

**A Theoretical Analysis of
The Effectiveness of
Transportation Demand Management
Strategies In Reducing Greenhouse Gas
Emissions**



August 1, 2010

DULLES AREA TRANSPORTATION ASSOCIATION

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The Dulles Area Transportation Association (DATA) is a Transportation Management Association (TMA) that identifies transportation needs; advocates steps to meet those needs; and provides a forum for members and other concerned parties to be informed of opportunities and to participate in timely actions that will bring about a more effective transportation system.

DATA's Area of Operations encompasses an approximately 160-square mile area bounded by the Potomac River on the north, Hunter Mill Rd. on the east, by the Route 15 corridor on the west, and the Rt. 66 corridor on the south. A true public-private partnership, DATA members include area businesses, property owners, state and local governments, and other groups and individuals concerned with growing traffic congestion and its resulting effect on the area's business environment.

*This report was funded through a grant from the
Virginia Department of Transportation's Multi-modal Planning Program.*

Table of Contents

| | |
|---|----|
| I. Introduction..... | 1 |
| II. A Theoretical Analysis of the Effectiveness of TDM Strategies in Reducing GHG Emission in the DATA Service Area..... | 2 |
| III. A Survey of TDM Programs in the DATA Service Area..... | 6 |
| IV. Summary of TDM Programs in DATA Service Area..... | 8 |
| V. Summary of TDM Programs in Fairfax County Portion of DATA Service Area..... | 9 |
| VI. Summary of TDM Programs in Loudoun County Portion of DATA Service Area..... | 10 |
| VII. Summary of TDM Programs in Prince William County Portion of DATA Service Area..... | 11 |
| VIII. Conclusion | 12 |
| Appendix A - GHG Emissions Analysis For The Dulles Area Transportation Association's Service Area | 13 |
| Appendix B - Employer Participation Level Descriptions..... | 15 |

Acknowledgements

The Dulles Area Transportation Association (DATA) would like to acknowledge the contributions of the members of the Technical Review Team. Participants on the Technical Review Team included: James Larsen, Executive Director of DATA; Doug Pickford, DATA Project Manager for Multi modal Study; Walter Daniels, Fairfax County Department of Transportation; Sharon Affinito, Loudoun County Office of Transportation Services; Christopher Arabia, Virginia Department of Rail and Public Transportation; Steve Coe, Virginia Department of Environmental Quality; and, David Ruble, Virginia Department of Environmental Quality. DATA would also like to acknowledge the contributions of the consultants who provided expertise and guidance to the project and were integral collaborators in developing E³Calc. The consultant team included: John Martin, Executive Director/CEO, Southeastern Institute of Research (SIR); Laura Turner Reid, Project Director, SIR; and Lori Diggins, LDA Consulting.

The contents of this report reflect the views of the Dulles Area Transportation Association (Association). The Association is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration and the Multi modal Office. This report does not constitute a standard, specification, or regulation.

FHWA or the Multi modal Office acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

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INTRODUCTION

The Dulles Area Transportation Association (DATA) secured funding from the Virginia Department of Transportation's Multi-modal Planning program to examine the effectiveness of transportation demand management (TDM) strategies in reducing the amount of greenhouse gas (GHG) emissions produced by employee commutes. Using this funding, DATA developed a sophisticated GHG emissions calculator that businesses and organizations can use to benchmark, track and manage their carbon footprint as it pertains to their employee commutes. The GHG calculator can be applied in three ways: 1) using local default information based on data collected during the regional State of the Commute report; 2) using information derived from an employee survey that was developed by DATA; or 3) inputting information on employee commuting behavior that the business may already have collected. The report generated by the GHG emissions calculator compares the business' information to either previous benchmarks, the local default data (if it is not used as input), or the assumption that prior to conducting the employee survey, all employees drove to work in a single occupancy vehicle.



This particular analysis will take a theoretical view of businesses in the DATA Service area by applying the local default data to ascertain what impact TDM related strategies have in reducing the carbon footprint of regional businesses. The information used in this theoretical analysis is based on employment data collected in 2008 by the U.S. Census Bureau

and the Virginia Employment Commission. The summary of TDM programs in the DATA service area is based upon surveys that were conducted by local government and DATA staff in 2009.

For years, methodologies have existed to determine the level of greenhouse gas (GHG) emissions that are emitted from individual automobiles. A simple search of the internet reveals a wide variety of calculators that help individuals determine their carbon footprint and/or level of greenhouse gases emitted during their commute. Over the past 12 months, DATA has been overseeing the development of a GHG emissions calculator that will examine the whole range of TDM strategies and their impact on reducing the carbon footprint of businesses. When DATA undertook this study, the test hypothesis was that the implementation of Transportation Demand Management (TDM) strategies in DATA's service area is a major contributor to helping the region reduce greenhouse gas (GHG) emissions. Until now, it was difficult to measure the collective contribution that TDM strategies and other alternatives to using a single occupancy vehicle contributed to a business' efforts to reduce its carbon footprint. With the development of E³Calc, businesses can now quantify the effect that TDM strategies, such as teleworking, flexible work schedules, and car and van pooling have on reducing employee vehicle miles traveled, which, in turn, help reduce

reducing its carbon footprint pertaining to these strategies. In Northern Virginia, where service oriented businesses are the norm, employee related GHG emissions comprise the vast majority of most businesses' carbon footprints. Moreover, it is highly likely that in the near future federal and state regulations will require businesses to benchmark, manage and reduce their carbon footprints. This study demonstrates the contributions that TDM strategies have in helping businesses reduce their GHG emissions.

A THEORETICAL ANALYSIS OF THE EFFECTIVENESS OF TDM STRATEGIES IN REDUCING GHG EMISSIONS IN THE DATA SERVICE AREA

In 2008, the U.S. Census Bureau reported that Northern Virginia was home to 864,439 jobs. Employment in the DATA Service Area accounts for over 34.5% of all jobs in Northern Virginia (approximately 299,000 jobs). Almost 60% of the jobs in DATA's Service Area are located in Fairfax County, 38% in Loudoun and a little over 2% in Prince William County. The respective total number of jobs in each locality, as they pertain to the DATA Service Area, was used in this theoretical analysis.



the Commute Survey is an extensive undertaking aimed at ascertaining details of the region's commuting behaviors.

The data gathered from each locality during the *2007 State of the Commute Survey* was used to determine the effectiveness of the TDM programs and the individual choices made by employees who chose not to drive alone to work, in reducing GHG emissions in the DATA Service Area. The survey information on TDM programs was then compared to a theoretical scenario which assumes that all employees in the DATA Service Area drove alone to work in a single occupancy vehicle. The results of this comparative analysis are summarized below. A more detailed explanation of the assumptions made during this analysis can be found in Appendix A.

a business' GHG emissions. If the business knows how much it is spending on its TDM programs, then it will also be able to determine the cost of

The basis for this analysis, as well as the default data for the GHG emissions calculator, was derived from information gathered during the *2007 State of the Commute Survey Report from the Metropolitan Washington DC Region*. The *State of the Commute Survey* is conducted every three years by Commuter Connections, a program of the Metropolitan Washington Council of Governments. The *State of*

The Impact of TDM Strategies in the DATA Service Area

On a yearly basis TDM strategies and alternatives to single occupancy vehicle use by employees in the DATA Service Area remove more than 396,000 tons of GHG emissions from the region's atmosphere. TDM programs in the DATA Service Area reduce the region's vehicle miles traveled by more than 2.85 million miles daily, or about 7% of the region's total daily vehicle miles traveled. The amount of GHG emissions removed by TDM strategies is the equivalent to:

- A reduction in almost 180,000 vehicle trips, a DAY;
- What 68,719 passenger cars driven daily, would emit over the course of a year;
- The annual CO₂ emissions from electricity used in 43,617 homes;
- Removing 2.85 million vehicle miles traveled, DAILY;
- Taking more than 89,000 cars off Northern Virginia's roads, DAILY, or over 23.3 million vehicles annually;
- Filling all four lanes of the Beltway with cars, every day;
- Filling a four lane highway every year that stretches around the earth's equator one and a half times; or
- Planting a forest the size of the District of Columbia in order to absorb the same amount of GHG emissions, annually.



Based on 2007 commuting patterns in Fairfax County, the average business that employs 100 workers reduces its carbon footprint by over 132 tons of GHG emissions annually because employees choose alternatives to driving alone to work.

A Regional Perspective

Adopted on a regional basis, TDM strategies and other alternatives to single occupancy vehicle use (when compared to a scenario where everyone commutes by single occupancy vehicles) removed over 10.7 million pounds of CO₂ a day! Because commuting patterns, as well as the availability of transit services vary considerably from locality to locality, the impact that TDM measures have on local carbon footprints varies as well. Specifically, the reduction of GHG emissions due to TDM strategies employed by businesses, or

those attributed to employees who chose alternatives to driving to work alone, produced the following GHG emission reductions in the region:

- Removed more than 316,000 cars from Northern Virginia roads, EVERY DAY;
- Eliminated almost 633,000 trips, EVERY DAY;
- Reduced the region's vehicle miles traveled by over 10 million miles, EVERY DAY; and
- Eliminated almost 1.4 million TONS of GHG emissions from the region's atmosphere every year!



From a regional perspective, TDM programs and alternatives to driving to work alone offer substantial opportunities for lowering green house gas emissions and easing the amount of traffic congestion on regional road networks. To put the before mentioned numbers in perspective, the reduction in GHG emissions and VMT in the region due to TDM programs include:

- Removing the GHG emissions of more than 1.85 million passenger cars every year;
- Eliminating the CO₂ emissions produced by the electricity generated in over 1.79 million homes, in a single year;
- Removing 316,000 vehicles every day which would fill all four lanes of the beltway, and lap it 3.7 times;



- Or on a yearly basis, filling a two lane highway that would circumvent the equator almost 5 times; and
- Reducing the number of miles driven annually in Northern Virginia by more than 2.6 trillion miles!

These reductions are quite significant in the scheme of attempting to reduce the region's carbon footprint. But what do these numbers really mean? How relevant is a one-ton reduction in GHG emissions? How do we

equate this number to “real world” equivalents beyond those already mentioned? To put this in perspective, DATA staff conducted a quick analysis and comparison of information compiled by one of the more progressive local governments that is currently tackling the GHG emission reduction challenge, Arlington County. In 2007 Arlington County produced a report on the County’s progress in reducing GHG emissions between 2000 and 2005. Arlington is one of the only local governments that has actually established a good GHG emission baseline and been monitoring their reductions over time. Therefore the Arlington analysis provides good comparative information for DATA’s E³Calc calculations.



According to Arlington County’s analysis, in 2005 the County’s operations (not including Arlington Public Schools) generated approximately 72,000 tons of GHG emissions annually. From a regional perspective, the annual reduction in GHG emissions attributed to TDM strategies and employees who choose not to drive to work alone (1.4 million tons), is equivalent to the total GHG emissions from the annual operations of more than 19 “Arlington Counties.” In 2007, Arlington County employed over 3,500 people, with operations in

numerous buildings and including a large fleet of automobiles and other service vehicles (by comparison, the largest private employer in Arlington in 2007 was the Virginia Hospital Center, which had 2,363 employees). Arlington County is considered one of the most advanced and progressive localities in the United States in terms of implementing strategies to reduce its carbon footprint. The County analysis points out that between 2000 and 2005, the County’s investment in wind energy, LED signals, building energy efficiencies, use of hybrid vehicles, tree plantings and the use of biodiesel resulted in an annual elimination of 1,925 tons of CO₂ in the atmosphere.

Using E³Calc to compute the impact that Arlington County’s 3,500 employees have on the County’s carbon footprint (in comparison to a situation in which all employees drove alone to work), TDM measures have reduced the County’s carbon footprint by almost 18 tons a day, or more than 4,680 tons a year. That more than doubles Arlington County’s other emission reduction efforts. Obviously, getting employees out of their cars is an effective means of reducing the carbon footprint of businesses, local governments, and the region as a whole.

A SURVEY OF TDM PROGRAMS IN THE DATA SERVICE AREA

Since 2008, DATA staff has been surveying businesses within its service area to ascertain to what degree they are implementing TDM programs. The survey of businesses, and subsequent technical assistance that is offered by DATA staff, is a core responsibility of most transportation demand management organizations across the United States. The premise of this study was to develop data and information that would help businesses better understand and appreciate the effectiveness of TDM strategies in reducing traffic and congestion in the region, while also providing the environmental benefits of reducing one's carbon footprint.

An important component of DATA's business outreach program is to conduct a brief survey to determine/ benchmark the level of TDM implementation at the site. Over time this survey and database are updated as DATA staff, and the staff from the respective local government's TDM programs, provide additional technical assistance in helping these businesses improve their TDM programs. The information in this report provides a "snapshot" of the programs that the surveyed businesses were implementing in 2009.

The survey information is particularly useful for businesses who are pondering ways in which they can improve employee morale, help reduce congestion in Northern Virginia, and identify strategies that will help them reduce their carbon footprint.

TDM Program Implementation Overview

Information on what types of TDM strategies businesses were utilizing in the DATA service area is based on a survey of businesses conducted by DATA staff in 2009. Surveys of 483 businesses in the DATA service area revealed that 42 were classified as Level 1 (contemplating TDM programs) and 85 employers (17.5%) were implementing TDM programs at levels 2, 3 or 4 (See Appendix B for Employer Participation Level descriptions.). The 85 businesses surveyed at levels 2, 3 and 4 employ over 35,000 employees, which represent approximately 12% of the total number of employees working in the DATA service area. The survey results from the 85 level 2, 3 and 4 businesses found that:

- The top four strategies used by businesses included flextime, formal telework policy, compressed work schedules and providing transit benefits to employees. The least popular strategies were shuttle services, ride matching and preferred parking for employees.



- The most common TDM strategy implemented by businesses is flextime; with more than 2 out of 3 businesses reporting flexible scheduling.
- One out of every two employers had a formal telework policy, and 1 out of 4 had an informal telework policy.
- More than one third of the businesses reported using compressed work schedules.
- Less than one third of the businesses offered employees transit benefits.
- More than 1 in 5 businesses had installed bike racks and/or lockers for employee use.



The TDM programs employed by these businesses vary considerably from jurisdiction to jurisdiction. An overview of the programs is summarized in the tables and graphs on the following pages.

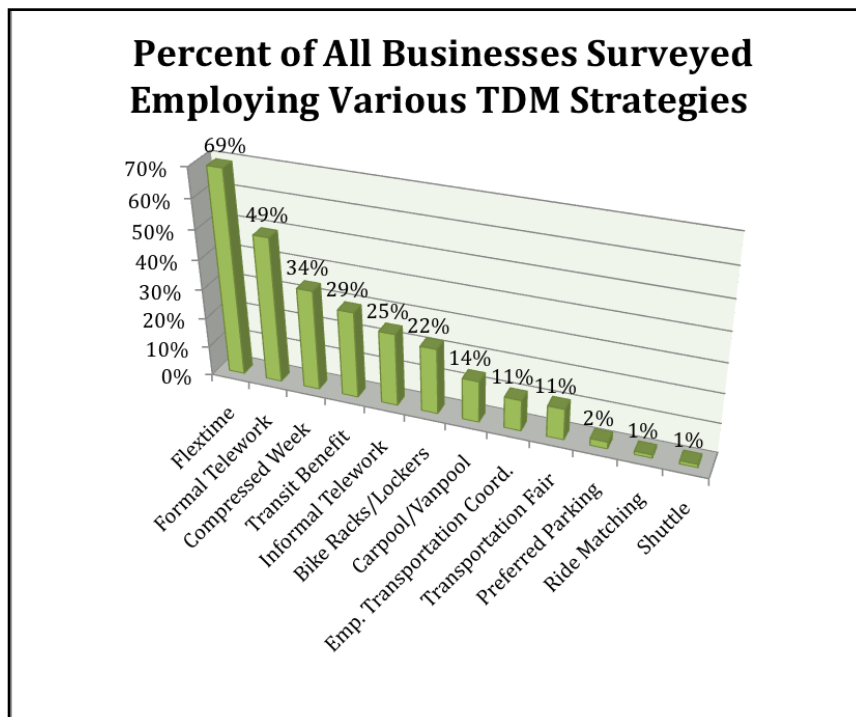
Summary of TDM Programs In The DATA Service Area

The most popular TDM program among businesses in the DATA Service Area is allowing employees to utilize flextime (flexible scheduling). More than 2 out of 3 businesses that are employing TDM programs use flextime as a strategy. Almost half of those businesses also implement a formal telework program, and more than one-third allow employees to use compressed work schedules. The least popular programs among those businesses that have embraced TDM programs are shuttle services, ride matching and preferred parking arrangements.

TABLE 1

| | | |
|----------------------------|------------------------|-------------------|
| Total # of Businesses | 85 | |
| No. of Employees | 35,120 | |
| TDM Strategy | # of Businesses | % of Total |
| Flextime | 59 | 69% |
| Formal Telework | 42 | 49% |
| Compressed Week | 29 | 34% |
| Transit Benefit | 25 | 29% |
| Informal Telework | 21 | 25% |
| Bike Racks/Lockers | 19 | 22% |
| Carpool/Vanpool | 12 | 14% |
| Emp. Transportation Coord. | 9 | 11% |
| Transportation Fair | 9 | 11% |
| Preferred Parking | 2 | 2% |
| Ride Matching | 1 | 1% |
| Shuttle | 1 | 1% |

CHART 1



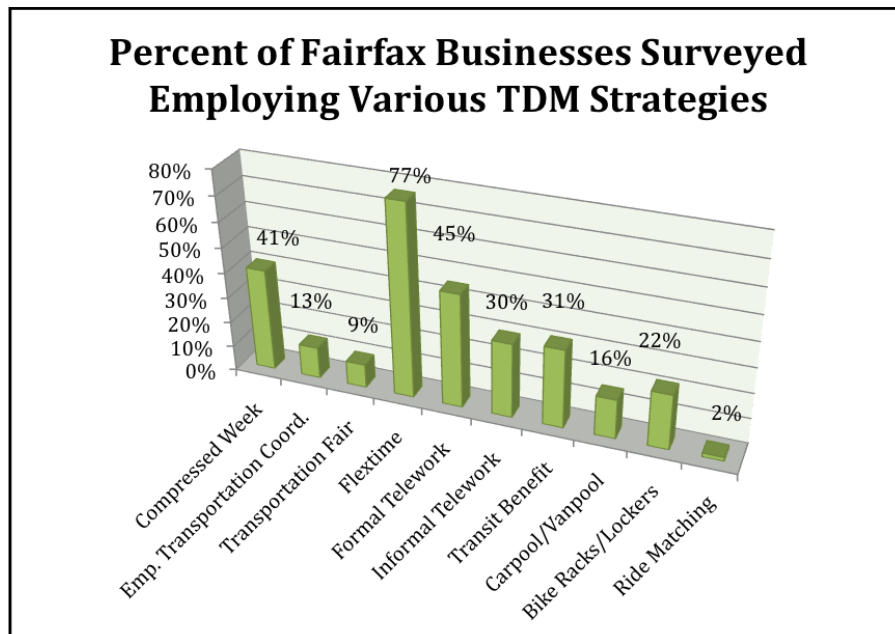
Summary of TDM Programs In The Fairfax County Portion of The DATA Service Area

The most popular TDM strategies employed by businesses in the Fairfax County portion of the DATA Service Area are flextime (77%), followed by a formal telework policy and compressed work scheduling. The breakdown of TDM strategies used by employers in Fairfax County is included below in Chart 2 and Table 2.

TABLE 2

| | | |
|----------------------------|------------------------|-------------------|
| Total # of Businesses | 64 | |
| No. of Employees | 24,238 | |
| TDM Strategy | # of Businesses | % of Total |
| Flextime | 49 | 77% |
| Formal Telework | 29 | 45% |
| Compressed Week | 26 | 41% |
| Transit Benefit | 20 | 31% |
| Informal Telework | 19 | 30% |
| Bike Racks/Lockers | 14 | 22% |
| Carpool/Vanpool | 10 | 16% |
| Emp. Transportation Coord. | 8 | 13% |
| Transportation Fair | 6 | 9% |
| Ride Matching | 1 | 2% |

CHART 2



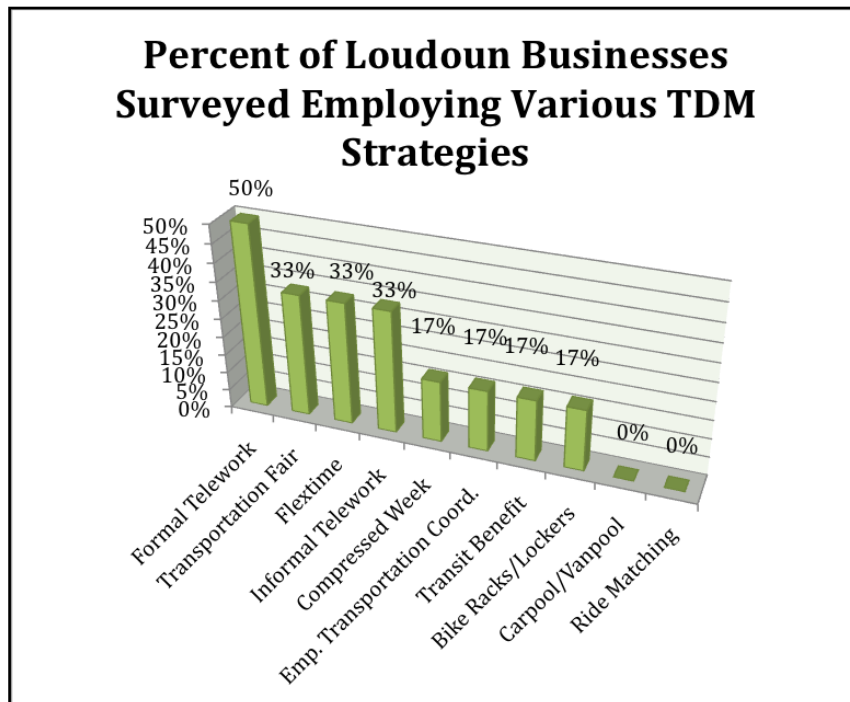
Summary of TDM Programs In The Loudoun County Portion of The DATA Service Area

The most prominent TDM programs instituted by the Loudoun County businesses that were surveyed include formal and informal telework, flextime and transportation fairs. None of the businesses surveyed reported supporting carpools/vanpools and ride matching programs.

TABLE 3

| | | |
|----------------------------|------------------------|-------------------|
| Total # of Businesses | 6 | |
| No. of Employees | 3178 | |
| TDM Strategy | # of Businesses | % of Total |
| Formal Telework | 3 | 50% |
| Transportation Fair | 2 | 33% |
| Flextime | 2 | 33% |
| Informal Telework | 2 | 33% |
| Compressed Week | 1 | 17% |
| Emp. Transportation Coord. | 1 | 17% |
| Transit Benefit | 1 | 17% |
| Bike Racks/Lockers | 1 | 17% |
| Carpool/Vanpool | 0 | 0% |
| Ride Matching | 0 | 0% |

CHART 3



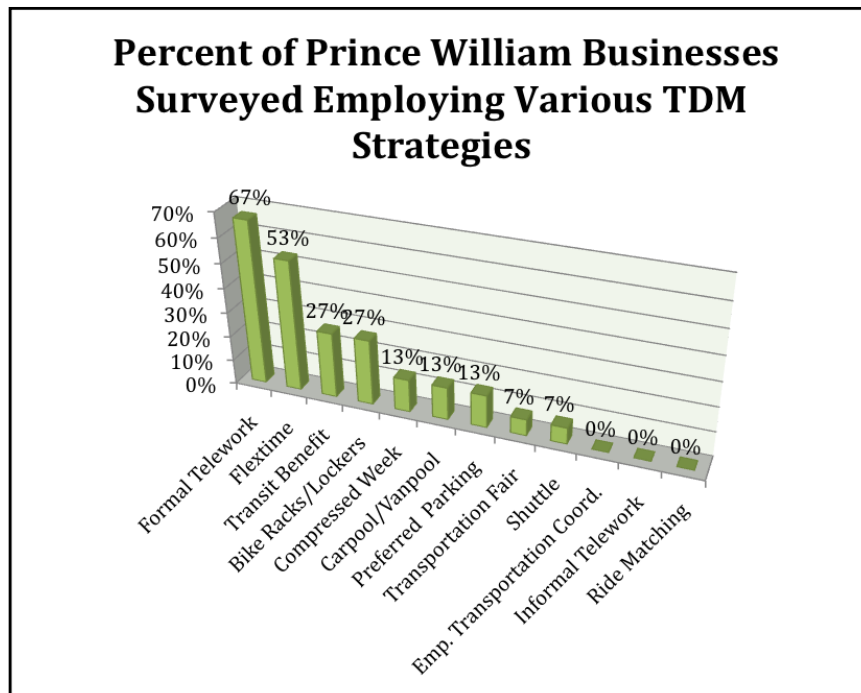
Summary of TDM Programs In The Prince William County Portion of The DATA Service Area

Of all the businesses surveyed in the DATA service area, only four were classified as Level 4 participants. All four of these businesses were located in Prince William County. In Prince William County the most popular TDM programs implemented include formal telework and flextime . None of the businesses surveyed in Prince William County supported a transportation coordinator position, informal telework or ride matching programs.

TABLE 4

| | |
|----------------------------|--|
| Total # of Businesses | 15 |
| No. of Employees | 7704 |
| TDM Strategy | # of Businesses % of Total |
| Formal Telework | 10 67% |
| Flextime | 8 53% |
| Transit Benefit | 4 27% |
| Bike Racks/Lockers | 4 27% |
| Compressed Week | 2 13% |
| Carpool/Vanpool | 2 13% |
| Preferred Parking | 2 13% |
| Transportation Fair | 1 7% |
| Shuttle | 1 7% |
| Emp. Transportation Coord. | 0 0% |
| Informal Telework | 0 0% |
| Ride Matching | 0 0% |

CHART 4



CONCLUSION

The popularity of TDM programs with businesses is slowly growing as a result of increasing regional congestion and a heightened awareness of the impact that employee commutes have on GHG emissions. By far the most popular strategies include flextime, formal telework and compressed employee work schedules. Rather than making participation mandatory, a combination of improvements in employer outreach, education, and financial assistance can help improve business participation. In the DATA service area, the opening of Metro to Dulles International Airport (and beyond) will help significantly in getting drivers out of their single occupancy vehicles. However, appropriate feeder systems in and around the planned Metro stops will be necessary to fully take advantage of the Metro system.

From an environmental perspective, TDM related strategies seem to be a very effective means of reducing the region's GHG emissions. The E³Calc is a tool that demonstrates the effectiveness of the strategies. As the E³Calc is introduced as another tool in the TDM toolbox, businesses will be able to benchmark, monitor and manage their carbon footprint as they pertain to employee commutes and travel. The E³Calc will be an important tool for TDM professionals in demonstrating the effectiveness of these strategies and their overall importance to a businesses operational viability.

And lastly, the survey information collected by DATA (and other TDM professionals) is somewhat limited in the breadth and number of businesses that were surveyed. And more importantly, the survey did not measure the number of employees participating in the various TDM programs. Once E³Calc is introduced, the first step of the process typically includes a survey of employees to determine their commuting patterns and means of getting to work. This information provides the benchmark for the E³Calc, from which all future information can be measured. The specific employee information will be very useful for TDM professionals to gauge the effectiveness of their programs and outreach, and can assist businesses in developing future strategies for improving employee participation. In this theoretical analysis, the results of using E³Calc's default data demonstrate the effectiveness of TDM related strategies in helping businesses and the region reduce their respective carbon footprint.

Appendix A

GHG Emissions Analysis For The Dulles Area Transportation Association's Service Area

GHG Emission Reductions From TDM Programs and Alternative Commutes

| | Total Daily Vehicle Trips | Daily "Cars off Road" | Daily Commute Miles Driven (VMT) By Employees | Daily Pounds of GHG Emissions (CO ₂ Equivalents) | Annual Tons of GHG Emissions (CO ₂ Equivalents) |
|--|---------------------------|-----------------------|---|---|--|
| Fairfax County | | | | | |
| All Drive Alone | 357,370 | | 5,682,183 | 6,065,076 | 788,460 |
| TDM Strategies Utilized | 249,990 | | 3,974,841 | 4,242,685 | 551,549 |
| Reduction Due to TDM Strategies | 107,380 | 53,690 | 1,707,342 | 1,822,391 | 236,911 |
| | | | | | |
| Loudoun County | | | | | |
| All Drive Alone | 227,006 | | 3,609,395 | 3,852,613 | 500,840 |
| TDM Strategies Utilized | 158,797 | | 2,524,872 | 2,695,010 | 350,351 |
| Reduction Due to TDM Strategies | 68,209 | 34,105 | 1,084,523 | 1,157,603 | 150,488 |
| | | | | | |
| Prince William County | | | | | |
| All Drive Alone | 13,234 | | 210,421 | 224,600 | 29,198 |
| TDM Strategies Utilized | 9,258 | | 147,202 | 157,121 | 20,426 |
| Reduction Due to TDM Strategies | 3,976 | 1,988 | 63,219 | 67,479 | 8,772 |
| | | | | | |
| DATA Service Area | | | | | |
| All Drive Alone | 597,610 | | 9,501,999 | 10,142,289 | 1,318,498 |
| TDM Strategies Utilized | 418,045 | | 6,646,915 | 7,094,816 | 922,326 |
| Reduction Due to TDM Strategies | 179,565 | 89,783 | 2,855,084 | 3,047,473 | 396,171 |
| | | | | | |
| Employee Counts - DATA Service Area | | | | | |
| Fairfax County | 178,685 | | | | |
| Loudoun County | 113,503 | | | | |
| Prince William County | 6,617 | | | | |
| DATA Service Area (Total) | 298,805 | | | | |

Appendix B

Employer Participation Level Descriptions

Transportation Demand Management Strategies

Employer Services Participation Levels

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 information to employees
- Posts alternative commute information on employee bulletin board(s), intranet sites, newsletter or email

Level 2 (Silver)

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
- 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 or 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

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 and Telework/
Compressed Work Schedules
5% to 20% With financial incentive/disincentive and 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 benefits, Smart Benefits, or parking "cash out" program
- Implements a carpool/bicycle/walk financial 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)

Level 4 (Platinum)

Likely range of trip reduction

| | |
|-----------|---|
| 2% to 8% | Without financial incentive/disincentive and Telework/ Compressed Work Schedules |
| 5% to 30% | With financial incentive/disincentive and 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