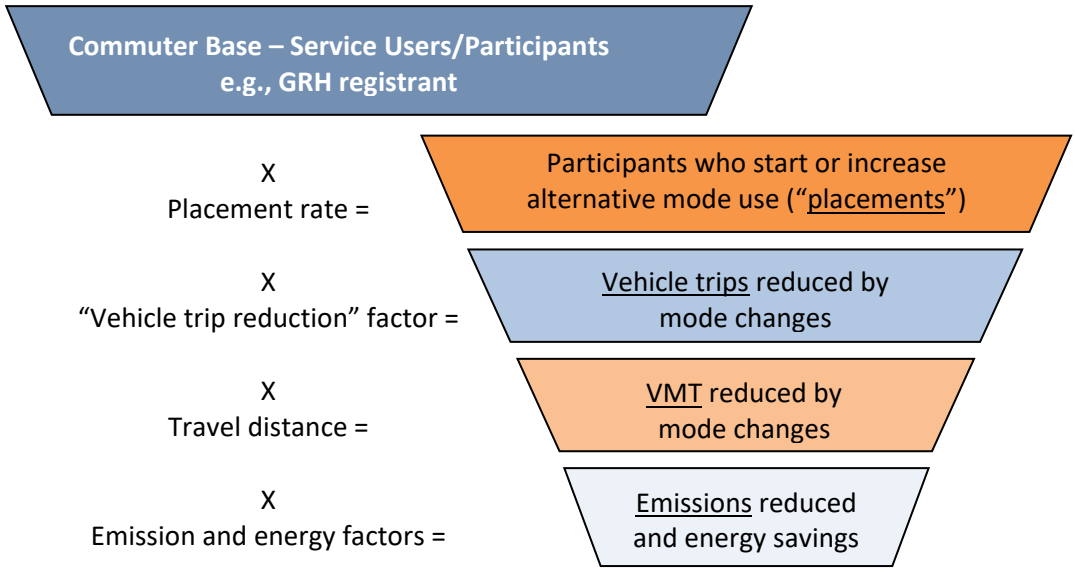
Calculating Program Impacts

Section 3 of this framework described performance measures in several categories. The final category defined travel, emissions, and energy impacts that would be generated by travel behavior changes made by TDM service users. The Commuter Connections TDM evaluation framework utilizes a basic method that measures the impact for individual TDM program elements then combines the individual impacts, with discounts to account for overlap between services, into a program total. The following subsection provides an example of how program impacts are computed for the four TDM program elements and for the Operations Center.

Figure 2 illustrates the method as applied to a single program element. The calculation for a specific service begins with a base service user or participant count for the service. Several multiplier factors derived from a survey of service users are then applied to the participant count, in sequential calculations to estimate impacts from travel behavior change.

This method is applicable for any TDM program element for which participation can be tracked and multiplier factors can be developed. Each program element will have a unique set of factors, depending on the characteristics of the users and the service, but the basic calculation method is the same for all services. Tailored surveys have been developed for each of these services to produce unique placement rates and VTR factors for each element. A brief description of each step is presented below the figure.

Figure 2: Impact Calculation Multiplier Steps



Nine basic steps, described below, are used to calculate program impacts. A hypothetical numerical example of the steps is presented in Figure 3 for one TDM program element.

Step 1 – Commuter Population Base

The first step establishes the population base, or population of interest, relevant to the specific program element. This is the population that potentially could have been influenced by the element. Depending on the element being evaluated, this could be all commuters, GRH applicants, teleworkers, or some other population. The population bases for GRH and the Commuter Operation Center will include both current registrants/users and past participants who continue to use alternative modes, as identified by the Retention Rate survey. In the example shown in Figure 3, the population base is 8,000 commuters.

Step 2 – Placement Rate

Step 2 derives the placement rate for the population base exposed to the program element. The placement rate is equal to the percentage of commuters in the population base who shift to an alternative mode (carpool, vanpool, transit, walk, bike, telework) after receiving assistance under the element. Placement rates are derived from user survey data.

Two placement rates are derived for each program element, to account for the length of time the commuter uses the alternative mode after shifting: continued rate (continued using the new alternative mode through the evaluation period), and temporary rate (tried new alternative mode but shifted back to original mode within the evaluation period). For simplicity, Figure 3 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 element. The placement rates for one element will not necessarily be the same as the placement rates for any other element.

TDM Program Element Evaluation
Basic Program Impact Calculation Methodology Steps

1. Estimate commuter "population base" for the element	= e.g., all commuters, GRH applicants, CC online system users, EO employees
2. Derive placement rate (from user survey data)	= Proportion of commuters who made a travel change as a result of the element
3. Estimate number of "placements"	= Population base x placement rate
4. Derive VTR factor (from user 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 = VMT x "running" emission factor	= Vehicle trips x "trip end" emission factors
9. Estimate energy and commuter savings	= VMT reduced x average fuel consumption = VMT reduced x average vehicle operating cost

Step 3 – 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 likely to have made the shift to alternative modes as a result of the element. 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 the example in Figure 3, the calculation of placements is as shown below:

Placements = 8,000 commuters (population base) x 20%
= 1,600 placements

Figure 3
Example of Basic Program Impact Calculation Methodology Steps for a TDM Program Element
(Note: hypothetical example; do not use factors in the example for actual evaluation purposes)

1. **Program element "population base"**	= 8,000 commuters
2. **Placement rate**	= 20%
3. **Number of "placements"**	= 8,000 x 20% =1,600 commuters placed
4. **VTR factor**	= 0.7 daily vehicle trips reduced per placement
5. **Vehicle trips (VT) reduced**	= 1,600 x 0.7 trips reduced per placement = 1,120 daily vehicle trips reduced
6. **VMT reduced**	= 1,120 vehicle trips reduced x 25 miles/trip = 28,000 daily VMT reduced
7. **Adjusted 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. **Emissions reduced (NOx)** *Similar calculations used to estimate reductions in VOC and CO2*	= 448 trips x 1.0309 g/trip = 462 g = 24,640 VMT x 0.1498 g/VMT = 3,691 gm = (462 gm + 3,691 g) / 907,185 gm/ton = 0.0046 daily tons NOx reduced
9. **Energy and commuter savings**	
Energy saving (gallons of fuel)	= 24,640 daily VMT / 19.9 mpg = 1,238 gallons per day x 250 workdays/year = 309,500 gallons saved per year
Commuter cost saving ($)	= 24,640 VMT x $0.230/mile = $5,667 per day x 250 workdays/year = $1,416,800 saved per year / 1,600 placements = $886 saved per placement per year

Step 4 – VTR Factor

From the same survey data used to calculate placement rate, the Vehicle Trip Reduction (VTR) factor is next derived. This is equal to the average daily vehicle trips reduced per placement. As described in Section 3, not all commuter placements 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 bus or bus to vanpool)
3) Alternative mode users increasing the number of days they use alternative modes

The number of trips reduced also depends on the frequency with which they use the alternative mode, compared to the number of days they used it before. The VTR factor combines the varied trip reduction results of all commuter placements to develop an average reduction per placement. An numeric example of how VTR Factor is derived is provided in Appendix A. As for placement rates, VTR factors might be different for different program elements. As shown in Figure 3, the VTR factor for the element in the hypothetical example is 0.70. This means that each of the placements for this element reduces, on average, 0.7 vehicle trips per day.

Step 5 – Daily Vehicle Trips Reduced

The number of daily vehicle trips reduced for the program element is then measured 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 3 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 – Daily VMT Reduced

The total daily VMT reduced is computed 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 obtained from the same survey data used to derive the placement rate and VTR factor. The example in Figure 3 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 trip
= 28,000 daily VMT reduced

Step 7 – Adjusted Vehicle Trips and VMT (for SOV Access)

Because a basic purpose for implementing the program elements is to meet regional air quality emission reduction targets, single occupant vehicle (SOV) access to alternative modes must be considered. Emission reduction, as explained in Step 8, is computed 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 create a “cold start,” their SOV access trips must be subtracted from the vehicle trip reduction to assess the air quality impact of elements. Additionally, the distance they drive to the meeting point must be subtracted from the VMT reduced to obtain an accurate VMT reduction count. It is these “adjusted” vehicle trips reduced and VMT reduced, rather than the initial totals, that are used to calculate emissions reduced.

In the Figure 3 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 – Daily Emissions Reduced

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 emission 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.

The emission factors[21] used in the 2020 TDM analysis were:

Emission Factors	NOx	VOC	CO2
• Start/Soak *(gm / one-way vehicle trip)*	1.0309	2.1358	212.54
• Running *(gm / mile)*	0.1498	0.0593	362.93

To compute 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 NOx reduced for our example in Figure 3 is:

NOx = 448 trips x 1.0309 g/trip = 462 gr
= 24,640 VMT x 0.1498 gr/VMT = 3,691 gr
= (462 gm + 3,691 gr) / 907,185 gr/ton

= 0.0046 daily tons NOx reduced

The emission reductions for the other pollutants (VOC, and CO2) are calculated similarly, using emission factors noted above for each pollutant. However, emissions for CO2 are reported as annual reductions, rather than daily reductions. This additional calculation is made by multiplying daily impacts by 250 working days per year.

Step 9 – Energy and Commuter Cost Savings

While travel and emission impacts are the primary focus of the TDM impact analysis, energy and consumer benefits also are real and tangible benefits. For this analysis, energy and commuter cost savings factors are applied to the VMT reduced. In 2020, these factors were:

[21] The emission factors presented here are derived by MWCOG staff from the EPA's MOVES emission model for the Washington metropolitan region. If the model parameters or inputs change, the emission factors also could change.

- ***Energy savings*** are based on an average fuel consumption factor of 18.0 miles per gallon for the Washington metropolitan area fleet of light duty vehicles (data derived from TRIMMS™ model)
- ***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 developed a composite national average cost as 23.0 cents per mile in 2020. When the 2023 TDM analysis is conducted, the cost per mile will be updated to reflect expenses at that time.

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 3, the daily and annual energy and cost savings for the example element are as follows:

Energy saving (gallons of fuel)	= 24,640 daily VMT / 18.0 mpg
Daily saving	= 1,369 gallons per day
Annual saving (250 work days)	= 342,250 gallons saved per year
Commuter cost saving ($)	= 24,640 VMT x $0.230/mile
Daily saving	= $5,667 per day
Annual saving (250 work days)	= $1,416,800 saved per year
Annual saving per commuter (based on 1,600 placements)	= $886 saved per placement per year

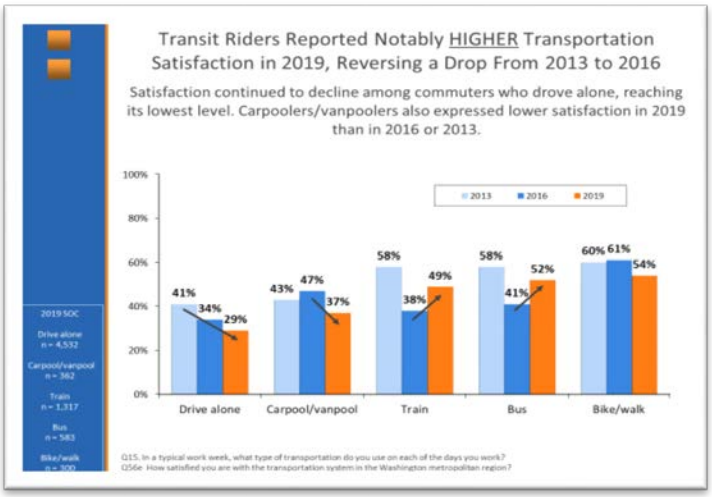
Sample Calculations of Impacts for each TDM Program Element

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

It should be noted that the numbers shown in the example are from the 2020 TDM Analysis Report, which forms the basis of this evaluation framework. The actual FY 2021–FY 2023 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 could be different than the values shown in the appendices examples. The appendices are provided for illustrative purposes on the method and calculation steps only.

Section 7 Reporting and Communication of Evaluation Results

The objective of the TDM evaluation process is to provide data on the performance of TDM program elements to assist regional and local decision-makers, funders, Commuter Connections program staff, and program partners to make sound program funding and operations decisions. To this end, the TDM evaluation produces a technical assessment of performance to apply to regional transportation and air quality planning and performance review efforts. Because the TDM program elements are offered, at least in part, to provide these benefits to the region, past TDM evaluations have focused primarily on analyzing travel and emissions impacts from use of Commuter Connections program.

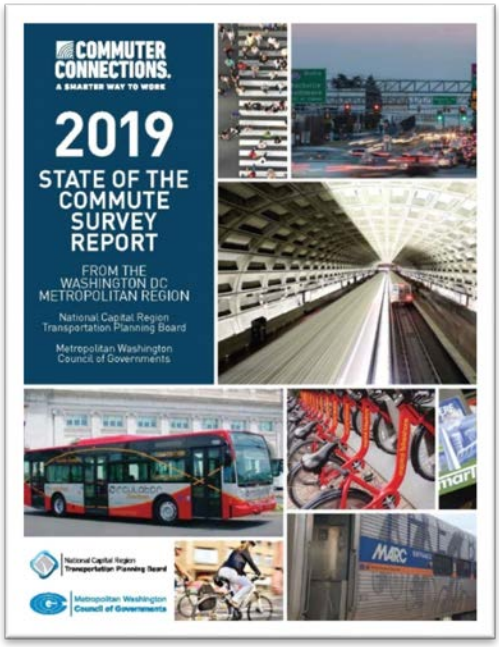


The many surveys and analyses performed for the evaluation also collect a wealth of data on travel patterns and trends, traveler attitudes, and customer satisfaction that can be used to relate Commuter Connections' story to other audiences and to contribute to a broad range of regional transportation planning activities. By expanding the range of data transmitted and focusing the presentation of data on the needs and interests of other audiences, Commuter Connections expands the value of its data collection and analysis investment and provides value to various new audiences.

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

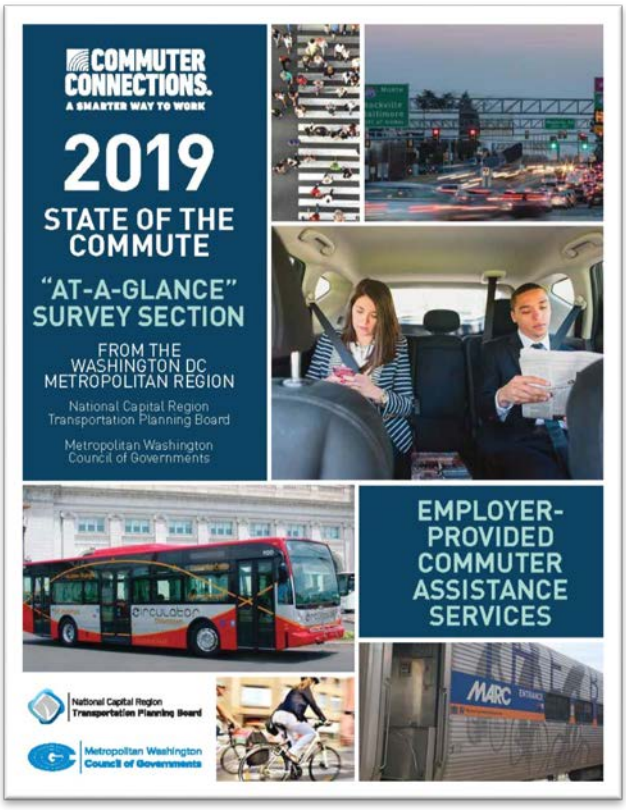
- Survey reports and presentations
- Quarterly "Report Card"
- Program Annual Report
- TDM Analysis Report

For each data collection activity, such as the GRH survey and State of the Commute survey, Commuter Connections and/or a contractor produces a technical report, which presents technical details of the survey methodology and results. Commuter Connections and/or the contractor also prepares presentation materials to summarize highlights of the research for technical audiences, such as the TDM Evaluation Group, Commuter Connections Subcommittee, the Transportation Planning Board, and the TPB Technical Committee. MWCOG media/publications staff also use survey data in press releases and infographics for other publications.



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

In ongoing discussions with local partners, Commuter Connections staff determined that "top findings" summaries of survey and evaluation data could be useful tools to disseminate evaluation results to audiences that would be unlikely to read technical reports. In the 2018-2020 evaluation period, the consulting team worked with COG staff to provide and format data that Commuter Connections used to prepare such survey and evaluation summaries in a variety of formats, such as printed survey topic "At-A-Glance" briefs and online distribution methods (e.g., social media, targeted emails, blogs, net-conferences, etc.). During the 2021-2023 evaluation period, the contractor will continue to provide data and results in similar formats.



This is an "At-a-Glance" section from the 2019 State of the Commute (SOC) Report showing key figures and tables for employer provided commuter assistance services. To view the full report, go to www.commuterconnections.org

Employer-Provided Commuter Assistance Services

The SOC survey also inquired about commute assistance services and benefits that might be offered to employees at their worksites, either by employers or a building management company. Respondents were asked about two types of services:

- Alternative mode support benefits and services
- Parking facilities and services

Results presented in this summary are in regards to respondents' availability and use of these services in 2019.

Incentives/Support Services

Six in ten (60%) respondents said their employers offered one or more commuter benefits or services. This was a slight increase over the rates for most past SOC surveys and nearly meeting the 61% rate recorded in 2010. This suggests that commute service outbacks made by employers during the economic recession years of 2013 and 2016 have been reversed. Note also that these percentages represent employees' perceptions or awareness of service availability. They could underrepresent the true availability of services if employees were unaware of some services that actually were offered.

Employee Reports Access to any Worksite Benefits/Services - 2007 to 2019

(2007 n = 6,071, 2010 n = 6,806, 2013 n = 6,624, 2016 n = 6,086, 2019 n = 7,991)

INDIVIDUAL INCENTIVES/SUPPORT SERVICES OFFERED

The percentages for individual commute services offered are displayed in the next figure. Thirty-seven percent of respondents said their employers offered one or two of these services and 22% said their employers offered three or more services.

The most commonly offered services were transit (SmarTrip)/vanpool subsidies available to 45% of respondents, and information on commuter transportation options, available to 26% of respondents. Two in ten (22%) respondents said their employer offered services for bikers and walkers and 17% said preferential parking was offered to carpools and vanpools. One in ten (10%) said their employer offered Guaranteed Ride Home (GRH). Carpool subsidies were mentioned by about 8% of employees. Two vehicle-sharing services, bikeshare and carshare membership, were mentioned by 9% and 7% of respondents, respectively.

Availability of most services was not significantly different in 2019 than in past SOC survey years. However, access to transit/vanpool subsidies increased by eight percentage points between 2016 and 2019, reversing a declining trend noted in 2013 and 2016. As this service can represent a sizeable cost commitment for employer commute programs, it reinforces the hypothesis that employers cut back on commute assistance services during the recession to save money and have now restarted some elements of the program. Availability of carshare and bikeshare, two services added to the SOC questionnaire in 2013, continued to grow. Availability of employer-sponsored GRH has shown a slight, but consistent, decline since 2010. Availability of preferential parking for carpools and vanpools also fell between 2016 and 2019, from a level that had been consistent since 2010.

Section 8 Evaluation Schedule and Responsibilities

The key to any successful evaluation effort is for evaluation information to be generated and reported in a timely manner. Commuter Connections prepares quarterly summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. Annual and triennial evaluation results are reported to COG/TPB staff, local jurisdiction program partners, and regional policy-makers 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 Frequencies and Schedule

Evaluation activities fall into three categories, with various recommended frequencies as described in Table 2. The first column shows evaluation activities in three categories: ongoing monitoring/tracking, surveys, and reporting. The second column indicates the frequency for each activity. The specific schedule for all data collection activities has been established by Commuter Connections and is included as Appendix K. The final column of Table 2 indicates the party 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, Retention Rate survey, etc.) to document the results of the survey and update placement rates and VTR factors (if applicable) for the populations surveyed. As Table 2 indicates, in addition to these reports, internal activity and evaluation reports also are produced to report the progress of the Commuter Connections program as a whole and for individual TDM program elements. A full TDM Analysis Report will be developed every three years to document the TDM program element impacts during the previous three-year period.

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 TDM 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 TDM evaluation activities.

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

Table 2
Data Collection and Reporting Activities
Frequency and Responsibility

Evaluation Activity/Tool	Frequency	Responsibility
Ongoing Monitoring		
• Telework assistance database	Ongoing	CC
• GRH registrant/archived database	Ongoing	CC
• ACT! employer contact database	Monthly	CC, Sales representatives
• COC website and call volume tracking	Ongoing	CC
• Documentation of media/marketing activities	Ongoing	CC, Contractor
• Bike-to-Work Day participant records	Annual	CC
• Car Free day participant records	Ongoing	CC
• 'Pool Rewards participant records	Annual	CC
• Flextime Rewards participant records	Ongoing	CC
• incenTrip participant records	Ongoing	CC
• CarpoolNow participant records	Ongoing	CC
• Commuter Connections applicant database	Ongoing	CC, Contractor
Commuter/Employer/User Surveys		
• Telework-assisted employer follow-up survey	Triennial	CC, Contractor
• State of the Commute survey	Triennial	Contractor
• GRH registrant survey	Triennial	CC, Contractor
• Employee commute surveys	Ongoing	CC, Sales representatives, Contractor
• CC online system user placement survey	Triennial	CC, Contractor
• Retention rate survey	Five-year	CC, Contractor
• Bike-to-Work participant survey	Triennial	CC, WABA
• Car Free Day participant survey	Triennial	CC, Contractor
• 'Pool Rewards participant survey	Triennial	CC, Contractor
Evaluation Results Reporting		
• Commuter Connections "Report Card"	Quarterly	CC
• CC Program Annual Report	Annual	CC
• TDM Evaluation Report	Triennial	CC, Contractor
• Commuter Connections survey reports	As produced	CC, Contractor

CC – COG TPB – Commuter Connections

WABA – Washington Area Bicyclist Association

List of Appendices

Appendix A
Basic Calculation of VTR Factor

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

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

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

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

The VTR factor is derived by determining the number of vehicle trips all placements would reduce together and dividing that total by the number of placements. The calculation assumes that a commuter makes two trips a day, one from home to work and a second from work to home. Thus, a commuter who drives alone would make 2 vehicle trips each day. A commuter who carpools would make ½ vehicle trip to work and ½ trip back home, for a total of 1 vehicle trip per day. A commuter who uses bus, train, bike, or walk is assumed to make 0 vehicle trips. A commuter who teleworks also makes 0 vehicle trips for telework days.

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

Appendix A, continued

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

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

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

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

Appendix B
2008 Adjustment to COMMUTER Model Coefficients and 2021 Review of Model for FY 2021-2023 Analysis

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

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

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

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

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

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

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

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

*Coefficient for Seattle **Coefficient for MWCOG region

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

Appendix B, continued

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

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

To obtain this -3.84 VTR value, the coefficient for MWCOG would have to be -0.0034. The VTR result of -3.84 would represent about a 16% reduction in impact compared to that produced using the -0.0043 cost coefficient. With these changes, the old (2005) and new (2008) coefficients used in the COMMUTER Model were as follows. No changes were made to the time coefficients. The 2008 coefficients also were used in the 2011 analysis.

	2008 Coefficients	2005 Coefficients
IVTT- In-vehicle travel time - all modes (minutes)	-0.0300	-0.0300
OVTT - Transit walk time (minutes)	-0.0750	-0.0750
OVTT - Transit wait time (minutes)	-0.0750	-0.0750
Cost - Auto parking (cents)	-0.0034	-0.0043
Cost - Transit fare (cents)	-0.0034	-0.0043

Consistency of the COMMUTER Model with MWCOG Regional Model – During 2010-2012, MWCOG developed a new regional travel model used for regional transportation planning and forecasting. To ensure that the COMMUTER Model was consistent with the new regional model, MWCOG modeling staff reviewed the COMMUTER Model cost and time coefficients that had been used in the 2011 evaluation. They concluded that no further coefficient adjustments were needed for the 2014 or 2017 TDM analyses to be consistent with the new regional model.

MWCOG continues to use this regional model and to add updates as the model evolves. In 2020, the research team reviewed regional model guidance documents prepared by MWCOG to determine if any regional model updates might indicate a needed change in the COMMUTER model coefficients to remain compatible with the regional approach. The review identified numerous model modifications, but none that would affect the validity of the current coefficients for the COMMUTER Model. Most changes were affected the efficiency and speed of model operation, rather than the model results. The few changes that altered the model results primarily adjusted assumptions related to bike and walk access to transit in suburban areas. As these changes were not cost related, the research team concluded that no additional COMMUTER model adjustments were needed for the 2020 evaluation.

Review of Other Possible Models for Employer Outreach Analysis – In 2020, the research team examined several other models to determine if any other options would be as reliable and efficient as the COMMUTER model for the Employer Outreach analysis. This review found that none of the alternative models offered both the capability to analyze the wide range of TDM strategy combinations that were implemented by EO employers as well as the capability to analyze efficiently impacts for individual employers. The research team previously developed a technique to run the COMMUTER model for large numbers of individual employers in “batch” mode, allowing an independent impact analysis for each employer, in a highly efficient process. Without this capability, it would be cumbersome to analyze the large number of employers in the EO analysis. Thus, the project team used the COMMUTER Model for the FY 2017 – FY 2020 EO calculation, with the revised coefficients referenced above. The team is currently expanding this review. If a new tool appears likely to be more accurate than the COMMUTER Model, with similar ease and capabilities, it will replace the COMMUTER Model for the 2023 analysis.

Appendix C
Assignment and Calculation of Telework Impacts in Commuter Connections TDM Analysis

The TDM analysis undertaken triennially by Commuter Connections includes assessment of telework impacts that have been generated by telework-supportive activities of Commuter Connections staff and/or local jurisdiction partners. Some of these services are directed to individual workers in the region to increase their awareness of telework options. Other services are directed to employers to encourage and assist with establishment of worksite telework arrangements and policies.

Because the telework services are implemented under several Commuter Connections TDM Program Elements and for both commuters and employers, the TDM analysis calculates individual telework impacts for each element, correcting for double-counting when impacts would otherwise be counted in more than one category. The impacts are calculated separately for the commuter and employer target telework populations and, as shown in Figure C-1, impacts are assigned to different TDM Program Elements depending on their location (District of Columbia, Maryland, Virginia) and the telework assistance services they received. Note that the calculated impacts do not include all telework in the region; only impacts that can be tied to a service provided by Commuter Connections or a Commuter Connections partner organization:

Commuters:

The left side of Figure C-1 shows assignment of impacts for commuters to one of three groups:

- Telework TDM Program Element
- Commuter Operations Center
- TW impacts not counted

1 – Was commuter assisted by CC – The first step is to determine if a commuter was assisted or influenced by a CC service to start or increase teleworking. The State of the Commute survey includes a question asking teleworkers the information sources/resources they used to start teleworking. They also are asked a direct question to determine if they received TW information/assistance from MWCOG or Commuter Connections.

– If they did report MWCOG/CC as a source/resource, their impacts will be credited to MWCOG/Commuter Connections and they move to step 2.

– If they did not report MWCOG/Commuter Connections as a source/resource, their impacts are not credited to MWCOG/CC. They are, however, part of regional telework.

2 – Where does commuter live and work – Assisted commuters are then separated into two categories, by the residence and work state(s).

– ***Live and/or work in Maryland*** – Impacts of assisted commuters who live AND/OR work in Maryland are assigned to the Telework TDM Program Element. Their vehicle trip and VMT reduction impacts are calculated from SOC data on their frequency of telework (days/week), modes used on non-TW days, and travel distance from home to non-TW work location.

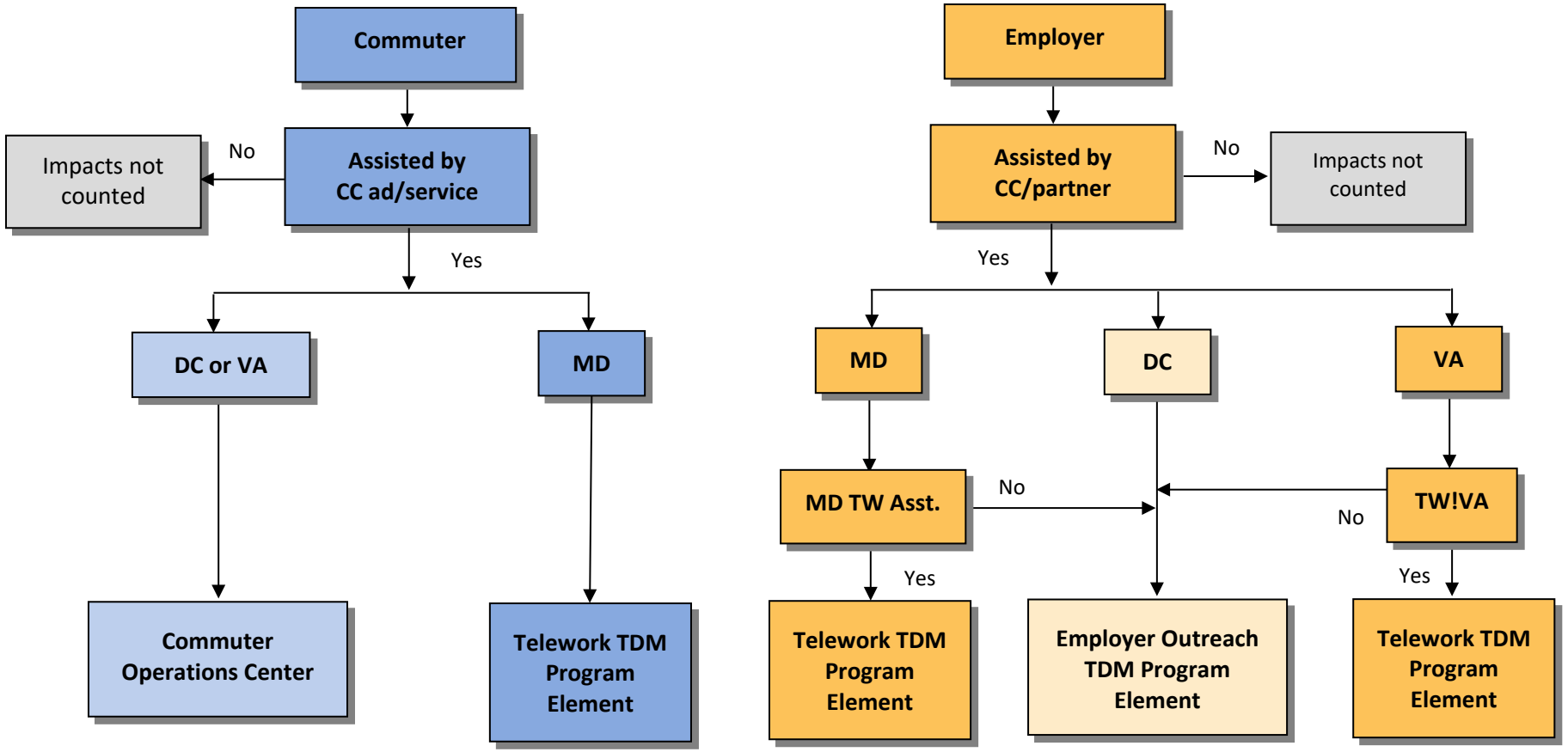
– ***Live and work outside Maryland*** – Impacts of assisted commuters who live AND work outside Maryland (e.g., DC, Virginia, or other state) are assigned to the Commuter Operations Center Program Element. Their vehicle trip and VMT reduction impacts are calculated from SOC data on their frequency of telework (days/week), modes used on non-TW days, and travel distance from home to non-TW work location.

Employers:

The right side of Figure C-1 shows assignment of telework impacts for employers. Impacts are assigned to one of three groups:

- TW impacts not counted
- Telework TDM Program Element
- Employer Outreach

Figure C-1
Assignment of Telework Impact to TDM Program Elements by Target Market, Location, and Services Received



Appendix C, continued

1 – Was employer assisted by Commuter Connections/partner program – Employer can receive telework assistance from several Commuter Connections-related sources:

– **Maryland Telework** – Employer is located in Maryland and is listed in MWCOG/CC assistance database (i.e., received assistance from MWCOG/Commuter Connections website, workshop, or other MWCOG/Commuter Connections resource). *Impacts are calculated and assigned in step 2.*

– **Telework!VA** – Employer is located in Virginia and received assistance through VDRPT's TW!VA program. *Impacts are calculated and assigned in step 2.*

– **Employer Outreach** – Employer is a client of one of the Commuter Connections local jurisdiction partner programs and the ACT! Database reported telework for the employer. *Impacts are calculated and assigned in step 2.*

– **No reported assistance** – Employer did not receive MD TW or TW!VA assistance and TW is not reported in the ACT! database. *Impacts not calculated.*

2 – Which assistance program was used – Assisted employers are separated into three categories, by the program used.

– **Maryland Telework assigned to Telework TDM Program Element** – Impacts of assisted employers who received Maryland TW assistance are assigned to the Telework TDM Program Element. These employers are surveyed by Commuter Connections in the Telework Assisted Employer survey to determine the number/percentage of employees who are teleworking. The telework impact is calculated as any increase in number of employees teleworking. Trips/VMT reduced are estimated by applying average TW frequency, drive-alone/carpool/vanpool mode use on non-telework days, and average commute distance from the SOC survey to the number of new telework employees at assisted worksites.

– **Telework!VA assigned to Telework TDM Program Element** – Impacts of assisted employers who received TW!VA assistance are assigned to the Telework TDM Program Element. Employees at assisted worksites are surveyed twice by VDRPT; baseline survey before assistance and follow-up survey after assistance. Their telework impact is calculated as the change in total telework days at the worksite from before assistance to after assistance. Trips/VMT reduced are estimated using data from the TW!VA surveys on average TW frequency, drive-alone/CP/VP mode use on non-telework days, and average commute distance.

– **Local Jurisdiction Partner Telework Assistance Assigned to Employer Outreach TDM Program Element** – Telework impacts of assisted employers that did not participate in either MD TW or TW!VA are assigned to the Employer Outreach TDM Program Element. Impacts of Employer Outreach assistance, both for telework and non-telework are estimated using the EPA COMMUTER model. The model estimates a final "with services" mode split that would be likely when a defined set of TDM services are offered to employees at the worksite with a starting "without services" mode split. The model estimates telework impacts from the percentage of employees who are reported to be teleworking and the mode split of employees on non-telework days.

3 – Adjustment to correct for overlap between Employer Outreach and MDTW and TW!VA – The final step in the calculation of assisted employer telework impacts is to check for overlap between Employer Outreach and the MDTW and TW!VA programs. The names and locations of MDTW and TW!VA assisted worksites are compared against the employers/worksites reporting telework in the Employer Outreach ACT! Database. If a MDTW or TW!VA employer or worksite is in the ACT! Database with telework reported, the telework portion of their EO impact is deducted from the total Employer Outreach impact so that the telework impacts are counted only once, in the Telework TDM Program Element. Impacts of other (non-telework) TDM services that the employer/worksite offers will continue to be included in the Employer Outreach calculation.

Appendix D
Sample Calculations of Maryland and Virginia Telework Assistance Impacts

3 impact components
- CC Assisted Telework – Maryland
- CC Assisted Telework – Non-Maryland
- Telework! VA

CC Assisted Telework – Maryland and Non-Maryland

Populations of Interest

All regional telecommuters	1,072,690	(from SOC survey)
Teleworkers with MD home or work	525,618	49% (from SOC survey)
Teleworkers not in MD	547,072	51% (from SOC survey)

Commuter Connections TW Placement Rates

Directly assisted TW

• Within Maryland	8.8%	(% of TC assisted by CC, from SOC survey)
• Not in Maryland	6.2%	(% of TC assisted by CC, from SOC survey)

TW Placements (Mixed home and Non-home based)

Maryland (credited to Telework Program Element)

• Directly assisted telecommuters	46,254	(regional TC x directly assisted placement rate)
Total assisted telecommuters - MD	**46,254**	

Not Maryland (to be credited to COC)

• Directly assisted telecommuters	33,918	(regional TC x directly assisted placement rate)
• Telecommuters at TW assisted sites	0	(employees at assisted sites x assisted site placement rate)
Total assisted telecommuters – Not MD	**33,918**	

Placements by Location (home-based and non-home-based)

• % Home-based telecommuters	91%	(from SOC survey)
• % Non-home (NH)-based telecommuters	9%	(from SOC survey)

Maryland (credited to Telework Program Element)

• Home-based telecommuters	42,091	(total assisted TW x % Home-based TW)
• NH-based telecommuters	4,163	(total assisted TW x % NH-based TW)

Not Maryland (credited to COC)

• Home-based telecommuters	30,865	(total assisted TW x % Home-based TW)
• NH-based telecommuters	3,053	(total assisted TW x % NH-based TW)

Appendix D, continued

Daily Vehicle Trips Reduced

VTR Factors

• Home-based factor – MD	0.32	(from SOC survey)
• Home-based factor – Not MD	0.22	(from SOC survey)
• NH-based factor – MD and Not-MD	0.04	(from SOC survey)

Maryland (credited to Telework Program element)

• Home-based VT reduced	13,469	(HB TW x HB VTR factor)
• NH-based VT reduced	167	(NH-based TW x NH VTR factor)
Daily Vehicle Trips Reduced - MD	**13,636**	

Not Maryland (credited to COC)

• Home-based VT reduced	6,790	(HB TW x HB VTR factor)
• NH-based VT reduced	122	(NH-based TW x NH VTR factor)
Daily Vehicle Trips Reduced – Not MD	**6,912**	

Daily VMT Reduced

Ave one-way trip distance (mi) to main workplace

• Home-based – MD	22.7	(SOC survey)
• Home-based – Not MD	14.9	(SOC survey)

Ave one-way trip distance (mi) for non-home-based TW (MD and Not-MD)

• Non-home based – to main workplace	21.6	(SOC survey)
• Non-home based – to TW location	8.1	(SOC survey)
• Non-home based – net VMT reduced	13.5	(SOC survey)

VMT reductions on TW days

Maryland (credited to Telework Program Element)

• Home-based VMT reduced	305,746	(HB VT reduced x average OW miles to main workplace)
• NH-based VMT reduced	2,255	(NHB VT reduced x net OW miles reduced per trip)
Daily VMT Reduced - MD	**308,001**	

Not Maryland (credited to COC)

• Home-based VMT reduced	101,171	(HB VT reduced x average OW miles to main workplace)
• NH-based VMT reduced	1,647	(NHB VT reduced x net OW miles reduced per trip)
Daily VMT Reduced – Not MD	**102,818**	

Appendix D, continued

Maryland (credited to Telework Program Element)

Daily Emissions Reduced – NOx and VOC

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	13,636	1.0309			14,057	0.0155
• From Running			308,001	0.1498	46,139	0.0509
Total NOx reduced (tons)					**Daily**	**0.0664**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	13,636	2.1358			29,124	0.0321
• From Running			308,001	0.0593	18,264	0.0201
Total VOC reduced (tons)					**Daily**	**0.0522**

Annual Emissions Reduced – CO2

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	13,636	212.54			2,898,195	3.19
• From Running			308,001	362.93	111,782,803	123.22
Total CO2 reduced (tons)					**Daily**	**126.41**
					Annual	**31,602.5**

Non-Maryland (credited to COC)

Daily Emissions Reduced – NOx and VOC

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	6,912	1.0309			7,126	0.0079
• From Running			102,818	0.1498	15,402	0.0170
Total NOx reduced (tons)					**Daily**	**0.0249**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	6,912	2.1358			14,763	0.0163
• From Running			102,818	0.0593	6,097	0.0067
Total VOC reduced (tons)					**Daily**	**0.0230**

Annual Emissions Reduced – CO2

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	6,912	212.54			1,469,076	1.62
• From Running			102,818	362.93	37,315,737	41.13
Total CO2 reduced (tons)					**Daily**	**42.75**
					Annual	**10,687.5**

Appendix D, continued

Telework! VA

Populations of Interest

Employees at TW! VA worksites	10,041	(from TW! VA data)

TW! VA Placements

• Placement rate-assisted worksites	19.1%	(from TW baseline/post-assistance surveys)
Total Placements	**1,918**	

Daily Vehicle Trips Reduced

• Continued VTR factor	0.28	(from TW baseline/post-assistance surveys)
Total Daily Vehicle Trips Reduced	**537**	

Daily VMT Reduced

• Ave one-way trip dist (mi)	18.3	(from TW post-assistance survey)
Total Daily VMT Reduced	**9,827**	

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	537	1.0309			554	0.0006
• From Running			9,827	0.1498	1,472	0.0016
Total NOx reduced (tons)					**Daily**	**0.0022**

VOC	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	537	2.1358			1,147	0.0013
• From Running			9,827	0.0593	583	0.0006
Total VOC reduced (tons)					**Daily**	**0.0019**

Annual Emissions Reduced – and CO2

CO2	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	537	212.54			114,134	0.13
• From Running			9,827	362.93	3,566,513	3.93
Total CO2 reduced (tons)					**Daily**	**4.06**
					Annual	**1,015.0**

Appendix E
Sample Calculations of Guaranteed Ride Home Impacts

Populations of Interest

FY 2018-20 Registrant Base (New credit)

• New GRH registrants (FY 2018-20)	7,429	(GRH database)
• Re-registrants from FY 2018	5,515	(Commuter Connections archive database)
• One-time exceptions (FY 2018-20)	0	(GRH database)
New FY 2018-20 GRH base	**12,944**	

Pre-FY 2018 Registrant Base (Retained credit)

• GRH registrants Pre-FY 2018	29,348	(COC GRH/Online databases)
• Valid contact percentage	63%	(Retention rate survey)
Retained Pre-FY 2018 GRH base	**18,489**	

Distribution of In/Out NAA

FY 2018-20 Registrant Base (New)

Within NAA	65%	8,414
Outside NAA	35%	4,530

Pre-FY 2018 Registrant Base (Retained)

Within NAA	65%	12,018
Outside NAA	35%	6,471

GRH Placement Rates and Placements (continued only) (NAA base x NAA placement rate)

FY 2018-20 Registrants (New)

• Within NAA rate	43.7%	3,677
• Outside NAA rate	50.9%	2,306

Pre-FY 2018 Registrants (Retained)

• Within NAA rate	12.2%	1,466
• Outside NAA rate	12.2%	789
Total Placements		**8,238**

VTR Factors and Daily Vehicle Trips Reduced (continued only) (NAA placement x NAA VTR factor)

FY 2018-20 Registrants (New)

• Within NAA VTR factor	0.83	3,052
• Outside NAA VTR factor	1.00	2,306

Pre-FY 2018 Registrants (Retained)

• Within NAA VTR factor	0.31	454
• Outside NAA VTR factor	0.31	245
Total Daily Vehicle Trips Reduced		**6,057**

Commute Distance and Daily VMT Reduced (NAA VT reduced x NAA distance)

FY 2018-20 Registrants (New)

• Within NAA distance	28.1	85,761	
• Outside NAA distance	28.1	64,799	(discount actual 49.8 miles from GRH survey)

Pre-FY 2018 Registrants (Retained)

• Within NAA distance	29.9	13,575
• Outside NAA distance	29.9	7,326
Total Daily VMT Reduced		**171,461**

Appendix E, continued

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

Inside NAA

- SOV access percentage 80% (GRH survey)
- SOV access distance (mi) 5.7 (GRH survey)

Outside NAA

- Adjustments are not applicable, because all access VT and VMT occur outside NAA

Adjusted VT Reduction – net of VMT access

- Total VT reduced 6,057
- Within NAA access VT (deduct) - 2,805 (Total VT reduction within NAA x SOV access %)
- Outside NAA access VT 0 No deduction (access trips are outside NAA)

Total VT for AQ analysis 3,252

Adjusted VMT Reduction – net of VMT access

- Total VMT reduced 171,461
- Within NAA access VMT (deduct) - 15,989 (SOV Access VT within NAA x SOV access distance)
- Outside NAA access VMT 0 No deduction (access VMT are outside NAA)

Total VMT for AQ analysis 155,472

Daily Emissions Reduced – NOx and VOC

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	3,252	1.0309			3,352	0.0037
• From Running			155,472	0.1498	23,290	0.0257
Total NOx reduced (tons)					**Daily**	**0.0294**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	3,252	2.1358			6,946	0.0077
• From Running			155,472	0.0593	9,219	0.0102
Total VOC reduced (tons)					**Daily**	**0.0179**

Annual Emissions Reduced – CO2

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	3,252	212.54			691,180	0.762
• From Running			155,472	362.93	56,425,453	62.198
Total CO2 reduced (tons)					**Daily**	**62.960**
					Annual	**15,740.1**

Appendix E, continued

Correction for Overlap with Mass Marketing

The GRH results were adjusted to eliminate double counting between GRH and Mass Marketing for new GRH applicants. About 16% of the FY 2018 – FY 2020 GRH impacts were assigned to Mass Marketing to recognize that 31% of new GRH applicants were influenced to apply for GRH after hearing a Mass Marketing advertisement. These new applicants accounted for 57% of the total GRH applicants (Reapply + New). The 12% of total impacts generated through Retained GRH users were excluded from the base. This calculation resulted in 16% of the GRH credit being assigned to Mass Marketing (31% x 57% new apps x 88% non-retained impacts).

Total GRH apps FYs 18, 19, 20	12,944	
New GRH apps FY 18, 19, 20	7,429	57%
Estimated MM share of new GRH	31%	
FY 2018-20 VMT as % of total VMT	88%	(Exclude Retained credit from discount)
Estimated MM share of GRH impact	16%	

Net GRH = GRH Base Total – Mass Marketing credit

	GRH Base Total	**GRH Excl Retained**	**Mass Mkt Credit**	**Net GRH Credit**
Placements	8,238	5,983	957	7,281
Vehicle Trips reduced	6,057	5,358	857	5,200
VMT reduced (mi)	171,461	150,560	24,090	147,371
Daily Emissions Reduced				
NOx (T)	0.0294	0.0259	0.0041	0.0253
VOC (T)	0.0179	0.0158	0.0025	0.0154
Annual Emissions Reduced				
CO2 (T)	15,740.1	13,851.3	2,214.7	13,523.9

Appendix F
Sample Calculation of Employer Outreach Impacts

Populations of Interest

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

	Employers	Employees
• Programs unchanged since 2017	1,589	516,062
• Expanded programs in 2020	80	21,359
• New programs in 2020	293	92,622
• Deleted programs since 2017	293	106,764

Average Vehicle Occupancy (AVO)

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

	Starting AVO	Ending AVO
• Programs unchanged since 2017	1.2718	1.3953
• Expanded programs – continued base	1.3412	1.4529
• Expanded programs – new impacts	1.4529	1.5394
• New programs	1.1740	1.2527
• Deleted programs	1.2220	1.3714

Daily person trips

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

	Starting	Ending
• Programs unchanged since 2017	1,032,124	1,032,124
• Expanded programs	42,718	43,718
• New programs	185,244	185,244
• Deleted programs	213,528	213,528

Daily vehicle trips

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

	Starting	Ending	Difference
• Programs unchanged since 2017	811,546	739,715	71,831
• Expanded programs – maintained base	31,851	29,402	2,449
• Expanded programs – new impact	29,402	27,750	1,652
• New programs	157,789	147,876	9,913
• Deleted programs	174,736	155,701	(19,035)

Total Daily Vehicle Trips Reduced

• Maintained impacts from 2017	74,280
• New/expanded impacts	11,565
Net 2020 reduction	**85,845**

Appendix F, continued

Daily VMT reduced

Results produced by COMMUTER model, assuming travel distance by mode from SOC survey

- Programs unchanged since 2017 1,256,202
- Expanded programs – maintained base 44,810
- Expanded programs – new impact 12,536
- New programs 175,617
- Deleted programs (336,703)

Total Daily VMT Reduced

- Maintained impacts from 2017 1,301,012
- New/expanded impacts 188,153

Net 2020 reduction 1,489,165

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

- Non-SOV access percentage 68% (from 2019 SOC survey)
- SOV access percentage 32% (from 2019 SOC survey)
- SOV access distance (mi) 2.8 (from 2019 SOC survey)

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

(Total VT reduced x non-SOV access %)

- Maintained impacts from 2017 50,510
- New/expanded impacts 7,864

VMT Reduction without SOV access

(Total VMT reduced – (Total daily VT reduced x SOV % x SOV access trip distance))

- Maintained impacts from 2017 1,234,456
- New/expanded impacts 177,790

Emissions Reduced – Maintained from 2017

Daily Emissions Reduced – NOx and VOC

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	50,510	1.0309			52,071	0.0574
• From Running			1,234,456	0.1498	184,922	0.2038
Total NOx reduced (tons)					**Daily**	**0.2612**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	50,510	2.1358			107,879	0.1189
• From Running			1,234,456	0.0593	73,203	0.0807
Total VOC reduced (tons)					**Daily**	**0.1996**

Appendix F, continued

Annual Emissions Reduced – CO2

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	50,510	212.54			10,735,395	11.834
• From Running			1,234,456	362.93	448,021,116	493.859
Total CO2 reduced (tons)					**Daily**	**505.692**
					Annual	**126,423.1**

Emissions Reduced - New / Expanded

Daily Emissions Reduced – NOx and VOC

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	7,864	1.0309			8,107	0.0089
• From Running			177,790	0.1498	26,633	0.0294
Total NOx reduced (tons)					**Daily**	**0.0383**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	7,864	2.1358			16,796	0.0185
• From Running			177,790	0.0593	10,543	0.0116
Total VOC reduced (tons)					**Daily**	**0.0301**

Annual Emissions Reduced – CO2

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	7,864	212.54			1,671,415	1.842
• From Running			177,790	362.93	64,525,325	71.127
Total CO2 reduced (tons)					**Daily**	**72.969**
					Annual	**18,242.35**

Distribution of Employer Outreach Impacts to EO Base and EO for Bicycling

	Total EO	EO w/o bike	EO-bike
Vehicle Trips Reduced	85,845	85,396	449
VMT Reduced (miles)	1,489,165	1,487,279	1,886
Daily Emissions Reduced			
NOx (tons)	0.2995	0.2987	0.0008
VOC (tons)	0.2297	0.2285	0.0012
Annual Emissions Reduced			
CO2 (T)	144,665.4	144,450.5	214.9

Appendix F, continued

COMMUTER CONNECTIONS
EMPLOYER SERVICES PARTICIPATION LEVELS
(EFFECTIVE Retroactively to July 1, 2015)
October 20, 2015

SUPPORT STRATEGIES

Likely range of trip reduction **0%**

- Expresses Interest and/or distributes/displays information on Ozone Actions Days

LEVEL 1 (BRONZE)

Likely range of trip reduction **0% to 1%**

- Expresses interest in telework, transit benefits, Smart Benefits, or other TDM strategy
- Conducts Commuter Survey
- Distributes alternative commute info to employees
- Posts alternative commute information on employee bulletin board(s), intranet sites, newsletter or e-mail
- Installs Electric Car Charging Station(s) at worksite

LEVEL 2 (SILVER) – **Implements two or more of the following strategies**

Likely range of trip reduction **0% to 3% without Telework/Compressed Work Schedules**
0% to 9% with Telework/Compressed Work Schedules

- Installs a permanent display case or brochure holders and stock with alternative commute information
- Installs electronic screens or desktop feed of real-time travel information for transit and/or other alternative mode availability.
- Participates in the Capital Bikeshare Program as a Corporate Partner
- Provides preferential parking for carpools and vanpools
- Implements a telework program with 1-20% of employees participating
- Facilitates car/vanpool formation meetings
- Hosts/sponsors an alternative commute day or transportation fair
- Implements flex-time or staggered work schedule
- Implements compressed work week for 1-20% of employees
- Installs bicycle racks or lockers
- Installs shower facilities for bicyclists and walkers
- Establishes an ETC who regularly provides alternative commute information to employees
- Becomes a Commuter Connections member and provides on-site ridematching
- Supplements GRH program with payment for additional trips or own program

Appendix F, continued

LEVEL 3 (GOLD)

Implements at least one of the following (in addition to the two or more Level 2 strategies):

Likely range of trip reduction **2% to 5% without financial incentive/disincentive, Telework/Compressed Work Schedules**
5% to 20% with financial incentive/disincentive, Telework/Compressed Work Schedules

- Implements a telework program with more than 20% of employees participating
- Implements compressed work week for 21%+ of employees
- Implements a transit/vanpool benefit, Smart Benefits, Federal Bicycle Benefit, or parking "cash out" program
- Implements a carpool/bicycle/walk benefit
- Provides free or significantly reduced fee parking for carpools and vanpools (valid only for companies where employees pay for parking)
- Implements a parking fee (valid only for companies that previously did not charge for parking)
- Provides employee shuttle service to transit stations
- Provides company vanpools for employees' commute to work
- Implements a comprehensive Bicycle/Walking program (includes installation of showers bicycle racks/lockers, and financial incentives for bicycling and/or walking, or a Capital Bikeshare Station)

LEVEL 4 (PLATINUM)

Likely range of trip reduction **2% to 8% without financial incentive, Telework/Compressed Work Schedules**
5% to 30% with financial incentive, Telework/Compressed Work Schedules

- Implements two or more of the Level 3 TDM programs (in addition to the 2 or more Level 2 strategies) and actively promotes these programs and alternative commuting

Appendix G
Sample Calculation of Mass Marketing Impacts

6 impact components
- Part 1 – Commuters influenced by ads to change mode – no contact CC (direct influence)
- Part 2 – 'Pool Rewards carpool/vanpool incentive participants
- Part 3 – Car-Free Day event
- Part 4 – Bike to Work Day event
- Part 5 – Commuters influenced by ads to contact CC (referred influence)
- Part 6 – Commuters influenced by ads to join GRH (referred influence)

PART 1 – Direct Ad Influence

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

Total commuters in region	3,044,554	(SOC)
• % recall any commute message	45%	(SOC)
• % recall CC/COG commute message	14%	(SOC)
• % chg to alt mode after CC/COG ads	11.5%	(SOC)
• % changers influenced by ad	57%	(SOC)
Placements – no contact with CC	**27,940**	(Commuters x CC recall X change % x influence %)
Placement Rates		
• Continued placement rate	46%	(SOC)
• Temporary placement rate	54%	(SOC)
Placements		
• Continued placements	12,852	(Placements x continued placement rate)
• Temporary placements	15,088	(Placements x temporary placement rate)
Daily Vehicle Trips Reduced		
• Continued VTR factor	0.73	(SOC)
• Temporary VTR factor	1.00	(SOC)
• Continued VT reduced	9,382	(Continued placements x continued VTR factor)
• Temporary VT reduced	604	(Temporary placements x temporary VTR factor x 4% credit for temporary use – Ave use of 2 weeks/50 work weeks)
Total Daily Vehicle Trips Reduced	**9,986**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)	20.4	(SOC)
Total Daily VMT Reduced	**203,714**	

Appendix G, continued

PART 1 (Direct Ad Influence) (cont.)

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

• SOV access percentage	30%	(from SOC – transit riders)
• SOV access distance (mi)	2.7	(from SOC – transit riders)

Adjusted VT Reduction

• SOV access VT	2,996	(Total VT x SOV access %)
• VT with no SOV access	6,990	(Total VT – SOV access VT)

Adjusted VMT Reduction

• SOV access VMT	8,089	(Total VT x SOV % x 2.7 mi access distance)
• VMT with no SOV access	195,625	(Total VMT – SOV access VMT)

Total VT for AQ analysis	**6,990**
Total VMT for AQ analysis	**195,625**

PART 2 – 'Pool Rewards Carpool/Vanpool Participants

Carpool program participants (FY 2018-20)	92
Vanpool program participants (FY 2018-20)	131

Placement Rates – by retention after program ended

Carpool Component

• Continued placement rate	87%	('Pool Rewards follow-up survey)
• Temporary placement rate	13%	('Pool Rewards follow-up survey)

Vanpool Component

• Continued placement rate	74%	('Pool Rewards NTD vanpool data)
• Temporary placement rate	26%	('Pool Rewards NTD vanpool data)

Placements

Carpool Component

• Continued placements	80	(Participants x continued placement rate)
• Temporary placements	12	(Participants x temporary placement rate)
Carpool placements	**92**	

Vanpool Component

• Continued placements	97	(Participants x continued placement rate)
• Temporary placements	34	(Participants x temporary placement rate)
Vanpool placements	**131**	
Total 'Pool Rewards placements	**223**	

Appendix G, continued

PART 2 ('Pool Rewards) (cont.)

Daily Vehicle Trips Reduced

Carpool Component		
• Continued VTR factor	1.00	('Pool Rewards follow-up survey)
• Temporary VTR factor	0.96	('Pool Rewards logging data for program period)
• Temporary discount	50%	(assumes 13 weeks of program + 13 weeks after program)
• Continued VT reduced	80	(Continued placements x continued VTR factor)
• Temporary VT reduced	6	(Temporary placements x temporary VTR factor x 50% credit for temporary use)
Carpool VT Reduced	**86**	
Vanpool Component		
• Continued VTR factor	1.72	('Pool Rewards NTD vanpool data)
• Temporary VTR factor	1.32	('Pool Rewards NTD vanpool data)
• Temporary discount	50%	(Ave temporary vanpool duration = 1.5 yr of 3 yr total)
• Continued VT reduced	167	(Continued placements x continued VTR factor)
• Temporary VT reduced	23	(Temporary placements x temporary VTR factor x 50% credit for temporary use)
Vanpool VT Reduced	**190**	
Total Daily Vehicle Trips Reduced	**276**	

Daily VMT Reduced

Carpool Component		
• Ave continued one-way trip dist (mi)	28.2	('Pool Rewards follow-up survey)
• Ave temporary one-way trip dist (mi)	28.2	('Pool Rewards follow-up survey)
• Continued VMT reduced	2,256	(Continued VT reduced x continued trip distance)
• Temporary VMT reduced	169	(Temporary VT reduced x temporary trip distance)
Carpool VMT Reduced	**2,425**	
Vanpool Component		
• Ave continued one-way trip dist (mi)	39.5	('Pool Rewards NTD vanpool data)
• Ave temporary one-way trip dist (mi)	38.9	('Pool Rewards NTD vanpool data)
• Continued VMT reduced	6,596	(Continued VT reduced x continued trip distance)
• Temporary VMT reduced	895	(Temporary VT reduced x temporary trip distance)
Vanpool VMT Reduced	**7,491**	
Total Daily VMT Reduced	**9,916**	

Appendix G, continued

PART 2 ('Pool Rewards) (cont.)

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

• SOV access percentage (carpool)	69 %	(SOC survey)
• SOV access percentage (vanpool)	86 %	(Placement survey)
• SOV access distance (mi) (carpool)	6.0	(SOC survey)
• SOV access distance (mi) (vanpool)	7.0	(Placement survey)

Adjusted VT Reduction

Carpool Component

• SOV access VT	59	(Total VT x SOV access %)
• **VT with no SOV access**	**27**	(Total VT – SOV access VT)

Vanpool Component

• SOV access VT	163	(Total VT x SOV access %)
• **VT with no SOV access**	**27**	(Total VT – SOV access VT)

Adjusted VMT Reduction

Carpool Component

• SOV access VMT	354	(Total VT x SOV % x 6.0 mi access distance)
• **VMT with no SOV access**	**2,071**	(Total VMT – SOV access VMT)

Vanpool Component

• SOV access VMT	1,141	(Total VT x SOV % x 7.0 mi access distance)
• **VMT with no SOV access**	**6,350**	(Total VMT – SOV access VMT)

Total VT for AQ analysis	**54**
Total VMT for AQ analysis	**8,421**

PART 3 – Car Free Day Event

Pledges (estimate 90% participation of pledges)

Total participants	18,731	(Pledges, 2017, 2018, 2019)
Number of unique participants	14,302	(Pledges, 2017, 2018, 2019 adjusted for participation in more than one event)

Placements (day of event)

• Participated in CFD for work trip	86%	(CFD follow-up survey)
• Used new alt mode for work trip	16%	(CFD follow-up survey)
• Event day commute placement rate	14%	(86% work participation x 16% new mode for work trip)
• Event day placements	2,622	(Participants x placement rate)

Total Event Day Placements	**2,622**

Event Impacts

Daily Vehicle Trips Reduced

• Event day VTR factor	1.43	(CFD follow-up survey)
• Event VT reduced	3,754	(Placements x event VTR factor)
• **Equivalent daily VT**	**5**	(Event VT reduced / 750 days over 3 years)

Appendix G, continued

PART 3 (Car-Free Day) (continued)

Event Impacts (continued)

Daily VMT Reduced

• Ave one-way trip distance (mi)	14.9	(CFD follow-up survey)
• Event VMT reduced	55,935	(Event VT reduced x 14.9 trip distance)
• **Equivalent daily VMT**	**75**	(Event VMT reduced / 750 days over 3 years)

Car Free Day Ongoing Impacts (from continued use of new alt modes for commuting after event)

Placements (ongoing following event)

• Number of unique participants	14,302	Calculated above
• Participant employed %	97%	(CFD follow-up survey)
• Cont placement rate (increased alt use)	11%	(CFD follow-up survey)
• Post-event ongoing placements	1,526	(Participants x placement rate)

Total Ongoing Placements	**1,526**

Daily Vehicle Trips Reduced

• Ongoing VTR factor (after CFD)	0.66	(CFD follow-up survey)
• **Ongoing daily VT reduced**	**1,007**	(Ongoing participants x ongoing VTR factor)

Daily VMT Reduced

• Trip distance	14.9	(CFD follow-up survey)
• **Ongoing daily VMT**	**15,004**	(Ongoing daily VT x trip distance)

Total Impacts – Event Day + Ongoing

Total Daily VT Reduced	**1,012**	(Event equivalent daily VT + ongoing daily VT)
Total Daily VMT Reduced	**15,079**	(Event equivalent daily VMT + ongoing daily VMT)

Summary of Travel Impacts for Parts 1, 2, 3

	Total 1, 2, 3	Direct Ads	'Pool Rewards	Car Free Day
Placements (ongoing)	29,689	27,940	223	1,526*
Vehicle Trips Reduced	11,274	9,986	276	1,012
VMT Reduced (miles)	228,709	203,714	9,916	15,079
Air Quality Adjusted VT / VMT				
Vehicle Trips Reduced	8,056	6,990	54	1,012
VMT Reduced (miles)	219,125	195,625	8,421	15,079

* Car Free Day ongoing placements = e.g., commuters who switched to alt mode for continued commuting after event

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Daily Emissions Reduced – NOx and VOC – Parts 1, 2, 3

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,056	1.0309			8,305	0.0092
• From Running			219,125	0.1498	32,825	0.0362
Total NOx reduced (tons)					**Daily**	**0.0454**

Appendix G, continued

Daily Emissions Reduced – NOx and VOC (continued) – Parts 1, 2, 3

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,056	2.1358			17,206	0.0190
• From Running			219,125	0.0593	12,994	0.0143
Total VOC reduced (tons)					**Daily**	**0.0333**

Annual Emissions Reduced – CO2 – Parts 1, 2, 3

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,056	212.54			1,712,222	1.887
• From Running			219,125	362.93	79,527,036	87.664
Total CO2 reduced (tons)					**Daily**	**89.551**
					Annual	**22,387.8**

PART 4 - Bike to Work Day Credit

Participants' riding percentage and frequency

Number of riders	25,504	(BTWD registration data, 2017, 2018 and 2019 adjusted for some participation in previous year)
% biking to work before event	87.4%	(BTWD survey)
% new riders	7.4%	(BTWD survey)
Number of new riders	1,887	
% who increase riding days	19.3%	(BTWD survey)
Number of increased riders	4,922	
Total placements	**6,809**	(Total new + increased riders)

Change in Bike Days

Summer Biking		
% new riders in summer	6.6%	(BTWD survey)
Weekly new bike days summer	1.6	(BTWD survey)
Weekly new bike days summer	2,693	(total riders x % new ride summer x ave days biking summer)
% increased riders in summer	16.3%	(BTWD survey)
Weekly increased bike days summer	1.7	(BTWD survey)
Weekly increased bike days summer	7,067	(total riders x % inc ride summer x ave days biking summer)
Winter Biking		
% new riders biking winter	5.3%	(BTWD survey)
Weekly new bike days winter	1.4	(BTWD survey)
Weekly new bike days winter	1,892	(total riders x % new ride winter x ave days biking winter)
% increased riders biking winter	12.1%	(BTWD survey)
Weekly increased bike days winter	1.9	(BTWD survey)
Weekly increased bike days winter	5,863	(total riders x % incr ride winter x ave days biking winter)

Appendix G, continued

PART 4 (Bike to Work Day) (continued)

Additional Bike Days (New and Increased Riding)

• NEW/INC bike days summer	9,760	(weekly new and increased bike days summer)
• NEW/INC bike days fall-winter	7,755	(weekly new and increased bike days winter)
• Total additional bike days summer	273,280	(new/inc weekly summer days x 28 weeks – Apr-Oct)
• Total additional bike days winter	170,610	(new/inc weekly winter days x 22 weeks – Nov-Mar)
• Total additional bike days - year	443,890	(summer bike days + winter bike days)
• Additional bike trips - year	887,780	(annual bike days x 2 trips per day)

Additional Bike Trips and Vehicle Trip and VMT Reductions

• Ave new daily bike trips	3,551	(Annual new bike trips / 250)
• % Drive alone/CP/VP on non-bike days	43%	(BTWD survey)
BTWD Daily Vehicle Trips Reduced	**1,527**	(daily new bike trips x DA/CP/VP percentage)

Daily VMT Reduced

• Ave trip distance (mi)	9.0	(BTWD survey)
BTWD Daily VMT Reduced	**13,743**	(vehicle trips reduced x average trip distance)

Daily Emissions Reduced – NOx and VOC – Bike to Work Day

NOx	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,527	1.0309			1,574	0.0017
• From Running			13,743	0.1498	2,059	0.0023
Total NOx reduced (tons)					**Daily**	**0.0040**

VOC	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,527	2.1358			3,261	0.0036
• From Running			13,743	0.0593	815	0.0009
Total VOC reduced (tons)					**Daily**	**0.0045**

Annual Emissions Reduced – CO2 – Bike to Work Day

CO2	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,527	212.54			324,549	0.358
• From Running			13,743	362.93	4,987,747	5.498
Total CO2 reduced (tons)					**Daily**	**5.856**
					Annual	**1,463.9**

Appendix G, continued

PART 5 – Referred Influence (Commuter Operations Center)

Mass Marketing received a 2.6% portion of the impacts calculated for the Commuter Operation Center. This credit recognized that 12.3% of the commuters who were new COC applicants reported in the Applicant Placement survey that they were influenced to contact Commuter Connections hearing a Mass Marketing advertisement. New applicants accounted for 21.3% of the total COC applicants (Excluding Retained Past applicants). This calculation resulted in 2.3% of the COC credit being assigned to Mass Marketing (21.3% new apps x 12.3% influence).

Populations of Interest – commuters influenced by ads to contact CC

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

• FY 2018	5,178	(CC database)
• FY 2019	5,497	(CC database)
• FY 2020 (through June 2020)	5,451	(CC database)
Total new applicants	**16,126**	
Total CC applicants	75,651	(includes new, re-apply, and follow-up)
New apps FY 2018-20 as % of total	21.3%	(new apps FY 2018-20 / total CC apps)
% influenced by ads to contact CC	12.3%	(COC applicant analysis; 2017 Applicant placement survey)
% ALL apps influenced by ads	2.6%	(21.3% new apps x 12.3% influenced by ads)

COC Impacts – MM Share (2.6% of total COC base for each impact below)

Travel Impacts	**MM Share**	**COC base (2018-2020, excluding retained credit)**
• CC placements	818	31,446
• CC Vehicle trips reduced	373	14,350
• CC VMT reduced	10,969	421,887

Emissions Impacts	**MM Share**	**COC base (2018-2020, excluding retained credit)**	
• NOx reduced (daily tons)	0.0019	0.0745	Daily
• VOC reduced (tons)	0.0012	0.0455	Daily
• CO2 reduced (tons)	1,036.9	39,881.4	Annual

PART 6 – Referred Influence to GRH – From GRH Analysis

About 16% of the GRH impacts were assigned to Mass Marketing to recognize that 31% of new GRH applicants were influenced to apply for GRH after they heard a Mass Marketing advertisement. These new applicants accounted for 57% of the total GRH applicants (Reapply + New). The 12% of total impacts generated through Retained GRH users were excluded from the base. This calculation resulted in 16% of the GRH credit being assigned to Mass Marketing (31% x 57% new apps x 88% non-retained impacts).

Total GRH apps FYs 18, 19, 20	12,944	
New GRH apps FY 18, 19, 20	7,429	57%
Estimated MM share of new GRH	31%	
FY 2018-20 VMT as % of total VMT	88%	(Exclude Retained credit from discount)
Estimated MM share of GRH impact	16%	(57% of total applicants x 31% MM credit-new applicants x 88% new/reapply)

GRH Impacts – FY 2018-20 (16% of total COC base for each impact below)

Travel Impacts	**MM Share**	**GRH base (2018-2020, excluding retained credit)**
• GRH placements	957	5,983
• GRH Vehicle trips reduced	857	5,358
• GRH VMT reduced	24,090	150,560

Appendix G, continued

PART 6 (Referred Influence for GRH) (continued)

Emissions Impacts	MM Share	GRH base (2018-2020, excluding retained credit)	
• NOx reduced (daily tons)	0.0041	0.0259	Daily
• VOC reduced (tons)	0.0025	0.0158	Daily
• CO2 reduced (tons)	2,216.2	13,851.7	Annual

Mass Marketing – Summary

Total – Sum of PART 1, PART 2, PART 3, PART 4, PART 5, PART 6 (See above for individual calculations)

Travel Impacts	Total MM	Direct Ad Infl	'Pool Rewards	Car Free Day	BTW	COC Credit	GRH Credit
Placements	38,273	27,940	223	1,526	6,809	818	957
VT reduced	14,031	9,986	276	1,012	1,527	373	857
Percentage total MM VT		71%	2%	7%	11%	3%	6%
VMT reduced	277,511	203,714	9,916	15,079	13,743	10,969	24,090

Emissions Impacts	Total MM	Direct Ad Infl	'Pool Rewards	Car Free Day	BTW	COC Credit	GRH Credit
Daily Emissions Reduced							
NOx (T)	0.0554		0.0454		0.0040	0.0019	0.0041
VOC (T)	0.0415		0.0333		0.0045	0.0012	0.0025
Annual Emissions Reduced							
CO2 (T)	27,104.8		22,387.8		1,463.9	1,036.9	2,216.2

Appendix H
Sample Calculation of Commuter Operations Center Impacts

PART 1 – Commute Information Requests

Populations of Interest – Commuter Connections Rideshare Applicants

FY 2018-20 Applicant Base (New credit) New, Reapply, Transit/other, follow-up requests

• FY 2018	26,348	(CC database)
• FY 2019	24,153	(CC database)
• FY 2020	25,150	(CC database)
New FY 2018-20 assisted commuters	**75,651**	

Pre-FY 2018 Applicant Base (Retained credit)

• Applicants Pre-FY 2018	6,327	(CC database)
• Valid contact percentage	52%	(Retention rate survey)
Retained Pre-FY 2018 applicant base	**3,290**	

Distribution of In/Out NAA

FY 2018-20 Applicant Base (New)			
Within NAA	63%	47,660	(Commuter Connections placement survey)
Outside NAA	37%	27,991	(Commuter Connections placement survey)
Pre-FY 2018 Applicant Base (Retained)			
Within NAA	63%	2,073	
Outside NAA	37%	1,217	

COC Placement Rates and Placements

(NAA applicant base x NAA placement rate; calculated for continued, temporary, and retained cases)

FY 2018-20 Applicants (New)	**Pl Rate**	**Placements**	
• Within NAA – continued rate	35.5%	16,919	(Commuter Connections placement survey)
• Within NAA – temporary rate	5.4%	2,574	(Commuter Connections placement survey)
• Outside NAA – continued rate	37.8%	10,581	(Commuter Connections placement survey)
• Outside NAA – temporary rate	4.9%	1,372	(Commuter Connections placement survey)
Pre-FY 2018 Registrants (Retained)			
• Within NAA – continued rate	16.6%	344	(Retention rate survey)
• Outside NAA – continued rate	16.6%	202	(Retention rate survey)
Total Placements		**31,992**	

Appendix H, continued

PART 1 – Commute Information Requests (continued)

VTR Factors and Daily Vehicle Trips Reduced (continued only)
(NAA cont. placement x NAA cont. VTR factor); (NAA temp placement x NAA temp VTR factor x temp discount)

FY 2018-20 Applicants (New)	**VTR Factor**	**VT Reduced**	
• Temporary discount	16.0%		
• Within NAA – continued VTR factor	0.50	8,460	(Commuter Connections placement survey)
• Within NAA – temporary VTR factor	0.37	152	(Commuter Connections placement survey)
• Outside NAA – continued VTR factor	0.53	5,608	(Commuter Connections placement survey)
• Outside NAA – temporary VTR factor	0.59	130	(Commuter Connections placement survey)
Pre-FY 2018 Applicants (Retained)			
• Within NAA – continued VTR factor	0.73	251	(Retention rate survey)
• Outside NAA – continued VTR factor	0.73	147	(Retention rate survey)
Total Daily Vehicle Trips Reduced		**14,748**	

Commute Distance and Daily VMT Reduced
(VMT reduced is calculated as number of vehicle trips reduced x one-way travel distance; individual calculations are performed for continued, temporary, and retained placements and for both Within the NAA and Outside the NAA)

FY 2018-20 Applicants (New)
Distances in miles derived from Commuter Connections placement survey

	O-W Dist	**VMT Reduced**	
• Within NAA - continued distance	29.5	249,570	
• Within NAA – temporary distance	24.4	3,709	
• Outside NAA – continued distance	29.5	165,436	(Actual outside distance 52.5 miles)
• Outside NAA – temporary distance	24.4	3,172	(Actual outside distance 48.8 miles)

Pre-FY 2018 Applicants (Retained)
Distances in miles derived from Commuter Connections placement survey

• Within NAA – continued distance	19.7	4,945	
• Outside NAA – continued distance	19.7	2,896	
Total Daily VMT Reduced		**429,728**	

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

Inside NAA	Cont	Temp	
• SOV access percentage	70%	60%	(Placement survey)
• SOV access distance (mi)	4.6	3.7	(Placement survey)

Outside NAA
- N/A - all access VT and VMT occur outside NAA

Pre-FY 18	Cont	
• SOV access percentage	72%	(Retention survey)
• SOV access distance (mi)	5.5	(Retention survey)

Appendix H, continued

PART 1 – Commute Information Requests (continued)

Adjusted VT Reduction – net of drive alone access

(Calculated as Within NAA VTs x SOV access % for continued, temporary, and retained placements)

FY 2018-20 Applicants (New)

• Total VT reduced	14,748	Calculated above
• Within NAA access VT (deduct)	- 6,194	(Total SOV access VTs for cont, temp, retained cases)
• Outside NAA access VT	0	No deduction (access trips are outside NAA)
Total VT (net of SOV access)	**8,554**	

Adjusted VMT Reduction – net of VMT access

• Total VMT reduced	429,728	Calculated above
• Within NAA access VMT (deduct)	- 28,574	(Total SOV access VMTs for cont, temp, retained cases)
• Outside NAA access VMT	0	No deduction (access VMT are outside NAA)
Total VMT (net of SOV access)	**401,154**	

Total VT for AQ analysis	**8,554**
Total VMT for AQ analysis	**401,154**

Daily Emissions Reduced – NOx and VOC (PART 1 – Commute Information Requests)

NOx	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,554	1.0309			8,818	0.0097
• From Running			401,154	0.1498	60,093	0.0662
Total NOx reduced (tons)					**Daily**	**0.0759**

VOC	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,554	2.1358			18,270	0.0201
• From Running			401,154	0.0593	23,788	0.0262
Total VOC reduced (tons)					**Daily**	**0.0463**

Annual Emissions Reduced – CO2 (PART 1 – Commute Information Requests)

CO2	Trips	20 Emission Factor	VMT	20 Emission Factor	Tot gm	Tot ton
• From Starts	8,554	212.54			1,818,067	2.004
• From Running			401,154	362.93	145,590,821	160.486
Total CO2 reduced (tons)					**Daily**	**162.490**
					Annual	**40,622.6**

Appendix H, continued

Correction for Overlap between COC Base and Integrated Rideshare and GRH

The COC supports several other TDM program elements, including Mass Marketing, Software Upgrades, and GRH and portions of the COC base impact are deducted from the COC and assigned to those program elements. Details of the determination of each credit are presented in the relevant appendices. The "Net COC Base" is calculated as the initial/total COC base – Mass Marketing credit – Software Upgrades credit – GRH credit.

	Initial COC Base	MM	Soft Upg	GRH	Net COC Base
Placements	31,992	818	3,536	7,739	19,899
Vehicle Trips Reduced	14,748	373	1,363	3,643	9,369
VMT Reduced (miles)	429,728	10,969	40,541	105,901	272,317
Daily Emissions Reduced					
NOx Reduced (tons)	0.0759	0.0019	0.0071	0.0187	0.0482
VOC Reduced (tons)	0.0463	0.0012	0.0044	0.0114	0.0293
Annual Emissions Reduced					
CO2 (T)	40,622.6	1,036.9	3,806.5	10,018.2	25,761.0

Notes:
- MM influenced commuters – from MM analysis
- Share of COC assigned to GRH= 28% of COC credit; calculated as the share of COC apps that were new apps/re-apps (47.4%) and who registered for GRH (63%) = (63% x 44.7% = 28%). The GRH credit is not added to the GRH impact; rather it is assumed to be an overlap and is deducted from the COC impact to avoid duplication.
- Software Upgrade component is calculated in Appendix I.

PART 2 – Telework Credit (Non-Maryland origin / destination)

- Credit for telework assistance provided directly to commuters who do not live or work in Maryland; credit for Maryland residents/workers is assigned to the Telework Assistance program element

NOTE: Calculation details for the Non-Maryland Telework credits below are shown in Appendix D (Telework)

Number of regional teleworkers	1,072,690	(State of Commute survey)
% of non-MD teleworkers	51%	(% of regional TWers who live and work outside MD)
Number of teleworkers (non-MD)	547,072	
Share of TW credited to COC	6.2%	(% of TWers learned of TW from Commuter Connections)
Total TW placements credited to COC	33,918	
Vehicle trips reduced	6,912	
VMT reduced	102,818	
Daily NOx reduced (tons)	0.0249	
Daily VOC reduced (tons)	0.0230	
Annual CO2 reduced (tons)	10,687.5	

Appendix H, continued

PART 2 – Telework Credit (Non-Maryland origin/destination) (continued)

Final Commuter Operations Center Credit – Including Base COC and Telework Credit
Net COC = Net COC Base + Non-MD TW

	Net COC Base	Non-MD TW	Net COC
Placements	19,899	33,918	53,817
Vehicle Trips Reduced	9,369	6,912	16,281
VMT Reduced (miles)	272,317	102,818	375,135
Daily Emissions Reduced			
NOx Reduced (tons)	0.0482	0.0249	0.0731
VOC Reduced (tons)	0.0293	0.0230	0.0523
Annual Emissions Reduced			
CO2 (T)	25,761.0	10,687.5	36,448.5

Appendix I
Sample Calculation of Integrated Rideshare (Software Upgrades) Impacts

Populations of Interest – Commuter Connections Rideshare Applicants
All data factors (Placement rate, VTR factors, trip distances) derived from Applicant Placement survey

FY 2018-20 Applicant Base (New credit) New, Reapply, Transit/other, follow-up requests

• FY 2018	26,348	(CC database)
• FY 2019	24,153	(CC database)
• FY 2020	25,150	(CC database)
New FY 2018-20 assisted commuters	**75,651**	

Within NAA (63%)	47,660
Outside NAA (37%)	27,991

COC Placement Rates	**In NAA**	**Out NAA**	
• Continued rate	3.1%	3.6%	(CC placement survey)
• Temporary rate	1.5%	1.2%	(CC placement survey)

Placements (Continued and Temporary; In NAA and Outside NAA)

• Continued	1,477	1,008	(Applications x continued rate)
• Temporary	715	336	(Applications x temporary rate)
Total placements	**3,536**		

Daily Vehicle Trips Reduced (Continued and Temporary; In NAA and Outside NAA)

VTR Factors	**In NAA**	**Out NAA**	
• Continued	0.53	0.50	(CC placement survey)
• Temporary	0.41	0.54	(CC placement survey)
• Temporary discount	16.0%	16.0%	(CC placement survey)
• Continued trips reduced	783	504	(Placements x cont. VTR factor)
• Temporary trips reduced	47	29	(Placements x temp VTR factor x temp discount)
Total VT reduced	**1,363**		

Daily VMT Reduced (Continued and Temporary; In NAA and Outside NAA)

Ave one-way trip distance (mi)	**In NAA**	**Out NAA**	
• Continued	30.0	30.0	(Actual Outside dist. 54.6 miles)
• Temporary	25.4	25.4	(Actual Outside dist. 57.0 miles)
• Continued VMT reduced	**23,490**	**15,120**	(Cont VT x ave trip distance)
• Temporary VMT reduced	**1,194**	**737**	(Temp VT x ave trip distance)
Total VMT Reduced	**40,541**		

Appendix I, continued

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

	In NAA	Out NAA	
• SOV access % -Continued	67%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	5.4	0.0	(CC placement survey)
• Non-SOV access % - Temporary	48%	0%	(CC placement survey)
• SOV access dist (mi) – Temporary	5.4	0.0	(CC placement survey)

Outside NAA – not applicable – all access outside NAA

VT Reduction	**In NAA**	**Out NAA**	
• Continued SOV access VT	525	0	(Total cont VT x SOV access)
• Temporary SOV access VT	23	0	(Total temp VT x SOV access)
• Continued VT (without SOV access)	258	420	(Total cont VT – SOV access VT)
• Temporary VT (without SOV access)	24	24	(Total temp VT- SOV access VT)

Total VT (net of SOV access) 815

VMT Reduction	**In NAA**	**Out NAA**	
• Continued SOV access VMT	2,835	0	(Total cont VT x SOV % x access dist)
• Temporary SOV access VMT	124	0	(Total temp VT x SOV % x access dist)
• Continued VMT (without SOV access)	20,655	15,120	(Total cont VMT- SOV access VMT)
• Temporary VMT (without SOV access)	1,070	737	(Total temp VMT- SOV access VMT)

Total VMT (net of SOV access) 37,582

Total VT for AQ analysis 815
Total VMT for AQ analysis 37,582

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	815	1.0309			840	0.0009
• From Running			37,582	0.1498	5,630	0.0062
Total NOx reduced (tons)					**Daily**	**0.0071**

VOC	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	815	2.1358			1,741	0.0019
• From Running			37,582	0.0593	2,229	0.0025
Total VOC reduced (tons)					**Daily**	**0.0044**

Annual Emissions Reduced – CO2

CO2	**Trips**	**20 Emission Factor**	**VMT**	**20 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	815	212.54			173,220	0.191
• From Running			37,582	362.93	13,639,635	15.035
Total CO2 reduced (tons)					**Daily**	**15.226**
					Annual	**3,806.5**

Appendix J
Sample Calculation of Societal Benefits Generated by TDM Program Impacts

Since its inception in 1997, the Commuter Connections TDM analysis has been undertaken primarily to document travel and emissions impacts of each program element and compare the impacts against the goals set for the elements. This remains a central focus of the analysis for the FY 2018 – FY 2020 analysis. But the program elements likely do offer other benefits to residents and commuters of the Washington region, in societal objectives such as Greenhouse gas emissions reductions, greater mobility, improved road safety, and enhanced transportation system performance.

These benefits have joined congestion and air quality as forces shaping the region's transportation policies, making them also issues relevant to Commuter Connections partners and funders. Documenting the types and magnitude of these benefits demonstrates the broad value of Commuter Connections programs to the community and the value of investments made in the programs. Documenting these contributions also supports the regional response to the federally-mandated, performance-based planning and programming (PBPP) process required of states and MPOs. Under this requirement, MWCOG must track a variety of performance indicators related to transportation system performance, such as hours of peak hour excessive roadway delay.

The FY 2018 – FY 2020 TDM evaluation included an analysis component to estimate regional cost savings generated for selected societal benefits of the TDM program elements' travel and emissions impacts. These benefits include the following:

- Air pollution/emissions reductions in NOx and VOC
- Greenhouse gas emissions (CO2) reduction
- Reduction in congestion (reduced hours of travel delay)
- Reduction in fuel consumption (gasoline cost saving)
- Improved road safety (accidents reduced per 1 million VMT)
- Noise pollution reduction (reduced motor vehicle noise)

Figure J-1 shows the basic method for calculating societal cost savings. The approach requires defining the unit of benefit associated with each type of benefit and cost per unit of benefit. The calculation then multiplies the benefit units by a unit cost factor and sums the individual benefit cost savings for a total across all benefits.

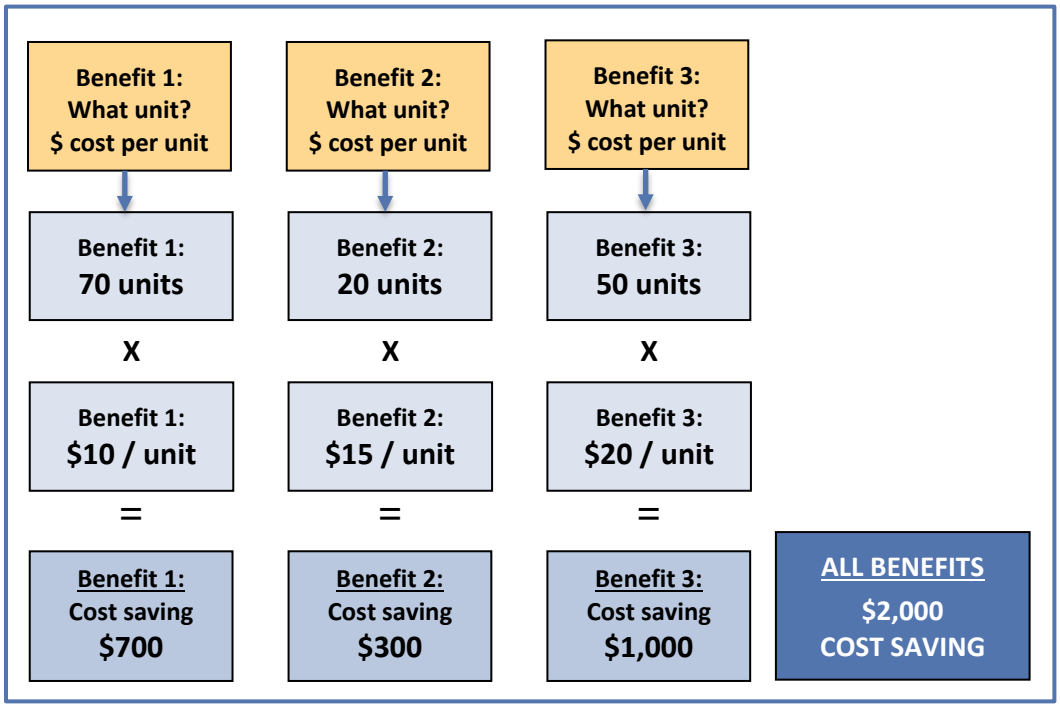
Define Units of Benefits and Cost Saving per Benefit Unit – First, the analysis must define a unit measure that represents performance for each benefit. For example, the benefit unit for traffic congestion reduction is the vehicle hours of peak period travel delay reduced and the unit of benefit for reduction in fuel consumption is gallons of gasoline saved (not used). The analysis also must define for each benefit the financial value, or societal cost saving, that a unit of benefit provides. For travel delay reduction, the unit cost is typically a value of time equal to an hourly wage rate. For fuel consumption saving, the unit cost would be the average cost of a gallon of gasoline.

Calculate Total Benefit Units – After the benefit units have been defined, the analysis calculates the number of units of benefits generated. The method to calculate units of benefit is specific to the benefit, so the methods can vary by benefit, but in this TDM analysis, all are derived from some measure of travel behavior impact, such as reductions in vehicle trips and/or vehicle miles traveled (VMT).

Continuing the example of travel delay reduction, the analysis calculates the number of hours of travel delay that the TDM program element eliminated. This count is made by estimating the VMT removed from congested roadway segments, then dividing that VMT count by a conversion factor of hours of delay reduced per 1000 daily VMT. Other benefits have similar but unique formulas to convert travel changes into benefit units. These conversion methods are described later in this appendix.

Appendix J, continued

Figure J-1 – Example Calculation of Societal Benefits Cost Savings for Three Benefits



Calculate Cost Saving for Each Benefit and Total Cost Saving – The societal cost saving for each benefit is then calculated by multiplying the number of benefit units by the cost saving per unit factor. The cost saving for delay reduction would be calculated by multiplying the hours of travel delay reduced by the average wage rate for workers in the region. Similar calculations are made for the other benefits in the TDM analysis, then the cost savings for individual benefits are summed to calculate the total cost saving for all benefits together.

In all cases, the VMT reduction was the starting point, with conversions made to translate VMT reduction into units of benefit. For most benefits, the method used to derive the units of benefit and the unit cost factors were obtained from the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS™) 4.0 model developed by the Center for Urban Transportation Research (CUTR). TRIMMS™ estimates societal cost saving benefits of TDM actions for the societal benefits shown above. Following are details of the calculation methodology and calculation results for each TDM program element.

Air Pollution/Emissions Reductions and Greenhouse Gas Reductions

Air pollution has various adverse societal consequences, in particular for human health and for physical impacts on the environment. Health research has documented links between increased levels of pollution and higher levels of respiratory and cardiopulmonary illness, with the greatest risk and incidence occurring among children, the elderly, and people with related diseases. Air pollution also can have negative environmental impacts, through reduced visibility, and damage to agricultural and forest land. Motor vehicles contribute to air pollution through pollutants emitted while vehicles are starting and operating. Thus, TDM program elements that reduce vehicle emissions contribute to less polluted air and offer benefits from reduction in the healthcare costs associated with pollution-related illness and costs incurred to repair environmental damages.

Appendix J, continued

The TDM analysis calculates the societal cost of four primary air quality pollutants: nitrogen oxides (NOx), volatile organic compounds (VOC), particulate matter 2.5 microns (PM2.5), and PM2.5 NOx precursors. These four pollutants are strongly associated with the health and environmental damage and with motor vehicle operation.

The TDM analysis also calculates the societal cost for Greenhouse gas emissions, defined as tons of carbon dioxide (CO2). Its environmental role is similar to that for other air pollutants, in that motor vehicle emissions are a primary contributor to the problem, but unlike VOC and NOx emissions, which dissipate relatively quickly, greenhouse gas emissions accumulate over time in the atmosphere, effecting a cumulative increase in the average global temperature. A warming planet presents potentially serious and long-term environmental consequences, including more extreme drought but also more extreme storms, rising sea level that threatens coastal lands, and the loss of arctic sea ice and the ecosystems that rely on it, among other concerns.

The societal cost for emission reduction can be calculated by estimating the tons of pollutant emitted and multiplying by the societal cost of one ton of pollutant. For example, the equation for NOx cost saving would be:

Cost saving for NOx reduction = ((VMT reduced x gm/mi NOx emission factor)
+ (VTrips reduced x gm/trip reduced)) / gm per ton conversion factor
x $ cost per tons NOx reduced

Calculating Benefit Units and Cost per Unit of Benefit – The emission factors are related to the types and ages of vehicles being operated and the speed and other conditions of travel and will vary by metropolitan region. They are most accurately derived through runs of emission models, such as the Environmental Protection Agency's MOVES (Motor Vehicle Emission Simulator) model used by MWCOG, which takes into account the types and ages of vehicles, the speed and operating conditions experienced by travelers, and atmospheric conditions, each of which can affect emission rates.

The dollar costs per ton of pollutant applied in the TDM analysis are taken from CUTR's TRIMMS™ model. As described in the TRIMMS™ User Manual (Version 4.0), TRIMMS™ uses costs associated with damage to health, visibility, and physical impact on the environment. TRIMMS™ "adopted the costs estimates of Delucchi, who estimated costs for several impact categories for urban areas of the U.S. in 1991. Delucchi updated the original values in 2005 to account for changes in information about pollution and its effects. He customizes these estimates by using regional exposure scalars to get from the average exposure basis in U.S. urban areas to the average exposure in each of the metropolitan statistical areas. According to Delucchi, population density is the best simple measure of exposure to air pollution. The original 2005 $/Kg are converted to current dollar values using the consumer price index (CPI). These estimates are scaled to each individual region using the ratio of median household income of each area to the U.S. median household income.[22]

Cost Saving Calculation – TRIMMS™ methodology estimates benefits for various air pollution emissions. The model calculates emissions by multiplying exhaust tailpipe emission rates generated from the EPA Agency Motor Vehicle Emission Simulator (MOVES2010a) in grams per mile to the VMT reduced. But, because the TDM analysis estimates emissions using locally-specific emission factors derived by MWCOG or the regional conformity determination, the evaluation team calculated emission reductions outside of the TRIMMS™ model, but then applied the default daily costs per day by pollutant to the TDM emissions estimates to calculate air pollution societal benefit costs. The relevant emissions calculations are presented in Table J-1.

As shown, the daily benefit cost saving for all air pollutant components combined is $906 per day, comprised of $53 per day from VOC and $853 per day from NOx. The daily cost saving for Greenhouse gas reductions, defined by a benefit unit of tons of CO2 reduced, equals $37,176 saved per day.

[22] TRIMMS™ User Manual, Version 4.0, Center for Urban Transportation Research, USF.

Appendix J, continued

Table J-1 - Daily Air Pollution and Climate Change Societal Benefit Cost Savings Generated by FY 2018 – FY 2020 TDM Program Elements and Commuter Operations Center Impacts

Societal Benefit	Benefit Unit	Benefit Base Units [1)]	Cost per Unit of Benefit [2)]	Total Daily Cost Saving
Air pollution				
- NOx	Tons NOx removed	0.529 T	$1,612	$853
- VOC	Tons VOC removed	0.397 T	$133	$53
Total air pollution				**$906**
Greenhouse gas	**Tons CO2 removed**	**1,033 T**	**$36**	**$37,176**

1) Daily tons of emissions reduced calculated in TDM analysis using MWCOG emission factors.
2) Cost per tons of emissions reduced obtained from TRIMMS™.

Noise Pollution Reduction

The societal benefit for noise pollution reduction is related to the reduced noise associated with the vehicle travel that has been eliminated from the roadway. Noise costs refer to negative externalities associated with motor vehicle noise emissions such as noise from engine acceleration and vibration, tire contact on road surfaces, and horn usage. Traffic noise is an annoyance, but has real health effects from impaired hearing, increased stress, and sleep disruption, and can contribute to reduction in property values in areas with high or sustained noise levels. An analysis of cost saving from noise pollution reduction estimates how much noise will be reduced and multiplies that reduction by a unit cost factor that represents the cost of abatement for that noise level.

Cost saving for noise reduction = Total VMT reduced
x Noise reduction per VMT reduced
x $ cost per adjusted VMT

Calculating Benefit Units and Cost per Unit of Benefit – The TDM analysis applies the approach and benefit unit and unit cost factors from the TRIMMS™ model. TRIMMS™ applies a unit benefit factor of 1.0 to convert total VMT reduced to a noise reduction component. It then multiplies the adjusted VMT by a noise costs of $0.022692 per mile for auto and vanpool and $0.115205 per mile for transit (derived from a literature review) to estimate the societal cost savings. The composite cost of $0.0223, which includes both health and property value impacts is scaled to account for cost-of-living differentials between national averages and the Washington metropolitan region.

This calculation estimates a total cost saving for noise pollution reduction of $59,040 per day, as shown below:

Total daily VMT reduced by TDM program elements = 2,647,551

Noise pollution daily cost saving = 2,647,551 x $0.0223 per VMT = **$59,040 per day**

Congestion (Delay) Reduction

A third societal benefit is cost savings from reductions in traffic congestion. Traffic congestion slows the flow of traffic, resulting in slower travel speeds and longer trip times. Longer trips create societal dis-benefit primarily through lower business productivity, reduced access to the workforce, and loss of personal time for travelers who travel in congested conditions. The impact of traffic congestion typically is defined by the additional travel time or travel delay experienced by vehicle operators. When TDM programs remove vehicles and VMT from congested

Appendix J, continued

segments of road, travel speeds on those road segments increase, resulting in shorter trip times and less delay. Because the Commuter Connections TDM analysis assesses benefits related to commuting travel, the benefit unit assigned to traffic congestion in the analysis is reduced vehicle hours of peak period travel delay.

The approach used to estimate vehicle hours of delay reduction estimates the percentage share of the TDM program elements' total VMT reduced that would have traveled on congested roadways and applies a per VMT delay factor to the reduced VMT to estimate the reduced hours of delay. For example, if 30% of the VMT reduced would have traveled on congested roadways during the peak period, how many additional hours of travel delay would be expected? The hours of delay reduced are then multiplied by a cost per hour of delay to estimate the total cost saving from reduced congestion.

Cost saving for reduced congestion = Congested VMT reduced
x Marginal delay hours per VMT
x $ cost per hour of delay

Calculating Benefit Units and Cost per Unit of Benefit – The calculation of "congested VMT" discounted the total VMT reduced to include only miles traveled on Interstate highways and major roadways in the Washington metropolitan region. The method additionally discounted to include only VMT that would have traveled in congested conditions to align with the marginal delay factor used by TRIMMS™ to convert VMT reduced into hours of delay reduction across the regional system. This factor is a national default value of **15.9 hours of marginal delay per 1,000 passenger car equivalent daily VMT**.

The unit cost of an hour of delay, often referred to as the value of travel time savings (VTTS), reflects the opportunity cost of time spent traveling that could be used for other activities. The demand for travel is derived from the benefit of accessing a destination, rather than the travel itself. Thus, time spent traveling has a negative value and a reduction in travel time represents a positive benefit. In its simplest form, the value of travel time saving includes costs to businesses in lost productivity and costs to travelers in lost personal time.

Transportation economic analyses typically value an hour of time saved as a labor wage rate. The VTTS will depend on the traveler, the circumstances of the trips, and the travel alternatives. The U.S. Department of Transportation (USDOT) published Departmental guidance regarding value of time for transportation economic analyses to "assist analysts in developing consistent evaluations of actions that save cost or time in travel."[23] For commuting, when travelers have a defined and non-discretionary trip purpose (getting to/from work), and for TDM strategies, which most often are available to a wide range of commuters, a cost saving analysis can reasonably approximate VTTS over the entire working population, using an average hourly wage rate over all commuters. The USDOT guidance recommends using a VTTS of 100% of the median hourly wage rate, including benefit costs, for "on-the-clock" local business/commercial travel and 50% of the median hourly wage rate, excluding benefits, for personal travel.

However, a consideration that is of great relevance to analysis of the TDM program elements is that the value travelers place on a congested minute appears to be different than the value for non-congested time, as much as 1.5 to 2.5 times the value of time spent in uncongested travel, depending on the extent of congestion. A substantial body of transit and mode choice research has documented differential values of in-vehicle travel time, out-of-vehicle wait time, and transfer times for transit. Travelers experience wait time and transfer time as longer than the actual time and experience travel time as shorter than actual time. For example, the USDOT guidance recommends that personal time spent walking or waiting, as is common for the rideshare, transit, bicycle, and walking trips generated by TDM strategies, also be valued at 100% of wage rate.

[23] The U.S. Department of Transportation (USDOT), September 28, 2011, Memorandum Subject: Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis. https://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf

Appendix J, continued

The average wage rate for the TDM analysis would be a composite rate comprised primarily of the local personal travel value, which would suggest a value closer to 50% than 100% of the local wage rate. However, as noted above, USDOT applies a 100% value to access/wait time for travel in non-drive alone modes, which are the focus of the TDM program elements. Finally, the role of congestion in commuting can be significant, suggesting the wage

rate applied should be account be closer to 100% than 50%. For simplicity, the TDM analysis uses a single VTTS of 100% of median hourly wage rate, excluding worker benefits. This number was chosen as an approximation because it is readily available from the U.S. Bureau of Labor Statistics.[24]

Cost Saving Calculation – The adjusted "major roadway" VMT calculation estimated that 331,914, or about 12.5% of the total VMT reduced by the Commuter Connections TDM program would have traveled on major roadways in congested conditions. When this "congested VMT" total is multiplied by the 15.9 hours of delay per 1000 VMT reduced, the estimated hours of delay reduced by the TDM program equals 5,277 daily hours of delay reduced:

Estimated delay reduction = (331,914 mi / 1,000) x 15.9 hours per daily VMT = **5,277 daily hours delay reduced.**

These hours of delay were multiplied by the $27.08 median hourly wage rate for all employees working in the Washington metropolitan region, as reported by the Bureau of Labor Statistics. When this cost is multiplied by the 5,277 daily hours of delay reduced, the total congestion (delay) reduction benefit equals **$142,913 per day**.

Excess Fuel Consumption Reduction

A reduction in vehicle use results in a direct reduction in the amount of fuel consumed for travel. The TDM analysis defines the societal benefit of reducing fuel use as the cost saved when gallons of fuel are not purchased. Reduced vehicle use also results in other vehicle operating savings, such as reduced vehicle maintenance and depreciation, but these costs are excluded from the analysis. The cost saving for reduction in fuel use is calculated by converting the VMT reduction into gallons of fuel saved and multiplying by an average fuel cost per gallon:

Cost saving for reduced fuel consumption = Total VMT reduced
/ Fuel consumption factor (miles per gallon)
x $ cost per gallon of fuel

Calculating Benefit Units and Cost per Unit of Benefit – Fuel consumption has a direct relationship with the number of vehicle miles traveled and is commonly defined by dividing the total VMT by the miles per gallon (mpg) fuel consumption rate. Fuel consumption per mile varies by vehicle type and by travel speed and operating conditions. For example, a large sport utility vehicle (SUV) uses more gasoline per mile or per hour than does a small compact car. And vehicles use different amounts of fuel when traveling as slow speeds than high speeds, with higher speeds generally more efficient use of fuel. TRIMMS™ methodology uses a default value of 18.0 miles per gallon fuel efficiency. This national factor represents the average fuel economy of a typical commuting vehicle in the passenger vehicle fleet, including both large and small vehicles, cars, SUVs, and vans and trucks used as commuting vehicles.

The gallons of fuel saved by reduced VMT is multiplied by an average cost per gallon of fuel. The U.S. Energy Information Administration publishes average gasoline prices for various parts of the country. In June 2020, the average cost reported for the Mid-Atlantic region was $2.73 per gallon.[25] The result of these calculations is as follows:

[24] U.S. Department of Labor, Bureau of Labor Statistics (BLS) wage data May 2016 – median hourly wage rate for all occupations combined; https://www.bls.gov/oes/current/oes_nat.htm

[25] Weekly Retail Gasoline and Diesel Prices, June 2020. U.S. Energy Information Administration. https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r1y_m.htm

Appendix J, continued

Total daily VMT reduced by TDM program elements = 2,647,551

Estimated gallons of fuel saved = 2,647,551 miles / 18.0 miles per gallon = 147,086 gallons

Excess fuel consumption daily cost saving = 147,086 gallons x $2.73 per gallon = **$401,545 per day**

The calculation estimates a fuel saving of 147,086 gallons per day and a cost saving from reduction in fuel use of $401,545 per day.

Improved Road Safety (Accident Reduction)

A reduction in motor vehicle travel generates a benefit of improved road safety by reducing the likelihood of a motor vehicle accident occurring. Quite simply, as vehicles are removed from a roadway, the remaining vehicles have a reduced risk of accidents. The cost saving from reduced vehicle accidents is equal to the reduced risk of a crash multiplied by the economic cost of the average accident.

The TDM analysis applies the road safety/accident reduction approach from the Health and Safety element of the TRIMMS™ methodology. TRIMMS™ applies expected crash rates for accidents of various severities to estimate an overall crash probability per 1 million VMT. In the TDM analysis, this crash risk factor is multiplied by the total VMT reduced by the TDM program elements to estimate the number of likely crashes that would have been avoided by the reduction in vehicle travel. The number of anticipated crashes is then multiplied by the average cost per accident to estimate the total cost saving:

Cost saving for improved road safety = Total VMT reduced
x Expected crashes per 1,000,000 VMT
x $ cost per accident

Calculating Benefit Units and Cost per Unit of Benefit – The value of reduced accidents is calculated by multiplying the estimated number of crashes by crash type by the cost per occurrence of each crash type. TRIMMS™ estimates a composite cost per unit benefit (crash avoided) that includes vehicle crash-related monetary costs for property and personal injury damages caused by collisions, and nonmonetary costs, for pain and loss of productivity. The TRIMMS™ methodology starts with the VMT reduction and applies a multi-level calculation that takes into account the occurrence probability of accidents with varying levels of severity (KABCO Injury Classification Scale)[26] and the average cost per type of accident. Crashes with minor property damage have a higher likelihood of occurring but a lower cost per occurrence. Conversely, crashes with serious or fatal injuries are less likely to occur but have a high societal cost when they do happen. Table A-3 shows crash types, occurrence probabilities and anticipated costs.

The calculation in Table J-2 produces an average composite risk of 1.01136 vehicle crashes per 1 million VMT and an average weighted cost per crash of $15,952. Note that this crash cost accounts for both the high probability (1.0000 per 1M VMT) but low cost ($3,650) of a no injury crash and the low probability (0.0076 per 1M VMT) but high cost ($1.4 M) of a fatal injury cost.

The calculation estimates that 2.678 crashes will occur over the 2.647 million VMT reduction. At a per occurrence cost of $15,952, the total cost saving from crash reduction is $42,721 per day.

Total daily VMT reduced by TDM program elements = 2,647,551

Expected crash occurrence = (2,647,551 miles / 1,000) x 1.01136 crash per 1000 VMT = 2.678 crashes

Health and Safety daily cost saving = 2.678 crashes x $15.952 per crash = **$42,721 per day**

[26] Federal Highway Administration. (2017, June 30). *KABCO Injury Classification Scale and Definitions.* Retrieved from FHWA Highway Safety Improvement Program - Safety Performance Management : https://safety.fhwa.dot.gov/hsip/docs/fhwasa18001.pdf Table 9 on p30 has comprehensive crash costs in 2017 dollars. Table 39 https://safety.fhwa.dot.gov/hsip/docs/fhwasa17071.pdf shows costs per state.

Appendix J, continued

Table J-2 – Crash Costs by Injury Severity

KABCO Injury Classification Scale	Probability per 1 M VMT	Cost per Occurrence	Expected Cost per 1 M VMT [1)]
No injury (O)	1.00000	$3,650	$3,650
Possible injury (C)	0.00055	$55,768	$31
Non-incapacitating evident injury (B)	0.00011	$2,828	$3
Incapacitating injury (A)	0.00194	$783,341	$1,520
Fatal injury (K)	0.00776	$1,408,533	$10,930
Overall probability and cost	1.01136		$16,134
Weighted cost per 1 M VMT [2)]			**$15,952**

1) Expected cost per 1 million VMT = Probability of occurrence in 1 million VMT x average cost per occurrence.
2) Weighted cost per 1 million VMT = Overall cost ÷ Overall probability.

Total Societal Benefit Cost Saving

Table J-3 presents the cost saving associated with each type of benefit and the overall societal cost saving calculated for the four TDM program elements and the Commuter Operations Center combined.

Table J-3 – Societal Benefit Cost Savings Generated by TDM Program Elements

Societal Benefit	Benefit Unit	Benefit Base Units	Cost per Unit of Benefit	Total Daily Cost Saving
Air pollution				
- NOx	Tons NOx removed	0.529 T	$1,612	$853
- VOC	Tons VOC removed	0.397 T	$133	$53
Greenhouse gases	Tons CO2 removed	1,033 T	$36	$37,176
Noise pollution	Total VMT reduced	2,647,551 VMT	$0.0223	$59,040
Congestion	Hours of delay reduced	5,277 hours	$27.08	$142,913
Excess fuel used	Gallons of fuel saved	147,086 gal	$2.73	$401,545
Health/safety [1)]	Accidents avoided/1 M VMT	2.678 acc.	$15,952	$42,721
All benefits				**$684,301**

1) Health and safety benefit base units and cost per unit are weighted averages of accident occurrences by severity.

As shown, the combination of the TDM program elements and Commuter Operations Center generate about $684,301 of daily cost saving across the societal benefits included in the calculation. The largest share of the cost saving is in reduction of excess fuel used; this benefit is valued at over $401,500 per day, or about 59% of the total daily benefits. Reduction in hours of travel delay accounts for about 21% of the total daily benefit ($142,913). Noise pollution reduction generates about 9% and the air pollution/Greenhouse gas reduction combined benefits and road safety accident reduction benefits each are responsible for about 6% of the total cost saving.

Appendix K
Commuter Connections TDM Evaluation Schedule – FY 2021 – FY 2023

TDM Program Element	Data Collection Activity	Deadline(s)	FY Completion
Telework	2022 State of the Commute Survey	January 2022 June 2022 (draft report)	FY22-FY23
	Employer Telework Assistance (MD)	April 2023	FY24
Employer Outreach	Database Information Analysis from ACT!	April 2023	FY23
GRH	GRH Applicant Survey Washington region	April 2022 June 2022 (draft report)	FY22-FY23
	GRH Applicant Survey Baltimore	April 2022 June 2022 (draft report)	FY22-FY23
	Retention Rate Survey ***(survey completed)***	February 2021	FY21
Commuter Operations Center	Placement Rate survey ***(survey completed)***	November 2020	FY21
	Retention Rate Survey ***(survey completed)***	February 2021	FY21
Mass Marketing	2022 State of the Commute Survey	January 2022 June 2022 (draft report)	FY22-FY23
	2022 Bike to Work Day Participant Survey	November 2022	FY23
	'Pool Rewards CP survey	June 2023	FY24
ALL	2021-2023 Framework Methodology	December 2021	FY22
	2022 State of the Commute Survey	January 2022	FY22-FY23
	2021-2023 TDM Analysis Report	January 2023	FY23-FY24

Appendix L
Glossary of Acronyms

CC	-	Commuter Connections
CCWP	-	Commuter Connections Work Program
CO2	-	Carbon dioxide (primary greenhouse gas)
COC	-	Commuter Operations Center
COG	-	Council of Governments
DDOT	-	District of Columbia Department of Transportation
FAST Act	-	Fixing America's Surface Transportation Act
FHWA	-	Federal Highway Administration
GRH	-	Guaranteed Ride Home
HOV(s)	-	High Occupancy Vehicle(s)
MAP-21	-	Moving Ahead for Progress in the 21st Century Act
MTA	-	Maryland Transit Administration
MDOT	-	Maryland Department of Transportation
MWAQC	-	Metropolitan Washington Air Quality Committee
MWCOG	-	Metropolitan Washington Council of Governments
NO_X	-	Nitrogen Oxides
P & R	-	Park and Ride
PM	-	Particulate Matter
PM2.5	-	Particulate Matter, 2.5 microns
SOC	-	State of the Commute
SOV	-	Single Occupant Vehicle
TDM	-	Transportation Demand Management
TERM	-	Transportation Emission Reduction Measure
TIP	-	Transportation Improvement Program
TMA	-	Transportation Management Association
TMO	-	Transportation Management Organization
TPB	-	Transportation Planning Board
VDOT	-	Virginia Department of Transportation
VDRPT	-	Virginia Department of Rail & Public Transportation
VMT	-	Vehicle Miles Traveled
VOC	-	Volatile Organic Compounds
VRE	-	Virginia Railway Express
VT	-	Vehicle Trips
VTR	-	Vehicle Trip Reduction
WMATA	-	Washington Metropolitan Area Transit Authority