Commuter Connections

Carpool Incentive Program Demonstration Project Study

Final Report
November 18, 2008

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Preface

With congestion an ever-present problem in the Metropolitan Washington Area, Commuter Connections and its network members actively investigate a variety of tactics and tools that may possibly encourage mode shift in an effort to reduce the number of automobiles on the road as well as to reap any ancillary benefits. One approach that has been instituted in several metropolitan areas across the county is the implementation of a carpool financial incentive program that provides some sort of financial payment to reward first-time carpoolers for shifting their commute mode or rewarding continue use of alternative commute modes.

In this study, the applicability and benefits of instituting a carpool financial incentive study for several corridors in the region is investigated. Recommendations are made for specific corridors that would benefit the most from a carpool financial incentive program. It is also suggested that pilot program(s) be undertaken for these corridor(s).

1 Executive Summary

Commuter Connections, the transportation-demand management program of the National Capital Region Transportation Planning Board (TPB) at the Metropolitan Washington Council of Governments, has undertaken a study to investigate the effects of implementing a carpool financial incentive program in the Washington metropolitan region. The study was conducted as part of the FY2009 Commuter Connections Work Program.

Carpool incentive programs offer a financial incentive in hopes of encouraging life-long solo drivers to try carpooling (or another alternative mode of transportation) or to reward and reinforce continued use of alternative commute modes. Financial incentives provided can come in the form of direct payment, gift certificates/cards or debit cards. The idea behind an incentive program is that solo commuters are more likely to change their driving habits when offered incentives to carpool rather than having disincentives imposed on them.

Two presentations were given before the Commuter Connections Subcommittee. On September 18, 2007, a general introductory presentation on carpool incentive programs was made. Topics included defining an incentive program, reporting on academic research findings, and outlining some active and past incentive programs from around the county. A November 20, 2007 presentation concentrated on retention rates of participants of incentive programs in Los Angeles and Atlanta.

Interest in exploring the possibility of implementing an incentive program in the metropolitan Washington region resulted in adopting the Carpool Incentive Program Demonstration Project Study line item into the Commuter Connections FY2009 Work Program.

A meeting was held on July 29, 2008 with the project's volunteer work group. The preliminary findings of the effects of a carpool financial incentive program in the Washington metropolitan region were discussed.

1.1 Introduction and Background

As outlined in the Commuter Connections FY2009 Work Program, Commuter Connections was tasked to investigate the effects of implementing a carpool financial incentive program in the Washington metropolitan region. A literary review is performed to learn about scholarly research regarding carpool financial incentive programs. An analysis of various current and past carpool incentive programs is included to learn some best practices of other incentive programs. Careful attention is paid to verification techniques that minimize violation rates associated with implementing an incentive program of this type. Finally, United States tax laws are investigated to determine any

restrictions or parameters on the amount of incentives that can be distributed.

1.2 Corridors of Interest Selection

Corridors from the region were selected for close examination in order to determine what types of roadways/corridors would most benefit from instituting a carpool financial incentive program. Criteria for selecting corridors were outlined and profiles of selected corridors are included.

1.3 Impacts of Incentives Programs on Corridors of Interest

The impacts of incentive programs on the selected corridors of interest are explored in this section. First, the criteria upon which corridors will be tested are selected and explained. The model that is used to help evaluate the effectiveness of the incentive is introduced. The calculations and research done to determine baseline corridor statistics are demonstrated. Next, the evaluation criteria are calculated and compared. Finally, implementation costs are calculated and analyzed.

1.4 Topics for Further Consideration

The lessons from the previous sections are summarized and applied to the Washington metropolitan region. Most notably, carpool incentive programs' flexibility, program administration issues are discussed, and the applicability of this report to the region are discussed.

1.5 Recommendations and Conclusions

Recommendations for pilot program(s) are made based on the expected effectiveness of the carpool incentive programs. The cost of a 3 and 6 month pilot program for each of the recommended corridors are calculated.

2 Introduction & Background

As part of the Commuter Connections FY2009 Work Program, Commuter Connections was tasked to investigate the effects of implementing a carpool financial incentive program in the Washington metropolitan region. Prior to this study, the Washington metropolitan Region had limited experience with offering financial incentives to encourage mode shift to carpool. Most notably, the Bridge Bucks programs that targeted commuters using the Frederick Douglass Memorial Bridge and the Wilson Bridge during major construction projects. Bridge Bucks, in addition to other carpool incentive programs offered across North America, are detailed in Section 2.3 below.

Using findings from a literary review, existing carpool incentive programs, and federal rules and regulations, this study comprehensively analyzes all aspects of implementing a financial incentive program in the Washington metropolitan region. Recommendations for implementing an incentive pilot program are made.

2.1 About Commuter Connections

Commuter Connections is a network of organizations that provides transportation program information and services in the Washington metropolitan area designed to inform commuters of the availability and benefits of alternatives to driving alone and to assist them to find mobility alternatives and incentives that fit their commute needs. COG/TPB administers and implements the regional service programs, called Transportation Emission Reduction Measures (TERMs), in a regional effort through Commuter Connections to reduce vehicle trips, vehicle miles of travel, and emissions resulting from commute travel.

2.2 Literary Review

Research specific to carpool incentive programs support the notion that positive reinforcement is more effective than negative reinforcement (offering a punishment/disincentive) at inspiring behavioral changes.

> The 1992 Orange County (CA) Annual Survey asked employed solo drivers to rate their likelihood of changing from solo driving in response to various fees and incentives. Fewer say they would be very likely to stop solo driving if they were charged a parking fee at work (20%), a smog fee (17%) or a congestion fee (16%), than if their employers paid them a cash bonus for stopping solo

driving (28%), or if more public transit (33%) or more carpools at work (35%) were available.[1]

It is important to note these preferences since the political practicality of policy is essential in determining the success of different policies.[2]

Both employees and employers have added benefits derived from an increase in carpooling.

Employee benefits include:[3]

- Cost sharing (cost per person decrease)
- Reduced wear and tear of vehicles
- Time savings (were high-occupancy vehicle lanes are available)
- Increased personal time

Employer benefits include:[4]

- Lower rates of absenteeism
- Reduced demand for parking (cost savings)
- Lower employees stress
- Improved productivity

While carpool incentive programs are likely to increase carpool mode share in any situation, programs are most effective when implemented in certain situations. Carpool incentive programs are most appropriate when:[5]

- HOV facilities are available
- Work place parking is at a premium
- A large employee/commuter base is present
- Urban settings where job concentration lends itself to carpooling

Financial Incentive programs are most effective when:[6]

- programs are introduced along with other TDM efforts including ridematching and guaranteed ride home programs
- programs are flexible so employees have the freedom to carpool on a part-time basis
- appropriate benefits are awarded according to how frequently employees use alternate modes
- employee/commuter input is considered in program development

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[1]Baldassare M, Ryan S, & Katz C. *Suburban attitudes toward policies aimed at reducing solo driving*. Transportation: 25 99-117, 1998.
[2] Baldassare et al
[3] *Carpool Incentive Programs: Implementing Commuter Benefits under the Commuter Choice Leadership Initiative*. U.S. EPA, Commuter Choice Leadership Initiative. September 2001.
[4] *Carpool Incentive Programs*
[5] *Carpool Incentive Programs*
[6] *Commuter Financial Incentives: Parking Cash Out, Travel Allowance, Transit and Rideshare Benefits*. Victoria Transport Policy Institute. Updated 7 March 2007.

2.3 Existing Carpool Financial Incentive Programs

A number of United States metropolitan areas have administered or currently administer a carpool financial incentive program. A description of several of these programs is included below.

Several themes or components of the incentive programs are repeated throughout many of the various programs. While not every program adheres to these best practices, the following incentive program elements are commonly utilized. First, life-long solo commuters are targeted to participate in the incentive programs. The logic behind this requirement is to provide an added incentive in order to cause mode shift from single-occupancy vehicle travel to carpooling. Several locations have also implemented programs specifically designed to reward current carpoolers and to reinforce and galvanize their alternative commute mode use. Generally these types of programs offer a smaller incentive or random drawings.

Additionally, each incentive program offered some sort of incentive over a set, defined period of time. The exact incentive could come in the form of monetary, in-kind, or gift certificate compensation. The length of the incentive program also varies, ranging from two months to several months long.

A third general theme of the incentive programs is monitoring and evaluation. Surveying program participants is essential in determining the effectiveness of the program in terms of achieving short- and long-term mode shifts and retention rates which are used to judge the overall effectiveness of the programs.

Finally, each incentive program had some sort of verification process in place to both minimize duplicate participants as well as to confirm the accuracy of commuters' commute modes. This is especially important because a financial reward is at stake, and steps need to be taken to minimize cheating of a (at least partially) publicly-funded program. As a general rule, the larger the financial incentive, the more comprehensive the oversight and verification process is. Additionally, the verification techniques tend to involve manual (individually reviewing applications and tracking sheets, or performing follow-ups) or low-tech (developing software that automatically flags suspect behavior such as possible duplicate participants or questionable trip tracking information) techniques. Existing incentive programs have identified three stages of the incentive program where abusers can most likely be isolated and identified, and safeguards have been put in place at these junctures. Below, specific fields or strategies for eliminating cheating during the application, tracking, and verification steps are listed. The strategies represent all possible specific strategies that have been utilized by current or past incentive programs. Note: not all of these tactics are/were employed by each incentive program.

- Application
  - Required Fields (unique identifiers for preventing duplicate accounts)
    - License #
    - Social Security #
    - Home/Work Phone #
    - Home Address
    - Work Address
    - Supervisor name and phone #
    - Work email address
  - Authorization/co-sign of application
    - Commuter/employee/participant signature
    - Employee Transportation Coordinator signature
    - Employer/supervisor signature
- Tracking of Commute Behavior (how are trips recorded?)
  - Online, public-facing tracking system
    - Track on daily, weekly, monthly basis
  - Paper tracking system
    - Track on a less frequent basis (weekly, monthly, quarterly)
- Verification (how are trips validated?)
  - Commuter/employee/participant
    - Signature
    - Email confirmation
  - Employer/supervisor signature
    - Signature
    - Email confirmation
  - Program Administrators
    - Low-tech techniques
    - Manual techniques
  - Employee Transportation Coordinator signature
    - Signature
  - Transportation Management Association
    - Follow up with supervisor/employer

It is important to note that a relatively limited amount of technological utilization is currently in place for the application, tracking and verification or commuters' actual behavior. Better utilizing current and future technologies should enhance the ability to accurately verify commuters' behaviors and minimize cheating of publicly funded incentive programs.

Summary of Past and Current Incentive Programs:

<u>Northern Virginia/Suburban Maryland – Bridge Bucks (Wilson Bridge)</u>
Bridge Bucks was a commuter incentive program sponsored by the Virginia Department of Transportation and Maryland State Highway Administration that provided $50 a month for one year to commuters who shifted from cars to transit or vanpools. The money could be applied to offset the cost of

Metrorail, bus, or organized vanpool services. The program was aimed at reducing traffic while the Woodrow Wilson Bridge was under construction from 2004 to 2006. Bridge Bucks was available to a limited number of eligible commuters who were affected by the construction. Users signed up for the program online. Follow-ups were performed every three months to verify the commuters' current commute mode.

Washington, DC – Bridge Bucks (Frederick Douglass Bridge)

Bridge Bucks was a commuter incentive program sponsored by the District Department of Transportation that provided $50 a month to commuters who shifted from cars to transit or vanpools. The money could be applied to offset the cost of Metrorail, bus, or organized vanpool services. The program was aimed at reducing traffic while the Frederick Douglass Bridge (often referred to as the South Capitol Street Bridge) was closed for major upgrades during the months of July and August 2007. Bridge Bucks was available to a limited number of eligible commuters (approximately 1500) who are affected by the temporary closure of this major access point in and out of Washington, DC.

New Jersey – Carpooling Makes Sense

The Carpooling Makes Sense program, targeted at life-long solo drivers, offers one $100 gas card per new carpool of two or more commuters. To qualify, the carpool must be in operation at least 24 days over a two month period. Commuters register for the program online and their behavior is monitored by transportation management associations (TMAs). This ongoing program began May 1, 2006.

An online or hard copy application is required for entry into the program. Only one application per carpool needs to be submitted. Required fields include home and work address, email address, supervisor name and phone number, and home and work phone number.

After the registration is submitted, the appropriate Transportation Management Association (TMA) sends the applicant a trip log booklet. Participants are required to track their weekly commute patterns. Once commuters have carpooled 24 times they submit their completed trip log. The TMA contacts the supervisor to verify the accuracy of the trip log.

Riverside and San Bernardino Counties, CA – Advantage Rideshare and Option Rideshare

The Advantage Rideshare and Option Rideshare programs are incentive programs offered in Riverside and San Bernardino Counties, respectively. Both programs are operated identically, however funding for the programs is separate. Participants must take an alternative mode of transportation at least 5 days per month to be eligible to earn $2.00 for every day an alternative mode is taken (offered in gift certificates) for a 3 month period (limit $120). Advantage Rideshare boasted the following retention rates:

- Retention Rates

- 75% continued carpooling 6 months after the program end date
- 40% retention rate 9 months after end of program

Applications must be submitted to the project administrator. Required fields include social security number or license number, home and work phone number, home and work address, email and supervisor contact info (phone number and email). Participants are tracked by their social security numbers or license numbers to avoid program abusers.

Participants track their commute modes on a paper log sheet. The commuter's travel habits for the 3 month duration of the program are logged on a single tracking log. A valid tracking log must be signed by the participant and the supervisor.

Redmond, Washington – R-Trip

The R-Trip program is open to commuters who live or work within Redmond's city limits. Commuters receive a point for each day they log an eligible commute trip on an online tracking system. Commuters are able to exchange 50 points for an $50 Amazon.com gift card or a $50 donation to Carbonfun.org. Additionally, commuters are entered into a monthly random prize drawing. While retention rates are not currently available, the program boasts a variety of environmental accomplishments including:

- Over 5 million pounds of CO2 reduced
- Over 260,000 gallons of gas saved
- Over 5.5 million miles worth of commute alternative miles logged
- Nearly 200,000 vehicle trips saved

Knoxville, Tennessee – Cash for Commuters and Commuter Bucks

Knoxville offered the Cash for Commuters program from February-April 2006. The program paid $2.00 a day (in the form of Visa check cards) to commuters who switched commute modes to ridesharing, transit, bicycling, or walking. The program was limited to 38 participants, 25 of which completed the program. Of those 25 participants, 77% continued to use alternative modes of transpiration at least 1 day a week 3 months after the program, and 65% continued to do so 6 months after the program. The program was attributed with saving 23,532 commuting miles equaling 1,200 gallons of gas over the 60 day period

The most recent iteration of an incentive program in Knoxville is known as Commuter Bucks. This program provides a $10 gift card to anyone who uses carpool, vanpool, transit, bike, walk, or telecommute to work 30 days (or 60 one-way trips) within a quarter.

Atlanta, GA – Cash for Commuters

The Cash for Commuter program provides up to $180 over a 90 day period (or $3/day for each day a commuter alternative was used) to commuters who shift modes from SOV travel to alternative modes. The program is geared towards commuters who would not otherwise try commuter

alternatives. Commuters sign up for the program and monitor their commute habits through an on-line tracking system. The program is on-going.

Commuters are required to submit a signed and completed application via mail or fax. Required information includes: driver's license number, home/cell and work phone numbers (two are required), complete work and home addresses, complete supervisor information, and participant and supervisor signatures agreeing to the conditions of the program. Participants have the option to log their trips online using an online tracking system[7] or on paper.

Upon acceptance into the program, participants will receive a welcome email with a URL link to the Commuter Rewards online tracking system. Commuters must register their online account. The logging system only allows participants to log the current day's commute and the previous six days.

At the end of the 90-day period, participants must print their Commuter Report from the online system. Both the supervisor and the participant must sign and date this report to confirm its validity. The participant then mails the report to the Clean Air Campaign. A check for the value of the incentive is sent to the commuter's work address.

Program monitoring and evaluation determined the following retention rates for the first two waves of the program:

Continued Use of Alternative Modes

Alternative Mode Status	Wave 1 3-6 Months After	Wave 1 9-12 Months After	Wave 2 3-6 Months After
Continue alternative modes on a weekly basis	71%	64%	74%
Stopped all alternative modes	29%	36%	26%

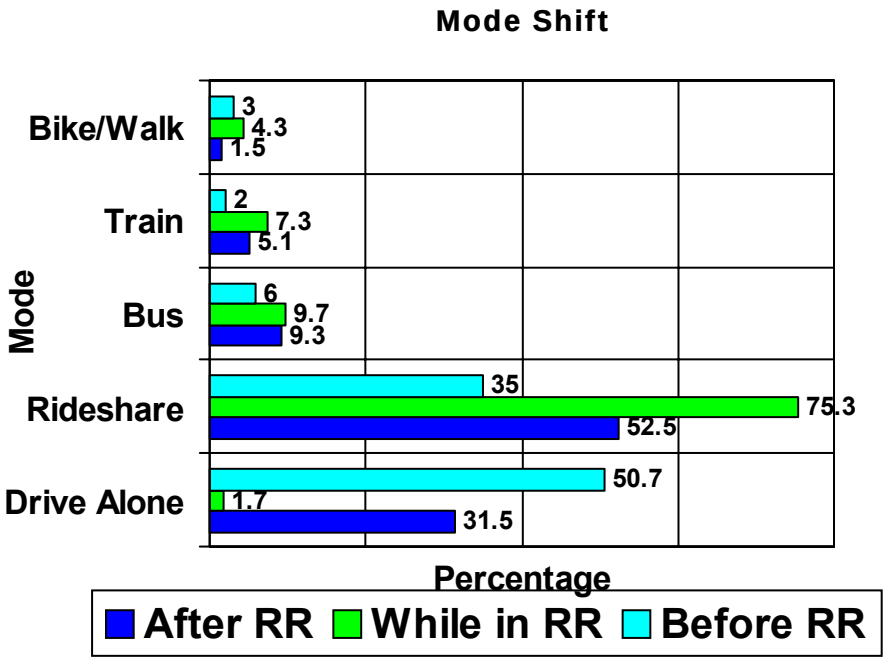
In an effort to encourage commuters to use alternatives even after completing the Cash for Commuters program, several complimentary incentive programs are in place that reward commuters who are currently using commuter alternatives. The Commuter Prizes program allows commuters to enter into a random monthly drawing for prizes valued at $25. Additionally, carpools with up 3 people are eligible for a $40 gas card each month for a 3 year period and carpools with 4 or more people are eligible for

[7] Commuter Connections will be acquiring this tracking software as part of Phase III of the web-based TDM Software development. Commuter Connections' software developer (Base Technologies, Inc.) developed the tracking software for the Atlanta and Knoxville incentive programs. See the Appendix section for screen shots of the software.

a $60 gas card over the same time period. Verification of commute modes for these supplemental programs is less thorough than the process for verifying Cash for Commuters behavior, likely because a lower incentive is offered for these two programs.

Los Angeles, CA – Rideshare Rewards Program, Club Metro and Metro Rewards

The Rideshare Rewards Program provided $2 per day for up to 3 months (up to $120) in the form of gift certificates to new ridesharers. The Rideshare Rewards program successfully changed commuter's travel modes from single-occupancy vehicle trips to alternate transportation modes (see graph below).



Retention rates were carefully monitored with a series of surveys. 80% of respondents said the $2/day incentive was either "very important" (41%) or "somewhat important" (39%) to their decision to rideshare. Only 45% of respondents said they were "somewhat likely" (34%) or "not likely" (11%) to rideshare without the incentive.

The Club Metro program was designed to reinforce desired behavior and to encourage continued use of commute alternatives to those who had been ridesharing for at least 6 months. In fact, 54% of respondents in a follow up survey said the Club Metro program was either "very important" or "somewhat important" in the decision to continue using commute alternatives. Incentives came in the form of coupons and discounts for various restaurant and entertainment establishments.

The Rideshare Rewards and Club Metro programs were phased out in favor of the Metro Rewards Program. The Metro Rewards program is an employer-

based incentive program that offers employees of participating employers a $15 gift card for using alternative commute modes at least 10 days per month for a 3 month period.

Employees are required to provide a home or work phone number, home address, and employer information as part of the application. Each new participant is manually reviewed to ensure that people are not creating duplicate accounts. The program places the burden on employers to verify employees' actual commute modes. For employers with fewer than 250 employees, the employee and supervisor sign off to confirm the accuracy of the commute log. For employers with more than 250 employees, the employee and Employer Transportation Coordinator (ETC) sign off on accuracy of the commute modes. The ETC sends a copy of the approved commute log to the employee's supervisor, who then provides a third verification of the participant's claims.

2.4 Federal Rules and Regulations

The Internal Revenue Service (IRS) requires that a 1099 Form be submitted (one copy each to the IRS and to the recipient) by the agency/individual making the payment for any payment or gift of $600 or more over the course of a tax year. 1099 Forms do not have to be submitted for payments valued at less than $600. A cash or gift certificate payment as part of a carpool financial incentive program would require the administrating agency to submit 1099 Forms for each participant who received $600 or more in incentives. In order to avoid the extra effort and paperwork associated with offering more than $600 per year in incentives, it is advisable to offer under $600 per year ($50/month if the program lasts 12 months) in incentives.

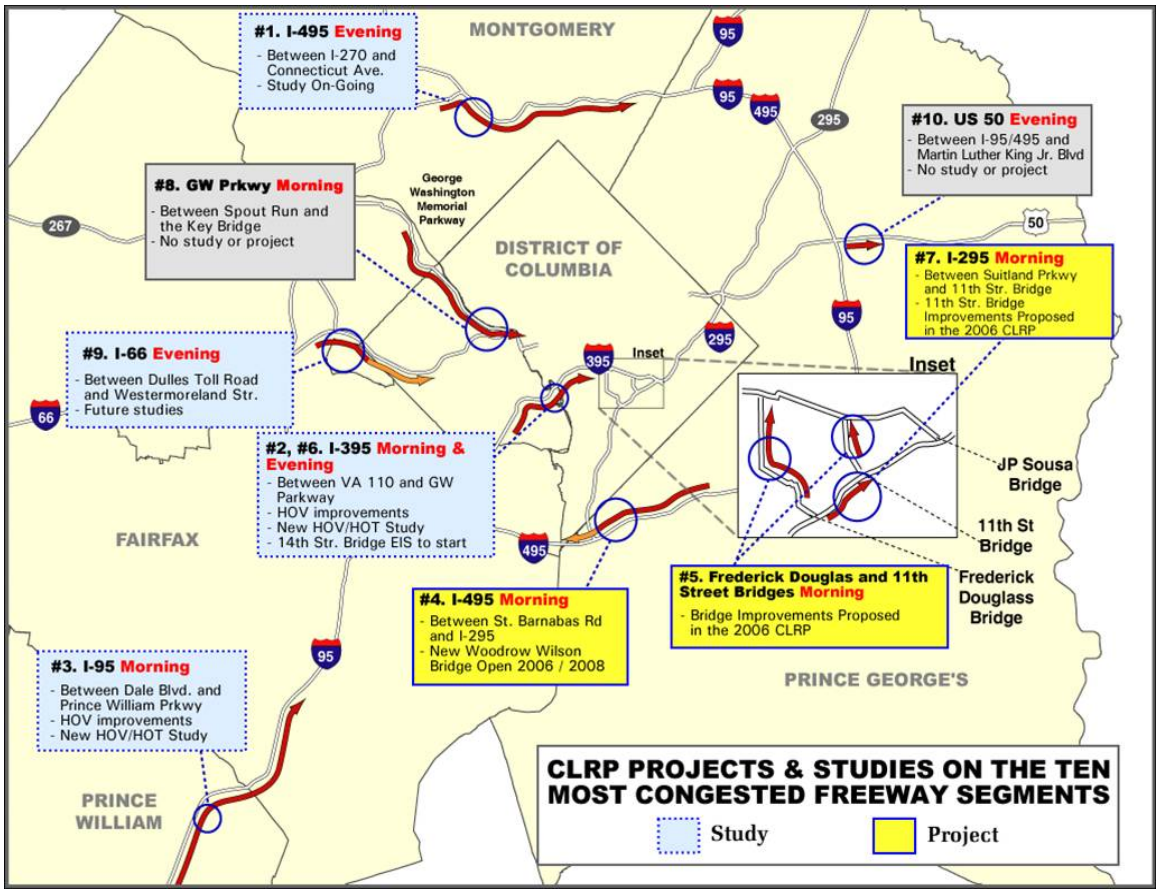
3 Corridors of Interest Selection

Most current and former incentive programs are offered across an entire region and not necessarily constrained to a specific location or corridor. However, separate corridors across a region have different characteristics (volume, peak direction, capacity, facilities, etc.). The effectiveness of an incentive program can be calculated using corridor statistics such as auto occupancy and volume (which differ between corridors). Therefore, the utility of an incentive program is dependent on the baseline statistics of a particular corridor. Carefully selecting corridors that have favorable baseline statistics could result in a more effective incentive program by utilizing favorable conditions to convince a large number of people to shift commute modes. Sections of roadway which were selected to investigate the effects of an incentive program are deemed a “Corridor of Interest” (COI).

It is important to note that while specific COI were selected for the purposes of this report, the selected corridors are certainly not the only ones in the region that would benefit from an incentive program.

3.1 Criteria for Selecting Corridors of Interest

The starting point for selecting COIs was to consider the Top Ten congested facilities developed for the TPB’s Constrained Long Range Plan (CLRP). The map (see below), based on the 2005 Skycomp report data, illustrates the average reoccurring evening peak period congestion throughout the region.



The most congested corridors during the afternoon peak period are the following: the northwestern half of the Capitol Beltway, I-270 from the Beltway to north of Gaithersburg, I-395 from the District's Southeast-Southwest Freeway to Dumfries, Virginia, and I-66 from the Beltway through the City of Fairfax, Virginia.

The ten most congested corridors provided a starting point for ultimately selecting the COI in that they identified areas where congestion is of particular concern. The actual selection of COIs, however, sought to look beyond simply the most congested areas in the region. Instead, several other factors and conditions in addition to level of congestion were considered. First, availability of commute alternatives was considered. Commute alternatives include the existence of HOV facilities, availability of commercial vanpool services, and transit service offerings. With few to no alternatives to automobile commutes, incentivizing the one commute alternative option that is available could encourage a significant number of former SOV commuters to try carpooling. Second, peak versus off-peak directions were considered. Because reverse commutes by definition attract fewer commuters, the pool for potential ridesharers is smaller than that of a peak commute, which may result in lower carpool usage. Offering an incentive could increase the pool of

potential carpoolers thus increasing the likelihood of providing successful carpool matches[8] for interested parties.

The purpose of investigating the application of roadways with different characteristics was to determine what corridor characteristics best lend themselves to establishing a successful incentive program. In order to determine which categories of roadways are best suited for an incentive program it was important to select a wide-ranging pool of test corridors with disparate characteristics.

3.2 Corridors of Interest Profiles

Based on the selection criteria detailed above, the following COIs were selected to study the effects of implementing a carpool financial incentive program:

Corridor	Profile
I-66: AM WB Outside the Beltway 	• Reverse commute • Few or no commercial vanpools • Transit coverage: local transit options • HOV facilities: no • Peak volume (during reverse commute): 7169 v/h
I-270: AM SB from Gaithersburg to I-495 	• Peak commute • Limited commercial vanpools • Transit coverage: Metrorail (Red line – indirect service), Metrobus, and local transit • HOV facilities: yes • Peak volume: 8092 v/h
I-495: AM WB from Bethesda to Tyson's Corner 	• Peak commute • Few or no commercial vanpools • Transit coverage: no transit coverage that offers cross-jurisdiction service • HOV facilities: no • Peak volume: 8192 v/h
I-495: AM WB from I-295 to I-270 	• Peak commute • Limited commercial vanpools • Transit coverage: Metrobus • HOV facilities: no • Peak volume: 8126 v/h

[8] Commuter Connections online TDM software could be utilized to help find carpool partners for people who are interested in participating in a carpool incentive program.

I-395: PM NB from Northern Virginia into DC 	• Reverse commute • Few or no commercial vanpools • Transit coverage: no transit coverage that offers cross-jurisdiction service • HOV facilities: no • Peak volume (during reverse commute): 4779 v/h

Again, although these corridors were selected for investigation, other corridors in the region could be an appropriate application of an incentive program.

4 Impacts of Incentive Programs on Corridors of Interest

The impacts associated with implementing an incentive program in the COIs are described in this section. It is important to note that all benefits are calculated on a *per hour* basis because peak hour traffic volume is used to calculate the impacts. Since peak volume does not simply last for one hour but up to four (two morning peak hours and two evening peak hours), the benefits calculated below could possibly be four times as large.

4.1 Determining Evaluation Criteria

The first step in determining the impacts of an incentive program on COIs is to determine evaluation criteria. Evaluation criteria were set with funding in mind. No specific funding source was envisioned. Instead, criteria that would generally prove the worth of an incentive program (its ability to accomplish certain desirable outcomes) and justify funding a program were considered. The evaluation criteria selected are:

- Vehicle trips (VT) reduction
- Vehicle miles traveled (VMT) reduction
- Emissions benefits (hazardous particles reduction)
  - NO_X
  - VOC
  - CO_2
  - $PM_{2.5}$

4.2 Selecting an Appropriate Model

With evaluation criteria selected, a tool is needed to measure the ability of the incentive program to fulfill the determined criteria. The model selected is the Mode Choice Model Sensitivity Analysis created by William G. Allen, Jr. for the Metropolitan Washington Council of Governments in 1992. The model was developed to provide insight into how the mode choice is affected by changes in the transportation system so that the results can be used to produce checks on the likely impacts of certain system changes. From the model, several tables were created to show the impact of changes in various transportation systems.

The *Estimated New Auto Occupancy Resulting from Decrease in the HOV-2 Parking Costs* table (below) derived from the model predicts the change in auto occupancy resulting from decreases in HOV-2 parking cost. This table was deemed an appropriate predictor of occupancy for a carpool financial incentive program. Although reducing the cost of parking for carpoolers may at first seem different from providing a financial incentive for carpoolers, both actions serve to reduce the (money) costs of driving to work. In other words, if all money costs associated with driving are considered (gas, parking, maintenance, etc.), providing a price reduction in parking costs is essentially the same as providing an incentive for carpooling in that the total

money costs of driving is decreased. If the value of the incentive is equal to the value of the parking reduction in the table, the table can confidently be used to measure changes in auto occupancy.

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs (1980 value of $)

Base Auto Occupancy	$0.25 / $0.13	$0.50 / -$0.25	$1.00 / $0.50	$1.25 / $0.63	$1.50 / $0.75	$2.00 / $1.00	$3.00 / $1.50	($/veh/day) / ($/person/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050	
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087	
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107	
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151	
1.125	1.132	1.137	1.148	1.154	1.160	1.173	1.205	
1.148	1.171	1.177	1.189	1.196	1.203	1.217	1.252	
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256	
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305	
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352	
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397	
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394	

The change in auto occupancy is determined by finding the intersection of the base auto occupancy and the value of the parking cost reduction. For example, a $1.00 parking reduction along a corridor with a base auto occupancy of 1.148 persons per vehicle would result in a new auto occupancy of 1.189 persons per vehicle.

Because the table was created using 1980 value of money, the table was updated (below) for 2008 values using the Consumer Price Index (CPI) maintained by the United States Bureau of Labor Statistics. Because the Base Auto Occupancy and associated changes to auto occupancy displayed in the table are products of the model, these values were not updated. Only the value of the parking reduction was updated to 2008 values.

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs (2008 value of $)

Base Auto Occupancy	$0.66 / $0.33	$1.33 / $0.67	$2.66 / $1.33	$3.32 / $1.66	$3.98 / $1.99	$5.31 / $2.66	$7.97 / $3.99	($/veh/day) / ($/person/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050	
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087	
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107	
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151	
1.125	1.132	1.137	1.148	1.154	1.160	1.173	1.205	
1.148	1.171	1.177	1.189	1.196	1.203	1.217	1.252	
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256	
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305	
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352	
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397	

1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394

Based on the Federal rules and regulations outlined earlier, the incentive cannot exceed $600 per year (or $50 per month). Based on the average number of work days per month of 21.83[9], an incentive valued up to $2.29 could be offered per participant per day. In order to utilize the table for determining changes in auto occupancy, the value closest to $2.29 per month on the table what selected as the hypothetical value of the incentive. Therefore, $3.98 per carpool per day or $1.99 per person per day (assumes HOV-2). Note: while it is unlikely that an incentive program would last for 12 months, keeping the daily incentive below the daily maximum keeps the option open should a 12 month program be selected.

4.3 Determining Baseline Corridor Statistics

In order to determine decreases in vehicle emissions (and the associated reduction in hazardous particles that are emitted), it is first necessary to determine the reduction in VT and VMT.

These values are calculated by determining the difference in the number of cars it takes to move a certain amount of people through the corridor (referred to as throughput). This calculation requires several baseline statistics:

- Base auto occupancy
- Peak volume
- Throughput (number of people moved) – a relationship between base auto occupancy and peak volume

Base auto occupancy data was gathered from several sources including COG's *2007 Performance of High Occupancy Vehicle Facilities in the Washington Region* study and data available from the Maryland (MDOT) and Virginia (VDOT) Departments of Transportation websites. The base auto occupancy is used to determine the change in auto occupancy when an incentive is provided.

Peak volume was calculated using data from MDOT and VDOT. The value was calculated differently based on the available data and characteristics of the corridor (peak versus reverse commute). MDOT provides peak volume data. VDOT does not, and, therefore, the data must be calculated. For the reverse direction COIs in Virginia, the total volume for on a mid-week day was multiplied by 0.09 (9% of volume occurs during peak hour) and again by 0.45 (45% of peak hour volume occurs in the reverse direction while 55% occurs in the primary direction).

For example, total volume for I-66 WB outside the I-495 is approximately 177,000 vehicles/day. To get the reverse direction peak volume for this

[9] Monthly Working Hours. University of California Office of Human Resources and Benefits. < http://hrop.ucop.edu/employees/work_hours08.html>.

corridor, 177,000 is multiplied by .09 and .45 to arrive at 7169 vehicles/hour.

Calculating the throughput requires multiplying the peak volume by the base auto occupancy. Again using the I-66 corridor as an example, 7169 * 1.1 = 7886 persons/hr.

4.4 Calculating VT Reduction

Using base auto occupancy and peak volume, the vehicle trips reduced can be calculated. Essentially, it is assumed that the number of people traveling through the corridor remains constant regardless of any other changes to roadway conditions. However, since the auto occupancy has increased (carpooling rate has increased) due to the incentive, it takes fewer vehicles to move the same number of people (lower traffic volume).

To calculate the difference in VT, the throughput (calculated in 4.3) is divided by the new auto occupancy rate. The difference equals the reduction in vehicle trips.

For example, implementing an incentive program on I-66 would result in removing approximately 96 vehicles from the corridor (7886 ÷ 1.115 = 7072, 7169 – 7072 = 97).

4.5 Corridors of Interest Calculation Profiles

Below are the data for each of the Corridors of Interest.

It should be noted that a 50% discount rate was applied to each corridor's calculated VT Reduction. This was done so as to not overstate the model.

I-66

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs

Base Auto Occupancy	$0.66	$1.33	$2.66	$3.32	$3.98	$5.31	$7.97	
	$0.33	$0.67	$1.33	$1.66	$1.99	$2.66	$3.99	($/veh/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050	($/person/day)
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087	
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107	
1.1	1.092	1.096	1.105	1.110	1.115	1.126	1.151	
1.125	1.132	1.137	1.148	1.154	1.160	1.173	1.205	
1.148	*1.171*	*1.177*	*1.189*	*1.196*	*1.203*	*1.217*	*1.252*	
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256	
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305	
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352	
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397	
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394	

Base Occupancy: 1.1
New Occupancy: 1.115
Base Peak Volume: 7169
Throughput: 7886
New Peak Volume: 7072
Vehicle Trips Reduction: 97

I-270

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs

Base Auto Occupancy	$0.66	$1.33	$2.66	$3.32	$3.98	$5.31	$7.97	($/veh/day)
	$0.33	$0.67	$1.33	$1.66	$1.99	$2.66	$3.99	($/person/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050	
1.050	**1.054**	**1.056**	**1.061**	**1.064**	**1.066**	**1.073**	**1.087**	
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107	
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151	
1.125	1.132	1.137	1.148	1.154	1.160	1.173	1.205	
1.148	*1.171*	*1.177*	*1.189*	*1.196*	*1.203*	*1.217*	*1.252*	
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256	
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305	
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352	
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397	
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394	

Base Occupancy: 1.050
New Occupancy: 1.066
Base Peak Volume: 8092
Throughput: 5497
New Peak Volume: 5376
Vehicle Trips Reduction: 121

I-395

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs

Base Auto Occupancy	$0.66	$1.33	$2.66	$3.32	$3.98	$5.31	$7.97 ($/veh/day)
	$0.33	$0.67	$1.33	$1.66	$1.99	$2.66	$3.99 ($/passenger)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151
1.125	1.132	1.137	1.148	1.154	1.160	1.173	1.205
1.148	*1.171*	*1.177*	*1.189*	*1.196*	*1.203*	*1.217*	*1.252*
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394

Base Occupancy: 1.150
New Occupancy: 1.206
Base Peak Volume: 4779
Throughput: 4779
New Peak Volume: 4557
Vehicle Trips Reduction: 222

I-495 (Bethesda to Tyson's Corner)

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs

Base Auto Occupancy	$0.66	$1.33	$2.66	$3.32	$3.98	$5.31	$7.97 ($/veh/day)
	$0.33	$0.67	$1.33	$1.66	$1.99	$2.66	$3.99 ($/person/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151
1.125	**1.132**	**1.137**	**1.148**	**1.154**	**1.160**	**1.173**	**1.205**
1.148	*1.171*	*1.177*	*1.189*	*1.196*	*1.203*	*1.217*	*1.252*
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394

Base Occupancy: 1.125
New Occupancy: 1.160
Base Peak Volume: 8190
Throughput: 9214
New Peak Volume: 7943
Vehicle Trips Reduction: 247

I-495 (I-295 to I-270)

Estimated New Auto Occupancy Resulting From Decrease in HOV-2 Parking Costs

Base Auto Occupancy	$0.66	$1.33	$2.66	$3.32	$3.98	$5.31	$7.97	($/veh/day)
	$0.33	$0.67	$1.33	$1.66	$1.99	$2.66	$3.99	($/person/day)
1.025	1.032	1.033	1.036	1.037	1.039	1.042	1.050	
1.050	1.054	1.056	1.061	1.064	1.066	1.073	1.087	
1.075	1.066	1.069	1.075	1.078	1.081	1.089	1.107	
1.100	1.092	1.096	1.105	1.110	1.115	1.126	1.151	
1.125	**1.132**	**1.137**	**1.148**	**1.154**	**1.160**	**1.173**	**1.205**	
1.148	*1.171*	*1.177*	*1.189*	*1.196*	*1.203*	*1.217*	*1.252*	
1.150	1.175	1.180	1.193	1.199	1.206	1.221	1.256	
1.175	1.216	1.222	1.236	1.243	1.251	1.268	1.305	
1.200	1.257	1.264	1.278	1.286	1.295	1.313	1.352	
1.225	1.296	1.304	1.320	1.329	1.337	1.356	1.397	
1.250	1.294	1.301	1.317	1.325	1.334	1.352	1.394	

Base Occupancy: 1.125
New Occupancy: 1.160
Base Peak Volume: 8126
Throughput: 9142
New Peak Volume: 8897
Vehicle Trips Reduction: 245

Summary of Effects

The summary of effects of an incentive program that offers each carpool $3.98 per day is detailed in the chart below:

	I-66	I-395	I-495 B→T	I-495 295→270	I-270
Base Occupancy	1.1	1.15	1.125	1.125	1.05
New Occupancy	1.115	1.206	1.16	1.16	1.066
Peak Volume (v/h)	7169	4779	8190	8126	8092
Peak Volume w/Incentive (v/h)	7121	4668	8066	8003	8031
Total VT Reduction (v/h)	48	111	124	123	61
% Change	-0.67%	-2.32%	-1.51%	-1.51%	-0.75%

4.6 VMT and Emissions Savings Calculations

Emissions impacts are calculated based on vehicle miles traveled (VMT) reduction because impacts are felt on a per mile basis. With the knowledge of VT reduction, VMT reduction and the associated emissions reductions benefits can be calculated. Based on commuter information from the Commuter Connections 2004 *State of the Commute*, the average commute in the metropolitan Washington region is approximately 15.5 miles (each way)

Benefits Per Corridor

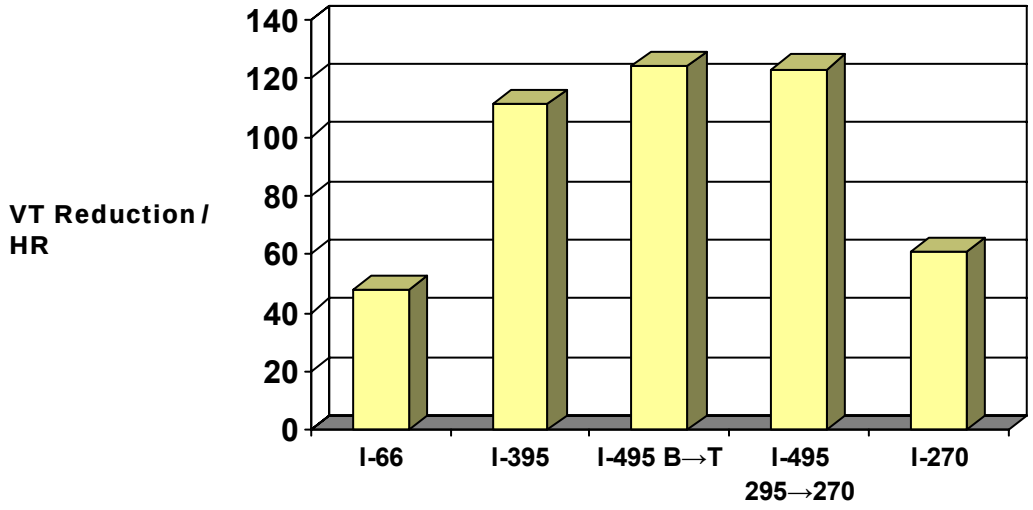
	I-66	I-395	I-495 B→T	I-495 295→270	I-270
VT Reduction (per hr)	48.177130	110.955224	123.556034	122.590517	60.727955
VMT Reduction (per hr)	746.745516	1719.805970	1915.118534	1900.153017	941.283302
NOX (ton/hr)	0.000331	0.000762	0.000849	0.000842	0.000417
VOC (ton/hr)	0.000212	0.000487	0.000543	0.000538	0.000267
CO2 (ton/hr)	0.382763	0.881529	0.981641	0.973970	0.482478
PM2.5 (ton/hr)	0.000009	0.000022	0.000024	0.000024	0.000012

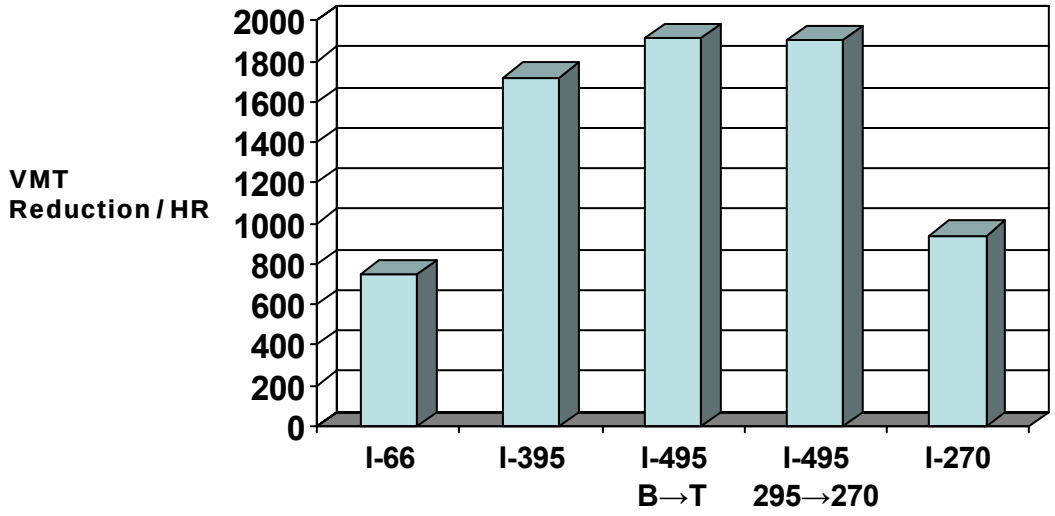
It is important to note that these values were computed for a one-way commute. However, if the carpool operated two-ways, these numbers could potentially be multiplied by two to represent and average 31 mile two-way commute per day.

Because the cost (per carpool) of implementing the incentive program is the same for all Corridors of Interest ($3.98 per carpool), a cost-benefit analysis of the different corridors reveals the same results below:

Vehicle Reduction ($/veh/day)	$3.98
VMT Reduction ($/vmt/hr)	$0.26
NO_X ($/ton/hr)	$579,452.31
VOC ($/ton/hr)	$906,194.56
CO_2 ($/ton/hr)	$500.95
$PM_{2.5}$ ($/ton/hr)	$20,255,799.72

While the cost-effectiveness across corridors cannot be compared, there are other ways to gauge to effectiveness of a prospective incentive program. First, the gross changes across corridors can be analyzed and compared. Below are the comparisons between the corridors for VT reduction and VMT reduction:





Additionally, the cost-effectiveness of the carpool financial incentive program can be compared to the cost-effectiveness of other transportation demand management or congestion mitigation programs, policies, and tactics.

5 Topics for Further Consideration

5.1 Program Flexibility

It is important to note the inherent flexibility of incentive programs. Components of the program can be controlled and parameters can be established to create a program that meets the demands of stakeholders. The following are characteristics or parameters that are easily controlled:

- Incentive type – Cash or gift card (or something else)?
  - The selecting of incentive type is up to the program administrators. The simplest type of incentive to distribute can be selected.
- Incentive length – How long will the program run?
  - Longer-running programs tend to suffer from high drop-out rates, but also benefit from higher rates of continued carpooling amongst those that stay in the program. Longer-running programs can also be more expensive since a greater amount of incentives may be given out (see Incentive cap/maximum below).
- Incentive cap/maximum – setting a cap can keep operating costs low
  - Caps or maximums can be set to limit the total amount of incentive that participants can receive. These limitations allow for programs to stay within their budgets.
- Participant cap/maximum – How many people can participate in the program?
  - Setting limitations for the number of participants can also help programs stay within their budgets. Often times, pilot studies call for a small number of participants in order to gauge the effectiveness of a program and pinpoint any areas of program administration that need to be altered.
- Occupancy requirements – mandating HOV-2 or HOV-3 or higher dramatically impacts the benefits of a program
  - While this study assumed program benefits based on HOV-2, program benefits could dramatically rise is higher occupancy is required for participation.
- Commute Frequency – how often do commuters have to use an preferred commute mode to qualify for the program
  - Programs can set requirements for the number of trips (one-way or two-way) over a set-period of time (daily, weekly, monthly, etc.)
- Program administrator – Who is responsible for administering the program
  - Examples from around the county demonstrate that a variety of groups can be in charge of the program including employers, transportation management associations, local governments, state governments, or regional organizations.

5.2 Operation/Administration of a program

Because this study is a preliminary investigation into the effects of implementing a carpool financial incentive program, it is premature to concentrate too heavily on logistical and/or administrative concerns at this time. There are several concerns, however, that should be addressed further.

One major concern of other jurisdictions with incentive programs is verifying the accuracy of commute mode to minimize/eliminate cheating or defrauding the incentive program. Currently, incentive program administrators use a variety of manual and low-tech techniques to prevent/remove duplicate participants and to verify the actual commute modes being used by participants described in Section 2.3. Better utilizing current and future technologies will reduce fraudulent use of the program

Another item of importance is the acquisition of BaseTrak, an online commute tracking log developed by Base Technologies, Inc, that the Atlanta and Knoxville incentive programs are using to track and verify commute modes, by Commuter Connections. This software could be available for any carpool financial incentive program or other program that requires tracking of commute mode. BaseTrak will also allow for quick and efficient data collection because program participants would be required to track their daily commute behavior using the software. See Section 8 for screen shots of the software.

The new Commuter Connections TDM Software can also be utilized to help commuters interested in participating in the incentive program find carpool partners. The software has the ability to track carpool activity in the Pool Admin section of the software, which would allow for attaining better and more accurate carpool rate data. See Section 8 for screen shots of the software.

5.3 Applicability of this report to the Region

While this report concentrated on five specific corridors in the Washington region, these selected Corridors of Interest are not the only possible corridors in which to implement an incentive program. The corridors selected for observation were done so in order to understand the effects an incentive program on a wide range of disparate corridors. Corridor not included as a Corridor of Interest may still benefit from an incentive program and therefore could be considered a candidate for implementation of an incentive program.

The Washington metropolitan region and its roadways are adequately prepared for an incentive program. Based on recommendations outlined in the Literary Review, the area's HOV facilities, Ridematching software, and Guaranteed Ride Home program provide many of the supporting and complimentary facilities that make an incentive program most successful.

6 Recommendations and Conclusions

6.1 Recommended Corridors

It is the intent of this report to recommend corridors that would see the greatest benefit from the adoption of a carpool financial incentive program. Based on the overall impacts of the incentive program on travel conditions and emissions that are outlined in Section 4, this report finds that the following corridors would benefit the most from an incentive program:

- the I-495 corridor from Bethesda to Tyson's Corner
- the I-495 corridor from I-295 to I-270
- I-395 from Northern Virginia into Washington, DC.

6.2 Cost of Pilot Programs

This report suggests starting pilot program(s) for the recommended corridors. The pilot program(s) would allow funding agencies to measure the benefits of the incentive program.

Based on other carpool financial incentive programs across the country, common durations for programs extend anywhere from 3 to 6 months. The costs for the three recommended corridors for 3 and 6 months are below:

	I-395	I-495 B→T	I-495 295→270
Total Cost for 3-Month Pilot*	$28,924.48	$32,209.33	$31,957.63
Total Cost for 6-Month Pilot*	$57,848.95	$64,418.66	$63,915.27

*Assumes an average of 21.833 work days per month

After measuring the benefits produced from the carpool financial incentive program, the funding agencies can compare the expected outcomes with the actual outcomes. Based on this information, funding agencies can make the determination to continue the incentive program on a more permanent basis and/or make changes to improve the quality of the program.

7 References

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Monthly Working Hours. University of California Office of Human Resources and Benefits. <http://hrop.ucop.edu/employees/work_hours08.html>.

8 Supplemental Documents and Figures

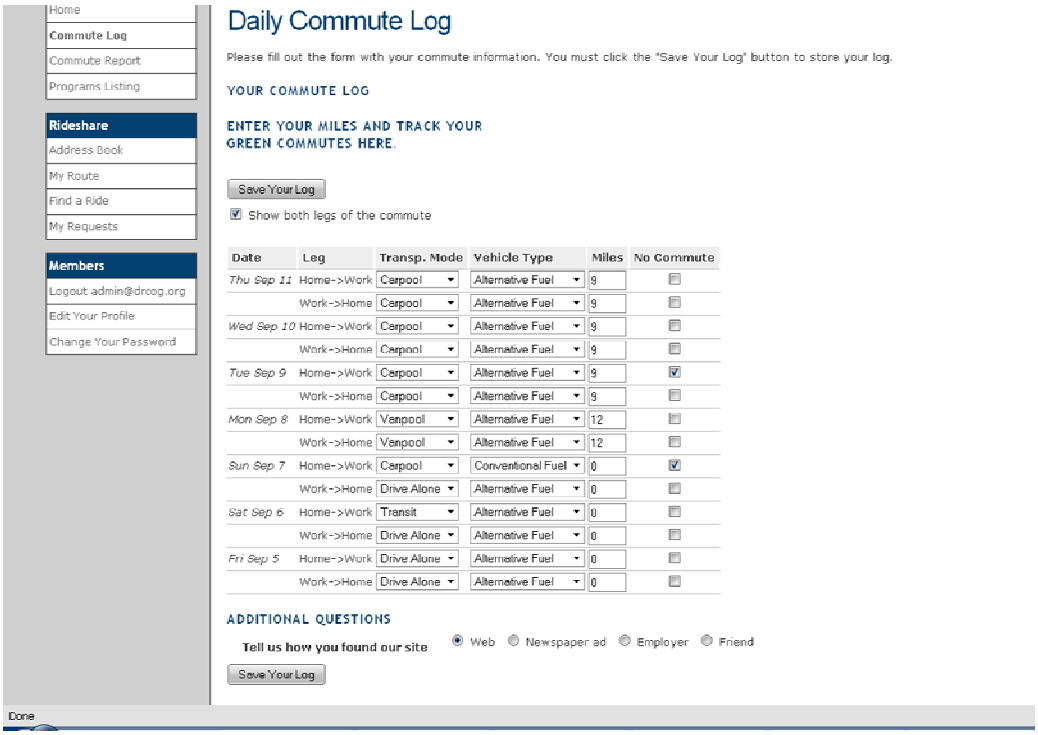

Figure 1 - Online Daily Commute Log

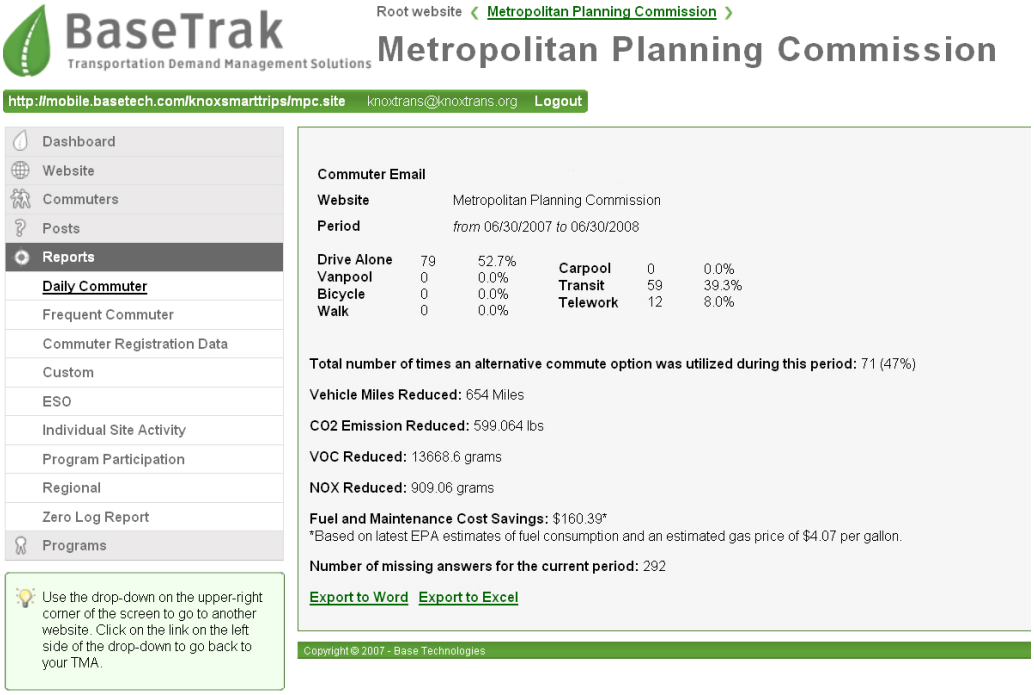

Figure 2 - BaseTrak report

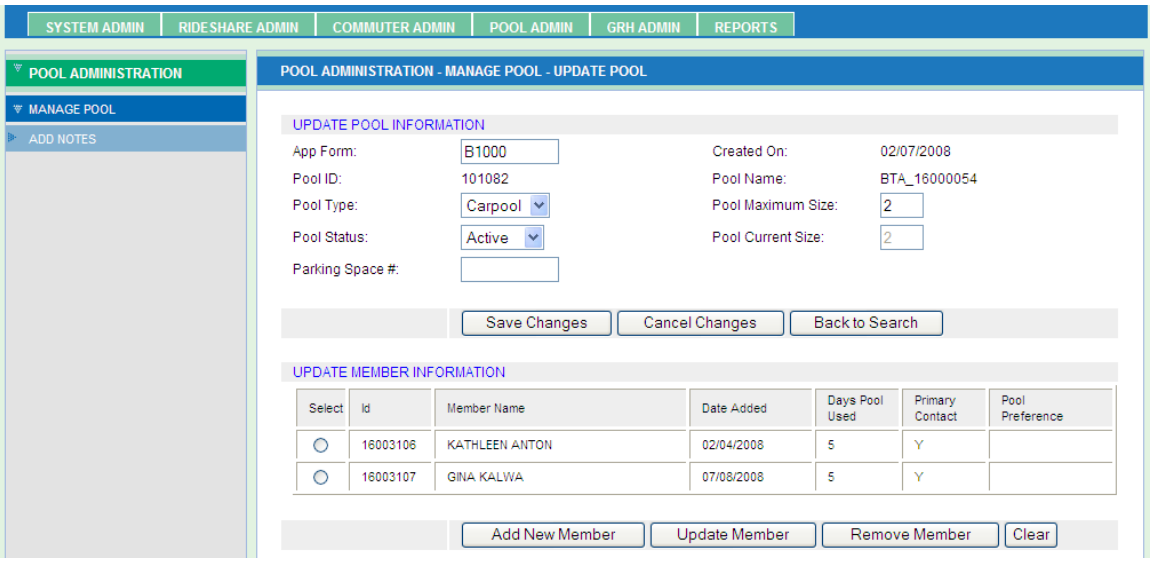

Figure 3 - Commuter Connections TDM Software Pool Admin Page

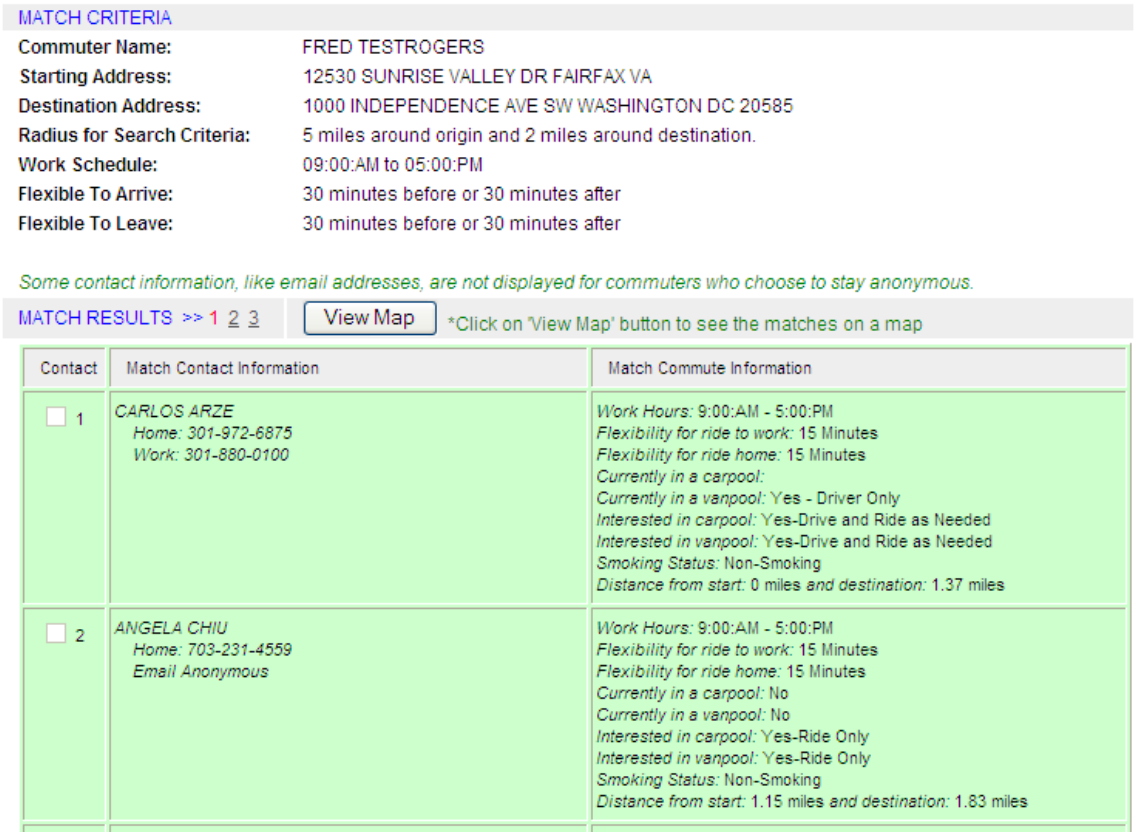

Figure 4 - Commuter Connections TDM Software Ridematch Search

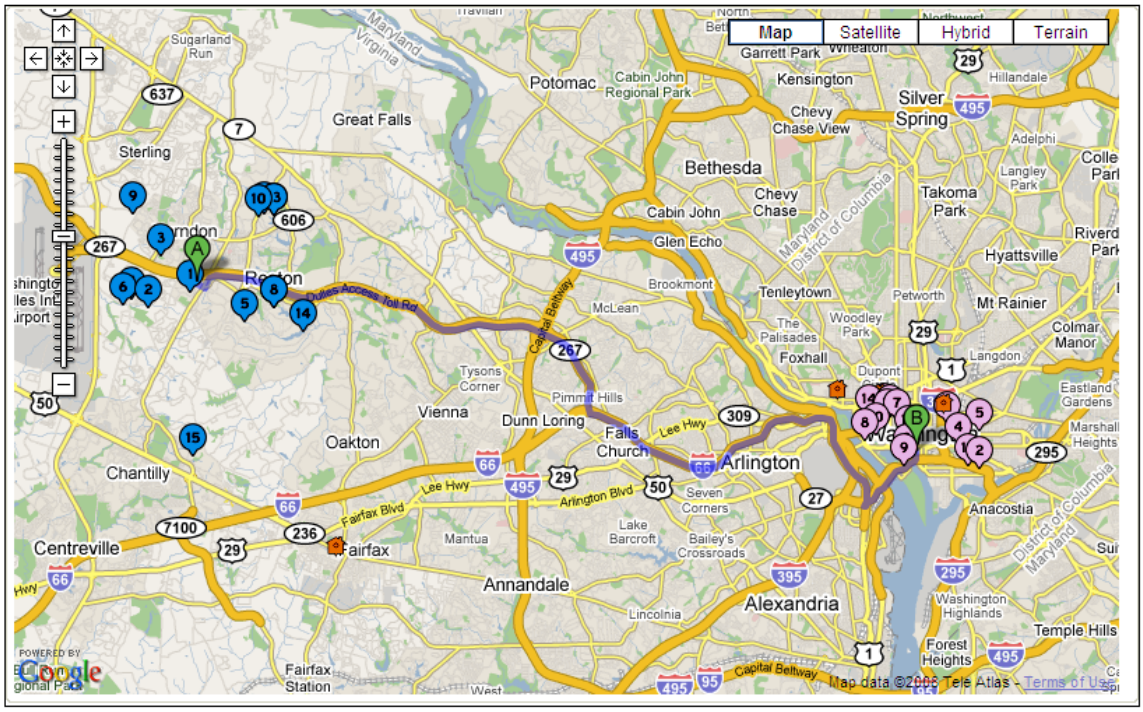

Figure 5 - Commuter Connections TDM Software Ridematch Map