Vanpooling in the Mid-Columbia River Gorge

A Feasibility Assessment and Investigation of Employer Preferences

by

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TERMINAL PROJECT

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"Vanpooling in the Mid-Columbia River Gorge", a terminal project prepared by Nicolas Garcia in partial fulfillment of the requirements for the Master of Community and Regional Planning degree in the Department of Planning, Public Policy and Management. This project has been approved and accepted by:

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Committee: Robert Parker, Marc Schlossberg

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Introduction

Vanpooling provides an opportunity to save commuters money and diminish the external costs of an automobile-dominated transportation system. Vanpooling's effectiveness in urban and suburban areas has been established, but its success in rural areas is less well researched. Furthermore, employer support is important to the success of vanpooling, but there is little research showing how agencies and non-profits can encourage that support.

This study uses a survey of major employers in the Mid-Columbia River Gorge to examine these issues. Results indicate that the potential for vanpooling in the Gorge is significant but limited to a small percentage of the region's commuters and that vanpooling would be cost-effective but unlikely to yield major changes in travel patterns. Furthermore, employer survey responses indicate a primary concern with minimizing costs and avoiding new responsibilities. Strategies for effectively promoting vanpooling in the Gorge are identified and discussed.

This report begins with a literature review which discusses the challenges facing the U.S. transportation system, describes the study area, and reviews the existing research about vanpooling. Following the literature review is a detailed description of the methods used, including an employer survey and several forms of quantitative analysis. Next it presents the findings, broken down into the vanpool feasibility assessment and the employer preferences survey. Finally, the Discussion section examines the implications of the findings, acknowledges this study's limitations, identifies avenues for further research, and outlines recommendations for improving transportation in the Gorge.

Literature Review

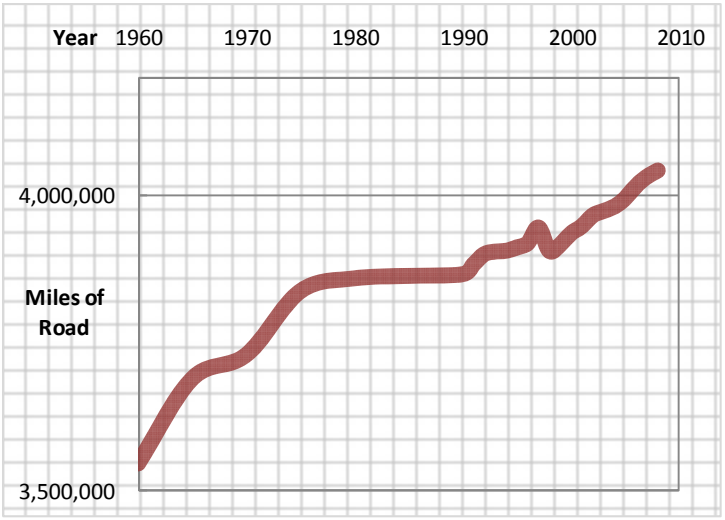
This literature review will provide background and context for this study. First it will describe transportation in the United States and address the challenges it poses. Next it will focus on the study area, the Mid-Columbia River Gorge, with a discussion of its geography and transportation needs. The literature review will then discuss vanpooling, including a detailed description of the many forms it can take, and a summary of the existing research on what makes vanpool programs successful or unsuccessful. Finally, it will present this study's research objectives.

Transportation in the United States

Size of U.S. Transportation System

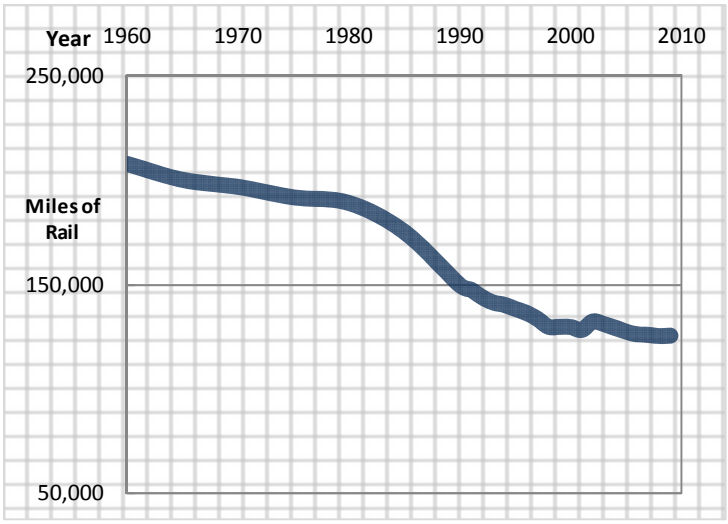
The U.S. transportation system is massive and extensive. In 2008 it consisted of just over 4 million miles of public roads, as well as over 125,000 miles of freight and passenger railway, 25,000 miles of navigable water channels, 172,000 miles of oil pipeline, and almost 1.4 million miles of natural gas pipeline.[1] The road network, in addition to being the most extensive component of the U.S. transportation system, has been increasing in size, from just over 3.5 million miles in 1960 (see Figure 1). Meanwhile, the rail network has been shrinking—it consisted of over 200,000 miles of track in 1960 (see Figure 2).[2]

FIGURE 1: U.S. HIGHWAY SYSTEM MILEAGE TRENDS



Source: U.S. Bureau of Transportation Statistics 2010

FIGURE 2: U.S. RAIL SYSTEM MILEAGE TRENDS



Source: U.S. Bureau of Transportation Statistics 2010

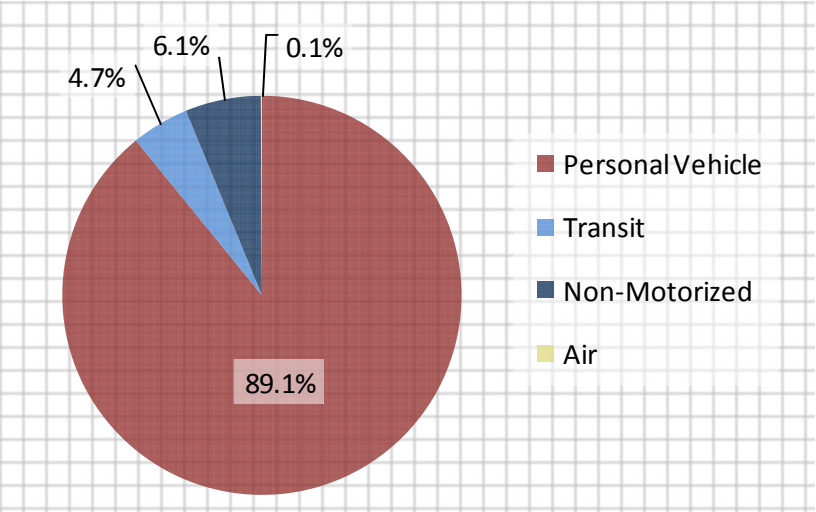
Transportation Modes in the U.S.

It should be no surprise, given these figures and trends, that personal motorized vehicles (cars, vans, SUVs, pickup trucks, etc.) are the primary mode of transportation for U.S. residents, nor

[1] U.S. Bureau of Transportation Statistics 2009
[2] U.S. Bureau of Transportation Statistics 2009

that personal vehicle usage has increased in the last half-century. Indeed, total annual passenger miles traveled (PMT) for personal vehicles increased from 3.3 trillion in 1990 to 4.5 trillion in 2005. In the same time period, PMT for transit (buses, trains, subways, ferries, etc.) also increased, but the amounts involved are much smaller – 147 billion PMT in 1990 to 174 billion in 2005.[3]

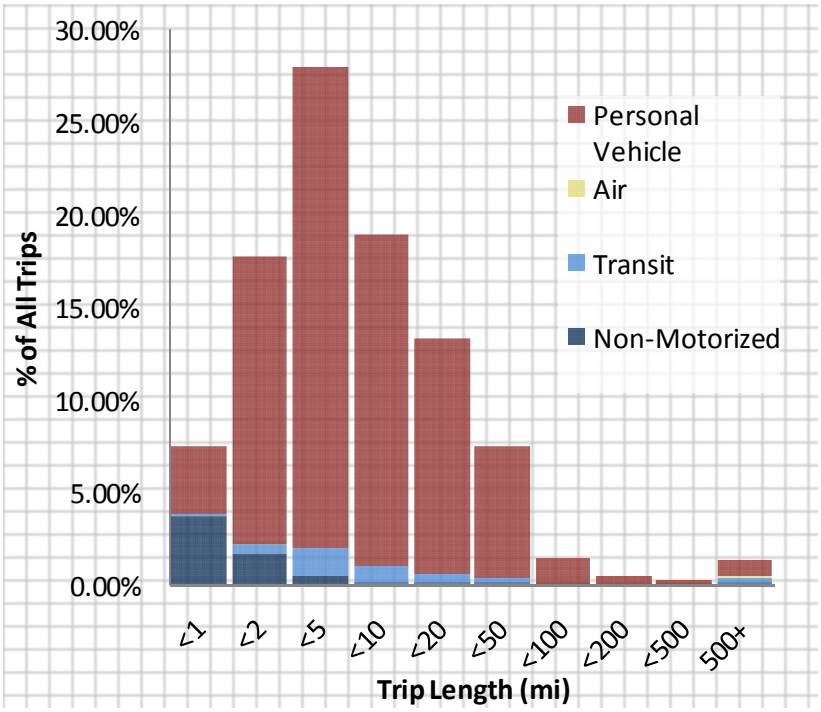
FIGURE 3: U.S. MODE SHARE, ALL TRIPS (1995)



Source: U.S. Bureau of Transportation Statistics 1995

Similarly, personal vehicles are by far the most common mode of travel, accounting for 89% of all trips, and 92.5% of trips farther than 1 mile in 1995 (see Figure 3).[4] For trips shorter than 1 mile, mode share is evenly split between personal vehicles and non-motorized transportation (walking and bicycling). Public transit and air travel become increasingly common mode choices as trip length increases, together accounting for about 30% of trips greater than 500 miles in length. However, the vast majority of trips are 1 to 20 miles in length, and personal vehicles dominate for these trips. Figure 4 shows the frequency of trips by various modes and of various lengths, and Figure 5 shows the % mode share for trips of different lengths.

FIGURE 4: U.S. TRIP FREQUENCY BY MODE AND LENGTH



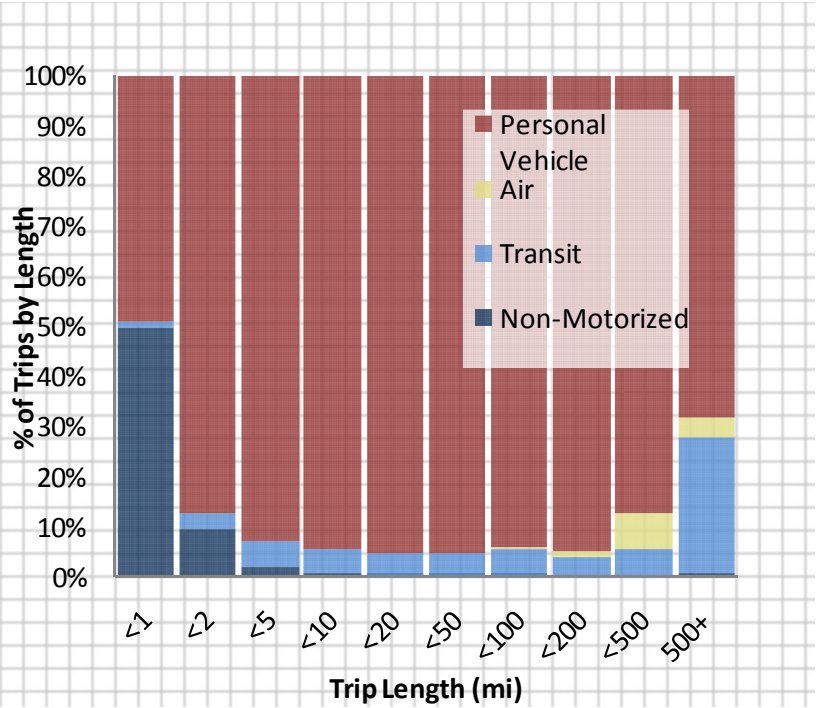
Source: U.S. Bureau of Transportation Statistics 1995

[3] U.S. Bureau of Transportation Statistics 2007
[4] U.S. Bureau of Transportation Statistics 2001

Commuting

U.S. residents travel for many reasons. One major trip purpose is commuting to work, which at almost 15% of trips is the third most common trip purpose, after family/personal business (45%) and social/recreational (27%).[5] Furthermore, although they only account for 15% of trips, commute trips account for a greater proportion of total passenger miles traveled—23% in 1995[6]. Finally, commute trips are more likely to be made in personal vehicles than trips for other purposes (91% vs. 87% are by personal vehicle).

FIGURE 5: U.S. MODE SHARE BY TRIP LENGTH



Source: U.S. Bureau of Transportation Statistics 1995

Problems with the Transportation System

The U.S. transportation system carries heavy costs. These costs can be roughly broken into two categories: private costs and public costs, which taken together make up the social cost of transportation. The costs are exacerbated by the high percentage of trips that are made in single occupancy vehicles (SOVs).

The private costs of SOV use include fuel, repairs, vehicle depreciation, and insurance premiums, and have been estimated at over $8000 for a year of vehicle ownership.[7] There is also the opportunity cost of time spent behind the wheel (an average of 55 minutes per day per U.S. resident), the risk of collisions, the stress of driving in congested conditions, and the long-term health consequences of a sedentary, automobile-dependent lifestyle.

The public costs of SOV use include local pollution, congestion, the construction and maintenance of road infrastructure and parking spaces, climate change, injuries and loss of life due to accidents, and national dependence on foreign oil. All told, the social cost of SOV use is massive. Attempts to quantify it have produced estimates ranging from $183 billion per year to $1.37 trillion per year[8].

[5] U.S. Bureau of Transportation Statistics 2009
[6] U.S. Bureau of Transportation Statistics 2001
[7] AAA 2008
[8] Parry et al. 2007, Delucchi 1998

Study Area: The Mid-Columbia River Gorge

The transportation challenges facing the nation are also present in this study's focal region – the Mid-Columbia River Gorge. This study was taken on in partnership with the Mid-Columbia Economic Development District (MCEDD), an economic development non-profit concerned with how to improve the transportation system of the Gorge.

Overview of the Mid-Columbia River Gorge

The Mid-Columbia River Gorge is made up of five counties: two (Klickitat and Skamania) in southern Washington, and three (Hood River, Sherman, and Wasco) in northern Oregon. Almost 81,000 people resided in the Gorge in 2010, an increase of about 7% from 2000 levels.

The Gorge is a predominantly rural area, with an average population density of about 11 people per square mile, well below the U.S. average of 81, the Oregon average of 39 and the Washington average of 94. Hood River County is the densest and also the smallest county in the Gorge, with its approximately 22,000 people living at an average density of 43 people per square mile. Sherman County is the most sparsely populated, with an average of 2 people occupying each square mile. Table 1 outlines the basic population characteristics of the Gorge and its context.

Historically, employment in the Gorge has been based in the agricultural, timber, and industrial sectors. The decline of these sectors in recent years has hurt the economy of the Gorge. Nonetheless, they do continue to employ workers in the region, and there has been growth in the high-tech and renewable energy manufacturing sectors.[9]

Transportation in the Mid-Columbia River Gorge

The states of Oregon and Washington both have slightly lower rates of SOV commuting than the country as a whole – 73% vs. 76%. Oregon has a slightly lower rate of transit commuting than the nation as a whole (4.2% vs. 4.7%), while Washington's transit commute mode share is slightly higher than average (4.9%). Rates of bicycling, walking, and working from home are all higher in Oregon and Washington than the national average.

TABLE 1: MID-COLUMBIA RIVER GORGE POPULATION CHARACTERISTICS

	Total Population		Pop. Change	Land Area	Pop. Density 2010
Geographic Area	2000	2010	2000 to 2010	(sq mi)	(ppl/sq mi)
United States	281,421,906	308,745,538	9.7%	3,803,290	81.2
Oregon	3,421,399	3,831,074	12.0%	98,381	38.9
Washington	5,894,121	6,724,540	14.1%	71,300	94.3
The Gorge	***75,169***	***80,708***	***7.4%***	***7,254***	***11.1***
Hood River County, Oregon	20,411	22,346	9.5%	522	42.8
Sherman County, Oregon	1,934	1,765	-8.7%	823	2.1
Wasco County, Oregon	23,791	25,213	6.0%	2,381	10.6
Klickitat County, Washington	19,161	20,318	6.0%	1,872	10.9
Skamania County, Washington	9,872	11,066	12.1%	1,656	6.7

Source: U.S. Census 2000, 2010

[9] MCEDD 2010

The counties of the Mid-Columbia Gorge (Gorge) display commute patterns that are similar to the national and state averages, with a few key interesting differences. SOV mode share in the Gorge ranges from slightly below average (about 72% in Hood River, Sherman, and Klickitat Counties) to above average (76% in Wasco and Skamania Counties).

The counties of the Mid-Columbia Gorge are all fairly rural, and this is reflected in their transit mode share, which is less than 1% in each of the counties. However, walk-to-work mode share is significantly higher than the national and state averages in all but one of the Gorge counties – 6.5% in Hood River and almost 10% in Sherman. Work from home rates are also higher in the Gorge, ranging from 4.8% in Wasco County up to 9.5% in Sherman County.

These high rates of walking and telecommuting suggest a demand for modes of transportation other than SOV, either because of commuter preference or because of expense. Coupled with the lack of transit service in the Gorge, this suggests an opportunity for vanpooling to fill the gap and provide transit-like commuting services to residents of the Gorge. Table 2 outlines the commute mode share of the United States, Oregon, Washington, and the five counties making up the Mid-Columbia Gorge region.

TABLE 2: MID-COLUMBIA RIVER GORGE COMMUTE MODE SHARES

Commute Mode	United States	Oregon	Washington	***The Gorge***	Hood River County	Sherman County	Wasco County	Klickitat County	Skamania County
Drive Alone	75.7%	73.2%	73.3%	***73.7%***	72.2%	71.6%	75.7%	71.8%	76.0%
Carpool	12.0%	12.1%	12.6%	***13.5%***	12.2%	8.5%	13.3%	15.3%	14.8%
Vanpool	0.2%	0.1%	0.3%	***0.1%***	0.2%	0.0%	0.2%	0.1%	0.1%
Public Transit	4.7%	4.2%	4.9%	***0.4%***	0.4%	0.0%	0.3%	0.7%	0.5%
Walk	2.9%	3.6%	3.2%	***5.0%***	6.5%	9.8%	4.8%	4.5%	2.3%
Bicycle	0.4%	1.1%	0.6%	***0.3%***	0.5%	0.3%	0.2%	0.3%	0.1%
Other	0.8%	0.8%	0.9%	***0.8%***	0.6%	0.4%	0.8%	1.2%	0.6%
Work from Home	3.3%	5.0%	4.3%	***6.2%***	7.5%	9.5%	4.8%	6.2%	5.7%

Source: U.S. Census 2000

Given its low population density, traffic congestion is not a major concern in the Gorge[10]. The area has low income levels, however: the median income in each of the Gorge counties is lower than the national, Oregon, or Washington median income[11], and wage rates were only 64%-83% of the national average in 2007[12]. This, coupled with the area's low density and lack of transit options, means that a relatively high percentage of Gorge residents' income is likely being spent on transportation.

[10] Hoey 2010
[11] U.S. Census 2000
[12] MCEDD 2010

Vanpooling

Introduction to Transportation Demand Management

In response to the high social cost of SOV use, many public agencies, private companies, and non-profit corporations have implemented transportation demand management (TDM) measures aimed at reducing SOV mode share. TDM is an attempt to encourage travelers to switch from SOVs to other modes, using incentives, pricing, education, improvement of alternative modes, or a combination of the above.

Some examples of TDM measures include free or subsidized transit passes, increased prices on parking, rideshare matching services, bicycling promotion campaigns, implementation of high-occupancy vehicle lanes, and many others. This study focuses on the encouragement of vanpooling as a strategy for reducing SOV mode share.

Definitions of Vanpooling

Definitions of vanpooling vary, but a representative example is: "Vanpooling is generally defined as 5 to 15 people commuting to and from work together in a van. The vehicle's capital costs and all related fuel, maintenance, and insurance expenses are paid by the participants."[13]

Vanpooling also has a legal definition: "Vanpool means a group of riders using a vehicle, with a seating capacity of not less than eight individuals and not more than fifteen individuals, for transportation to and from their residence or other designated locations and their place of employment, provided the vehicle is driven by one of the pool members.[14]"

History of Vanpooling

Vanpooling arose in the 1970s as a way of mitigating the effects of the oil crisis on commuters. The first instance of vanpooling is generally agreed to be the program formed in 1973 by the 3M Company east of St. Paul, Minn.[15]

The popularity of vanpooling peaked in the late 70s and early 80s, with somewhere between 15,000 and 23,000 vanpools in operation.[16] Vanpool popularity tapered off in the 1990s and early 2000s, as lower gas prices and a booming economy made the financial benefits of vanpooling less of a motivator. From a peak of over 15,000 vanpools, the U.S. had only about 8,500 vanpools in operation in 1998-99. However, recent years have seen a resurgence in vanpooling, with an estimated 10,000 operational vanpools by 2005.[17] This resurgence is likely a response to increasing fuel prices, environmental awareness, and government support[18], and can be expected to continue as fuel prices continue to rise and the economic downturn encourages thrifty behavior on the part of commuters.

[13] Jon Mielke 2006
[14] U.S. Department of Energy 1997
[15] Evans and Pratt 2005
[16] Evans and Pratt 2005
[17] Evans and Pratt 2005
[18] Evans and Pratt 2005

Potential Benefits and Drawbacks of Vanpooling

Commuters choose to vanpool, and governments, nonprofits, and employers choose to support vanpooling because of the many benefits it can offer. Benefits to commuters range from cost savings to a more relaxing commute. Governments see the potential for reduced congestion and pollution, and the possibility of delaying or forgoing costly infrastructure maintenance or expansion. And finally, businesses stand to benefit from tax incentives, reduced parking needs, and better employee retention.

Many people choose to drive alone rather than vanpooling, however. The primary reasons seem to be the relative inconvenience, inflexibility, and increased travel time (on average 10-12 minutes more each way than SOV commuting[19]) of vanpooling compared to driving alone.[20] For employers or vanpool operators, the downsides come in the form of capital and operations costs, as well as staff time spent organizing and/or promoting the program.[21] Table 3 outlines the potential benefits and drawbacks of vanpooling for commuters, employers, and society at large.

TABLE 3: BENEFITS AND DRAWBACKS OF VANPOOLING

To Commuters	• Reduced commute cost • More relaxing commute • Possibility of doing work during commute • Knowledge of reduced environmental impact • Financial benefit from pre-tax vanpool credit (up to $230/month) • Program-specific benefits and incentives	• Less flexibility in commuting • Less ability to run errands during or immediately after work • Lack of privacy during commute • Slightly longer commute times • Time needed to find and/or organize a vanpool
To Employers and Vanpool Operators	• Improved recruitment and retention of employees • Decreased need to construct, rent, or maintain costly parking spaces • Frees up parking spaces for customers and visitors • Better employee on-time performance • Financial benefit from pre-tax vanpool credit (up to $230/month)	• Staff time needed to promote and/or organize a vanpool • Cost of subsidies or incentives • Up-front capital cost of vans • Maintenance costs of running the vanpool program • Decreased opportunity for employee overtime work
To Governments, Non-Profits, and Society at Large	• Reduced congestion • Reduced local pollution • Reduced carbon emissions • Less traffic leading to need for costly infrastructure repair or expansion • Reduced dependence on foreign oil • Reduced likelihood of automobile collisions	• Vanpools cause the same external costs as SOVs, but at a reduced level

Source: Evans and Pratt 2005, CTAA 2008

Types of Vanpool Programs

Vanpool programs come in many forms. A common way to categorize vanpool programs is by the type of organization or individual responsible for the direct operational costs,

[19] Evans and Pratt 2005
[20] Evans and Pratt 2005, CTAA 2008
[21] CTAA 2008

organization, and financial risk of running a vanpool program[22]. There are three primary types of ownership strategies:

- **Employer-sponsored Vanpool Programs**;
- **Third-Party Vanpool Programs**, divided into two subcategories:
    - **Public-interest Third-Party Vanpool Programs**, including non-profit corporations, public transit agencies, and other public entities; and
    - **Private Corporation Third-Party Vanpool Programs**; and
- **Individual Owner-Operator Vanpool Programs**.

In the early days of vanpooling, employer-sponsored programs were the most common form of vanpool. Now, third-party programs are much more common, both in the form of privately operated programs and public-interest programs.[23] Among private third-party vanpool operators, the largest company by far is VPSI, Inc., which operates over 5000 vanpools in the U.S. and Europe[24]

Among public interest vanpool operators, transit agencies have become the most common, increasing from operating 447 vanpools in 1984 to almost 4000 by 2001.[25] About 40% of the transit agency sponsored vanpool programs in the U.S. are in the Puget Sound region, largely because of public policies that support vanpooling in the Seattle metro area.

Vanpool programs also vary in terms of the incentives offered by operators to commuters, or by governments and non-profits to participating employers. There are many different possible incentive schemes and encouragement strategies. Some general categories of common incentives offered by vanpool operators to encourage vanpooling include[26]:

- **Direct financial incentives**, through which the vanpool operator helps employees cover the cost of vanpooling, either as an incentive for signing up or on a continuing basis. Up to $230/month of this sort of expenditure can be tax-free under the Federal Commuter Choice Program;
- **Parking incentives**, in the form of either more convenient and cheaper (or free) parking spots for vanpool vans or an increase in the cost of parking for SOVs;
- **Non-cash incentives**, whereby employees who participate in vanpooling are recognized or rewarded in the form of gift cards, raffle tickets, discounts at local stores, etc.;
- **Driver incentives** in the form of rewards to the vanpool driver or backup driver such as free rides, cash compensation, and personal use of the van on weekends;
- **Flexibility strategies** that mitigate the inflexibility of vanpooling relative to driving alone. These include Emergency Ride Home (ERH) services (often in the form of subsidized taxi fares) for employees who miss their scheduled vanpool ride home or who experience a family emergency,

[22] Evans and Pratt 2005
[23] Evans and Pratt 2005
[24] VPSI 2011
[25] Wambalaba 2004
[26] Ungemah 2009, Evans and Pratt 2005

mid-day shuttle service allowing employees to run errands during their lunch hour, and flexible work hours to make it easier to find a vanpool schedule that works for all participants;
- **Convenience strategies** that improve the relative convenience of vanpooling through services such as door-to-door pick-up/drop-off and wifi on vans;
- **Organizational support** such as hosting a ride-matching service to make it easier for employees find others who live nearby, and to help determine the most convenient vanpool route; and
- **Outreach, education, and promotional efforts** advertising vanpool services to commuters and providing them with informational materials.

Some examples of types of incentives provided by governments or non-profits to employers to encourage them to support vanpooling include[27]:

- **Direct subsidies** in the form of cash grants, tax breaks on vanpool support costs through the Federal Commuter Choice Program, interest-free vehicle loans, or covering the cost of empty seats in a vanpool which is actively seeking new members;
- **Commute time/cost strategies** such as High Occupancy Vehicle (HOV) lanes and preferential tolling structures at highways and bridges;
- **Organizational support strategies** such as resources, training, and/or informational materials that are provided free of charge to help employer staff organize or promote a vanpool program, or ride-matching and routing services that are provided free of charge; and
- **Employer promotion strategies** such as offering advertisement space on vans or some form of positive public recognition of employer participation in the vanpool program.

Vanpool Program Success Factors

Despite all of its potential benefits, vanpooling accounts for only 0.2% - 0.5% of commute trips nationwide.[28] However, within employment sites that have implemented vanpool programs, mode share can be much higher, regularly accounting for 5% of employees' commute trips, and sometimes over 20% of commute trips (in one case up to 40%).[29]

There are many factors affecting a vanpool program's success or failure in attracting commuters. Perhaps most important is the structural context in which the vanpool operates. Factors like the relative location of employment centers and employee residences, the capacity and design of the road network, the legal environment surrounding vanpooling, and the price of fuel all have profound effects on the success of a vanpool program but are not under the control of the vanpool operators or participants.

The organization of the vanpool program itself also has important effects on its chance of success, however. Unfortunately, there is little comprehensive quantitative research on the effects of different structural and programmatic factors on the success of a vanpool program. Nonetheless, in surveying the literature we can arrive at tentative conclusions about the effects of certain factors on vanpool success:

[27] Ungemah 2009, Evans and Pratt 2005
[28] Census 2000
[29] Wegmann 1989

- **Commute distance:** Many vanpool studies cite commute distance as an important factor in vanpool success, with longer commutes being more conducive to vanpooling. The minimum optimal one-way distance for a vanpool trip is usually cited as 15[30] or 20 miles[31]. The observed average trip length for vanpool programs ranges from 24 to 54 miles[32].
- **Employer size:** The more employees at a site, the greater the potential for vanpooling; however, there does not appear to be a significant correlation between employer size and the percent of employees participating in vanpooling[33].
- **Vanpool fare:** Many different fare elasticity of demand[34] values have been calculated, but most settle on the -0.65 to -0.95 range[35]. Furthermore, vanpool commuters respond well to a simple and stable fare structure. A number of programs have implemented a "flat rate" fare system[36], wherein the fare is charged based only on distance traveled, not on the number of people in the van. The Pace VIP vanpool program in Chicago is a good example of a successful flat rate system (see sidebar).

PACE'S VANPOOL INCENTIVE PROGRAM IN SUBURBAN CHICAGO

Pace, the Chicago Regional Transportation Authority's suburban bus division, established its Vanpool Incentive Program (VIP) in 1991. The program serves the suburban area surrounding Chicago – a region of 3,446 sq mi, 4.4 million people, 6 counties, and 264 municipalities.

VIP provides a variety of services for those wanting to vanpool, including:

- Providing a van and insurance;
- Planning a route;
- Paying for fuel and maintenance;
- Setting fares;
- Billing riders individually; and
- Offering Emergency ride home (ERH) service.

VIP's fares are calculated based on mileage, not the number of riders, meaning that riders don't have to worry that if someone in their van drops out their own fares will increase. The program staff also worked with the Sears Company prior to its 1992 relocation to help develop transportation alternatives for its employees.

VIP has been very successful at promoting vanpooling in the Chicago area, even during a time of relatively low gas prices: the number of vans increased to 162 by 1994 and 291 by 1997. Most of the trips (80-90%) were suburb-to-suburb, suggesting that vanpooling can function well in relatively decentralized areas. And, in keeping with research suggesting that vanpooling thrives among long-distance commuters, trip lengths averaged almost 40 miles each way. *(Source: Evans and Pratt 2005)*

- **Subsidy effect:** Wambalaba (2004) found that when a subsidy is provided to encourage vanpool ridership, the effect can range from small but significant (commuters are 8.9% more likely to join

[30] Maxwell and McIntyre 1979, Wiersig 1981
[31] Torluemke and Roseman 1989
[32] Evans and Pratt 2005
[33] Wegmann 1989
[34] Fare elasticity of demand is the amount of change in demand for a given change in price. For a vanpool fare elasticity of demand of -0.8, every 10% increase in the cost of vanpooling will correspond to an 8% decrease in the number of people vanpooling. This means that a vanpool operation can likely increase its revenue by increasing fares.
[35] Evans and Pratt 2005, Wambalaba 2004
[36] Ungemah 2005

with the subsidy than without) to fairly major (79% more likely to join).[37] Subsidies to new vanpoolers are particularly cost effective: Barone and Jain (1986) found that interest-free loans to potential operators led to the formation of 63 new vanpool groups in the state of Connecticut, and the experience of the Ventura Vanpool program suggests that four months of subsidization was sufficient to form a habit[38].

- **Emergency ride home (ERH):** The effectiveness of emergency ride home services in increasing vanpooling is uncertain. Kadesh and Elder (1989) found that an ERH program increased HOV mode share among a small group of participants in Bellevue, WA. However, Polena and Glazer (1991) found no significant correlation between ERH and ridesharing, although almost all program coordinators in their study cited ERH service as important to their programs' success.
- **Outreach and employer support:** The consensus in the literature is that outreach, education, and employer support all help a vanpool program achieve success. In particular, active employer promotion of ridesharing helps ensure long-term success[39], particularly when combined with wider promotional efforts by government or nonprofits. Additionally, case studies from the 1980s have found that direct follow-up calls to vanpool participants, though labor-intensive, are a very effective way of lowering membership attrition rates.[40]

For a government agency or non-profit interested in promoting vanpooling, most of the above factors would be either clearly within their sphere of influence, or clearly outside of it. Commute distance would be out of the organization's power to affect, at least directly and in the short term. The same is true for employer size. Conversely, vanpool fares, subsidization, and presence or absence of ERH services would all be clearly within the organization's sphere of influence, provided the necessary funds were available.

The last factor on the list is more complicated, however. Employer buy-in is very important to the success of a vanpool program, but it is not obvious what a government or non-profit can do, if anything, to ensure that the employer is active in supporting the program. Furthermore, although there is some research on the relative attractiveness of different types of vanpool programs to commuters, there is little to no research in the literature about what might make a vanpool program more or less attractive to the employers who must support it with their staff time and resources.

Research Objectives

Based on the current state of the transportation system in the Mid-Columbia Gorge, and the identified gaps in the research surrounding vanpooling, this study aims to do two things:

1. **Assess the viability of vanpooling as a commute option for residents of the Gorge**, in order to mitigate the private costs and external costs of SOV use outlined above; and
2. **Meet the need for research on how to encourage employer support of vanpool programs** by surveying major Gorge employers about the specific vanpool program incentives and design elements which would be most attractive to them.

[37] Wambalaba 2004
[38] Kodama 1991
[39] Chun 1993
[40] Hershey and Hekimian 1983, Chambers 1981

Methods

The preceding literature review described the rationale for, benefits of, and barriers to vanpooling, and identified some of the factors that help make a vanpool program successful. It also identified a need for further research into which factors make employers more likely to support vanpooling.

This study attempts to fill this gap in the literature and determine the potential extent of vanpooling in the Mid-Columbia River Gorge. It does this through a combination of research, analysis, and an employer survey. These methods are outlined in this section starting with the data collection process, followed by the vanpool feasibility assessment, and finishing with the employer preferences survey.

Data Collection

Sample Population

The target population for the employer survey was developed from a list of major employers kept by the Mid-Columbia Economic Development District (MCEDD), an economic development non-profit organization in the Gorge. Because vanpooling is most effective where large concentrations of employment exist[41], organizations employing fewer than 80 people in one location were removed from the list, leaving 47 employers.

The employers on the list were contacted by phone. During the phone calls, the purpose of the study was briefly explained and the employer contact was asked to provide the name and email address of the most appropriate person to fill out an online survey about vanpooling. As much as possible, the personnel thus identified were spoken to directly and told about the study.

Collection Procedures

An email was sent to 41 of the employers on the list (six employers did not provide an email address) explaining the purpose of the study and providing a link to an online survey hosted on *surveymonkey.com*. Employers who did not respond within two weeks were encouraged to do so via additional email reminders and direct telephone calls.

Survey Design

The online survey was designed to do two things: collect information about each employer pertinent to the vanpool market analysis, and study the employers' perceptions of vanpooling and preferences for different types of vanpool programs. The survey contained 13 questions, many of which had multiple parts, and was designed to take about 20 minutes to complete. The full text of the employer survey is available in Appendix A.

[41] Evans and Pratt 2005

Vanpool Feasibility Assessment

The vanpool feasibility assessment consisted of four interrelated analyses:

1. A **Market Analysis**, estimating the range of potential vanpool adoption in the Gorge;
2. A **GIS Analysis**, refining the market analysis by identifying high-potential target areas;
3. A **Financial Feasibility Assessment** detailing the financial cost of maintaining a vanpool program; and
4. A **Benefit-Cost Analysis**, estimating the total potential social costs and benefits of vanpooling the Gorge based on the previous analyses.

This section will present the methodology for each of these analyses in turn.

Market Analysis

The purpose of the market analysis was to estimate how many commuters might be expected to switch to vanpooling if a vanpool program were developed in the Gorge. This study's market analysis was modeled in part on previous analyses in the literature, such as Kostyniuk (1982), Mielke (2006), iTrans Consulting (2007), Strochlic (2009), and The IBI Group (2009).

The market analysis consisted of four steps:

1. Identify relevant and measurable vanpool success factors;
2. Identify the total market of possible vanpoolers in the Gorge (all commuters);
3. Use the success factors and data about Gorge commuters to narrow down the pool of possible vanpoolers to a sub-set of high-vanpool-potential commuters; and
4. Multiply the size of this sub-set by the expected vanpool adoption rate to estimate the total number of active vanpoolers that might be expected in the Gorge.

Of the vanpool success factors identified in the literature review, a handful was identified as being measurable, quantifiable in their effect on vanpooling, and variable across commuters in the area. These factors were:

- Large concentrations of workers;
- Long-distance commuting; and
- Active employer promotion of vanpooling.

Other vanpool success factors relevant to the Gorge but not included in the analysis were fuel prices, lack of reasonable transit options, fare price and subsidization, and existence of ERH service. These factors were excluded either because their status was unknown and difficult to forecast, because their effects on vanpooling are unknown, or because any effect would be the same across all commuters in the area.

First, large concentrations of workers were identified by excluding all employers with fewer than 80 workers from the survey population. Next, employers were asked in the survey to report how many long-distance commuters they employ – employees who commute more than 15 miles each way.

Finally, those employees at organizations who answered "No." to the question "Would you be willing to promote vanpooling?" were removed from the population.

At this point in the analysis, different assumptions were used to yield a range of vanpool market size estimates, from conservative to very optimistic. First, many employers answered "I don't know," to the question of promoting vanpooling. Inclusion of these employees produced a more optimistic result; exclusion produced a more conservative one.

Second, non-respondent employers could either be assumed to answer the question of promotion in the same proportions as the respondent employers, or to all have tacitly answered "No." Assuming "No" answers for all non-respondents yielded a more conservative result, and assuming a proportional level of support for vanpooling yielded a more optimistic result.

To estimate the eventual amount of vanpooling, a range of four vanpool adoption rates was used:

- Conservative (3.7%): Half of the mean vanpool mode share calculated from Evans and Pratt (2005).
- Most Likely (7.3%): The mean vanpool mode share calculated from a vanpool dataset in Evans and Pratt (2005).
- Optimistic (11.2%): The mean vanpool mode share among the employers in Evans and Pratt (2005) with fewer than 1000 employees (all employers in the Gorge have fewer than 1000 employees).
- Very Optimistic (20%): A typical example of a highly successful vanpool program from the dataset presented in Evans and Pratt (2005).

This analysis yielded a matrix of potential vanpool adoption rates. The values in this matrix were divided by assumed vanpool occupancy rates to determine the number of vans that would be needed to serve each market. The vanpool occupancy rates were also taken from the data in Evans and Pratt (2005): 10 people per van was used as the most likely occupancy and optimistic rate; 8 per van was used as the conservative rate; and 14 people per van was used as the very optimistic rate.

GIS Analysis

Spatial characteristics play a major role in the success or failure of a vanpool program[42]. Because even the major employers in the Gorge are relatively small, a spatial analysis was undertaken to determine the potential for multi-employer vanpooling. Geographic Information Systems (GIS) software was used to identify clusters of employment where vanpooling might be particularly suitable.

First, Gorge employers were geocoded – located on a map of the area. These employer locations were linked with survey data about number of employees, number of long-distance employees, and willingness to promote vanpooling.

[42] Weisbrod 1981

Multi-employer vanpooling is most effective when employers are within one mile of each other.[43] Therefore, clusters of employment were identified by drawing half-mile buffers around each employer and grouping together those with overlapping buffers.

The number of long-distance commuters in each employment cluster was then calculated, broken down by employer willingness to promote vanpooling. The largest concentrations of long-distance commuters at vanpool-supportive employers were identified as the highest-potential locations for vanpool adoption.

Financial Feasibility Assessment

A vanpool "lifetime profit and loss statement" developed in 1981[44] was used as a structure for determining the financial feasibility of vanpooling in the Gorge. Costs and other inputs were updated using 2010 figures when possible, or simply inflated to 2010 levels using a standard inflation rate calculator[45].

Inputs to the financial model included:

- Average vanpool occupancy (number of passengers per van);
- Line haul distance (average distance traveled by a van each way);
- Pickup/drop-off distance (average total distance traveled by a van at each end of its trip);
- Miles the van is used for the driver's personal use;
- Initial van purchase price;
- Cost of insurance;
- Cost of vehicle wear and tear;
- Cost of tires;
- Cost of fuel;
- Van fuel efficiency;
- Cost of marketing, sales, and administration of the vanpool program; and
- Amount of employer or government subsidization.

Three different scenarios were developed representing a conservative, mid-range, and optimistic assessment of the potential costs of running a vanpool program. The outputs of the model were the projected net operating expenses per van per year for the first five years of operation; the monthly per-passenger fare required for the van to break even during the first year of operation; and the level of profit or loss based on various fixed monthly fare rates. The detailed financial feasibility analysis is presented in Appendix B.

[43] Weisbrod 1981
[44] Herk 1981
[45] Friedman 2010

Benefit-Cost Analysis

As discussed in the literature review, SOV transportation bears many costs. Vanpooling has the potential to eliminate many of those costs, both for individual commuters and for society at large. This portion of the analysis attempted to capture the potential costs and benefits of vanpooling in the Gorge.

First, the costs of SOV use per gallon of fuel consumed or per vehicle-mile-travelled (VMT) were collected from the literature. Then, findings from the market analysis and research on the existing transportation system in the Gorge were used to estimate the difference in these costs that could be expected from vanpool programs of varying size and effectiveness (based on conservative, mid-range, and optimistic assumptions). The costs savings were compared to the cost of operation for the vanpool program (calculated in the financial feasibility portion of the analysis) to determine the net benefits and the benefit-cost ratio of vanpooling in the Gorge.

First, the amount of VMT and fuel use reduction due to potential levels of vanpooling in the Gorge was calculated based on the model developed by Evans (1984). Inputs to this model included:

- Average one-way commute trip length in the Gorge;
- Average trip circuity factor for vanpool trips (pickup/drop-off distance as proportion of total commute length);
- Average van occupancy;
- Number of new vanpoolers;
- Average van fuel efficiency;
- Average private vehicle fuel efficiency; and
- Price of fuel.

The model's outputs were:

- Daily VMT savings per new vanpooler;
- Total annual VMT savings;
- Total annual fuel savings; and
- Cost savings from decreased fuel use.

Next, the outputs of this model were multiplied by emissions factors for CO_2[46] and the local pollutants carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NO_x)[47] to arrive at the total annual emissions reductions (by mass of pollutants) that might be expected due to vanpooling in the Gorge. Comparing these results with estimated current levels of fuel use and emissions[48], potential percent emissions reduction was calculated.

[46] US EPA 2011
[47] Delucchi 2003
[48] US DOE 2011

The next step was to quantify the external benefits of vanpooling so they could be compared to its costs. External costs per VMT or per gallon were taken from a meta-analysis of the external costs of automobiles performed by Parry (2007).

The following low, mid-range, and high estimates of external costs were used:

- Climate change: $0.05, $0.12, or $0.72 per gallon of fuel;
- Dependence on foreign oil: $0.08, $0.12, or $0.50 per gallon of fuel;
- Local pollution: $0.02 per VMT;
- Congestion: $0.04, $0.05, or $0.07 per VMT;
- Accidents (including injury, loss of life, and property damage): $0.02, $0.03, or $0.07 per VMT;
- Parking: $0.03, $0.07, or $0.10 per VMT; and
- Highway wear and tear: Negligible – most wear and tear comes from heavy trucks.[49]

Multiplied by the net changes in fuel use and VMT, these factors yielded the total annual external cost reductions due to vanpooling. Low estimates were used for the conservative calculations, mid-range for the most likely and optimistic calculations, and high estimates for the very optimistic calculations.

Finally, all of the benefits and costs calculated throughout this analysis were combined into a benefit-cost comparison of the potential for vanpooling in the Gorge. Benefits, in the form of private fuel cost savings and external cost reductions, were weighed against total vanpool operating costs, yielding the potential Net Annual Benefits (benefits – costs) and the Benefit-Cost Ratio (benefits ÷ costs) of vanpooling in the Gorge.

Employer Preferences Survey

The employer preferences survey[50] aimed to answer this study's second research question: How can employers be encouraged support vanpooling? The questions in this portion of the survey were designed to help understand what employers feel about vanpooling—what the most important benefits and concerns about vanpooling are, and what specific forms of vanpool program or incentives would most likely encourage them to participate.

Overview

The questions were all multi-part, with a heading question asking for the employer's opinion on each of a list of individual items. Responses were in the form of five-point qualitative Likert scales with an "I don't know" option. There were five heading questions concerned with the following subjects:

- Benefits of vanpooling;
- Concerns about vanpooling;
- Vanpool program organizational structures;
- Incentives to encourage employer promotion of vanpooling; and
- Incentives to encourage commuter participation in vanpooling.

[49] Parry 2007
[50] Mielke 2006

Benefits

In this section employers were given the following instructions: “Below is a list of the potential benefits of vanpooling. Please indicate how important or unimportant each benefit is to your organization in deciding whether or not to participate in a vanpool program.”

They were then asked to rate items on the following Likert scale: Very Important, Important, Neither Important nor Unimportant, Unimportant, Very Unimportant, I Don’t Know.

The following potential benefits were presented:

- Vanpooling reduces employee commute costs.
- Up to $230/month of vanpool expenses may be paid for with pre-tax income through the Federal Commuter Choice program.
- Riding to work in a van is less stressful for employees than driving.
- Having a vanpool option makes your organization more attractive to potential employees.
- Having a vanpool option improves your organization’s retention of current employees.
- Vanpool riders have better on-time performance.
- Vanpools conserve fuel and create less pollution.
- Vanpools reduce traffic congestion.
- Vanpools reduce the need for employee parking.
- Vanpool riders can do work during commute time.
- Other (please specify).

Concerns

In this section employers were given the following instructions: “Below is a list of possible concerns about vanpooling. Please indicate how important or unimportant each concern is to your organization in deciding whether or not to participate in a vanpool program.”

They were then asked to rate items on the following Likert scale: Very Important, Important, Neither Important nor Unimportant, Unimportant, Very Unimportant, I Don’t Know.

The following possible concerns were presented:

- There is a high up-front capital cost of purchasing vans (for an employer-run program).
- There are high operating costs (for an employer-run program).
- Employers might be liable in the case of an accident involving a vanpool van.
- Valuable administrative time must be spent on organizing or promoting a vanpool program.
- Vanpooling would increase employee travel times.
- Vanpooling is less convenient for employees than travel via personal car.
- Vanpools allow employees less schedule flexibility.
- Other (please specify).

Organizational Structure

In this section employers were given the following instructions: "Below is a list of different ways in which a vanpool program might be organized. Please indicate how likely or unlikely your organization would be to participate in a vanpool program organized in each of the following ways."

They were then asked to rate items on the following Likert scale: Very Likely, Somewhat Likely, Neither Likely nor Unlikely, Somewhat Unlikely, Very Unlikely, I Don't Know.

The following possible vanpool organizational structures were presented:

- The vanpool program is owned and operated by a third party company or organization.
- The vanpool program is owned and operated by your company or organization, which absorbs all of the costs and revenues.
- The vanpool program is owned and operated by a private employee of your organization.
- The cost of vanpooling is paid for through the Federal Commuter Choice program in the form of a tax-free transit benefit paid by your organization to your employees in addition to their standard wages.
- The cost of vanpooling is paid for through the Federal Commuter Choice program in the form of a pre-tax transit benefit taken out of employees' salaries before taxes are applied and used to cover vanpool costs.
- Other (please specify).

Employer Incentives

In this section employers were given the following instructions: "Below is a list of some ways in which your organization might be encouraged to participate in a vanpool program. Please indicate how much each incentive would affect your organization's likelihood of participating in a vanpool program."

They were then asked to rate items on the following Likert scale: Much More Likely to Participate, Somewhat More Likely to Participate, No More or Less Likely to Participate, Somewhat Less Likely to Participate, Much Less Likely to Participate, I Don't Know.

The following employer incentives were presented:

- Direct subsidies are provided to help cover the cost of new vanpools.
- Advertising space on the vans is made available to your organization, for free or at minimal cost.
- Resources, training and/or informational materials are provided free of charge to help your staff organize or promote a vanpool program.
- Preferential public parking (on-street or in lots) is provided for vanpool vans.
- Preferential toll lanes at bridges allow vanpool vans to cross the river more quickly.
- Emergency Ride Home (ERH) services are available for employees in case they miss their scheduled vanpool ride home, or who experience a household emergency or family illness.
- Other (please specify).

Commuter Incentives

In this section employers were given the following instructions: “Below is a list of ways in which an employer might promote or encourage vanpooling by its employees. Please indicate how likely you would be to provide each of these services for your employees, if you were participating in a vanpool program.”

They were then asked to rate items on the following Likert scale: Very Likely to Provide Service, Somewhat Likely to Provide Service, Neither Likely nor Unlikely to Provide Service, Somewhat Unlikely to Provide Service, Very Unlikely to Provide Service, I Don’t Know.

The following commuter incentives were presented:

- Provide convenient parking spots for vanpool vans.
- Engage in a vanpool recognition/support effort, advertising vanpool services to employees and providing them with informational materials.
- Help employees cover part of the cost of vanpooling to encourage participation (can be tax-free under the Federal Commuter Choice Program).
- Provide non-cash incentives to employees to participate in vanpooling (gift cards, raffles, etc.)
- Host a ride-matching service to make it easier for employees to find a convenient vanpool route.
- Allow vanpooling employees to use company vehicles to run errands during their lunch hour.
- Sponsor wifi on vans so that employees can work during their commute.
- Allow flexible work hours so that employees can find commute times that work for everyone.
- Other (please specify).

A full version of the employer survey is presented in Appendix A.

Findings

Through the analyses outlined above, this study found significant potential for vanpooling in the Mid-Columbia River Gorge among a limited percentage of the commuting population. This is in line with what might be expected from experiences with vanpooling around the country. Through the employer preferences survey, it found that employers tended to value those elements of vanpooling which reduced or minimized their own costs, or at least maintained the status quo in terms of employer responsibilities. Employers also valued the benefits that vanpooling would provide to their employees, but these benefits tended to be of secondary importance.

The first section of this chapter briefly describes the organizations that responded to the employer vanpool survey. The subsequent sections describe the results of the survey and the analysis of the data. The second section describes the findings of an assessment of the potential for vanpooling in the Mid-Columbia River Gorge (Gorge), including a market analysis, financial feasibility assessment, and benefit-cost analysis. The third and final section presents the results of the employer preferences portion of the survey, which asked questions about employer perceptions of vanpooling and their preferences for different vanpool program structures and encouragement incentives.

Characteristics of Survey Population and Respondents

The employer survey achieved a response rate of about 59%. Twenty-four employers, employing a total of over 3500 people, provided usable survey responses. The employers who responded ranged in size from 34 to 371 employees, with an average of about 155 employees.

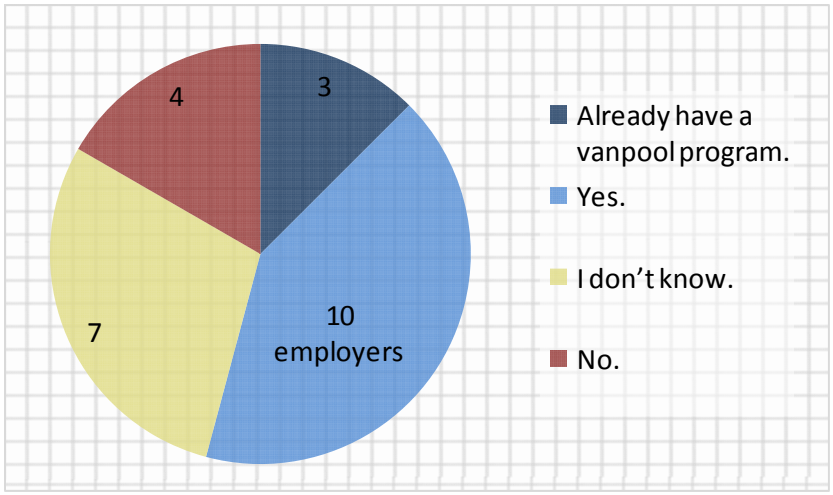
Seventeen of the respondents, representing 59% of the employees employed by respondents, were based in Oregon, nine of which were located in The Dalles and six of which were located in Hood River. Furthermore, about 57% of the employees represented by survey respondents worked in either The Dalles or Hood River. The organizations that responded included public agencies and private companies from a variety of sectors including the agricultural/food processing, industrial, technology, medical, and service sectors.

The group of organizations not responding to the survey consisted of 21 employers representing 4,357 employees, based on MCEDD's existing data about employment at each organization. However, most responding organizations reported fewer employees than had been listed in MCEDD's records prior to the survey; on average, the number of employees at the time of the survey was only 69% of the number of employees on record prior to the survey. Assuming this proportion held for the non-response organizations, it was estimated that the 21 non-respondent employers likely represented about 3,000 employees at the time of the survey.

Assessment of Vanpool Potential

The results of the vanpool potential assessment are presented here, starting with a vanpool market analysis of the Gorge, followed by a GIS analysis of suitable employment clusters in the area, a financial feasibility assessment, and a benefit-cost analysis of vanpooling in the Gorge.

FIGURE 6: EMPLOYER RESPONSE TO "WOULD YOU SUPPORT VANPOOLING?"

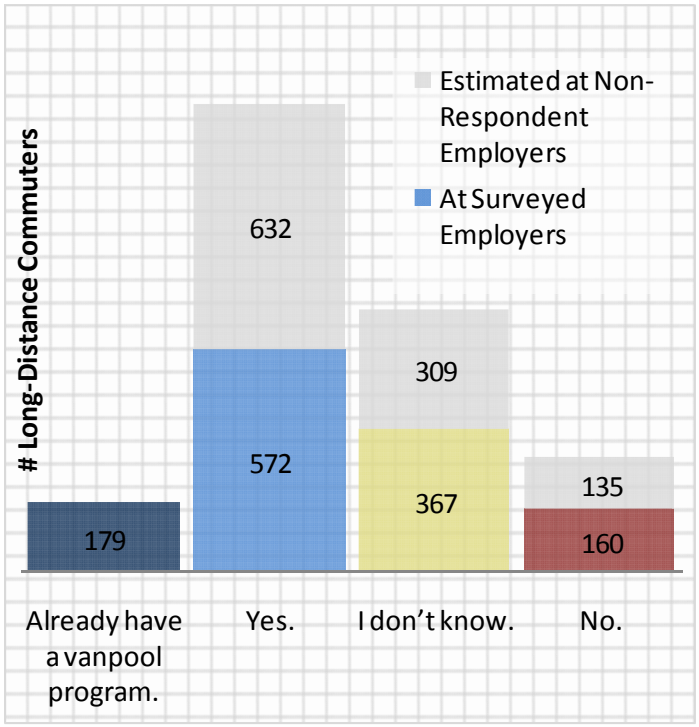


Market Analysis

The techniques used for the market analysis were modeled on the literature[51] and used existing data on vanpool adoption rates to estimate the potential market size and adoption rate for vanpooling in the Gorge. The analysis focused on three primary success factors outlined in the literature in order to estimate vanpool market size: large concentrations of workers, long-distance (>15 miles) commute patterns, and employer support for vanpooling. Other possible success factors, including high fuel prices, a lack of reasonable transit options, and dense residential clusters, were excluded from this portion of the analysis either because data were unavailable or because the effect of these factors on vanpool adoption has not been measured.

The response of employers to the question of promoting vanpooling is outlined in Figure 6. Of the 24 employers that responded to the survey, 10 employers (representing 1,785 employees) responded "Yes" to the question: "Would you Promote Vanpooling?" Of the employees represented by these organizations, 572 were long-distance commuters, commuting at least 15 miles each way to work.[52] A further 367 long-distance commuters worked at employers who responded "I don't know" to the question of support for vanpooling, and 179 long-distance commuters worked at companies that already have a vanpool program.

FIGURE 7: EMPLOYER RESPONSE TO "WOULD YOU SUPPORT VANPOOLING?" BY NUMBER OF POTENTIAL VANPOOLERS



Based on the proportions observed among survey respondents there were an estimated 632 long-distance employees at non-respondent organizations that would have responded "Yes" to promoting

[51] iTrans 2007, Bailey 1983
[52] Maxwell & McIntyre 1979, Wiersig 1981

vanpooling, and a further 309 at organizations that would have responded "I don't know." Using different assumptions about the validity of these estimates and the likelihood of the "I don't know" employers to participate in a vanpool program, four possible market size estimates were assembled, ranging from conservative (572 employees) to very optimistic (1880 employees). These estimates are presented in Figure 7.

These four market sizes were combined with a similar set of four vanpool adoption rates, from conservative (3.7%) to very optimistic (20%). The estimated most likely vanpool mode share was 7.3%, the average vanpool mode share from a dataset of vanpool programs presented in Evans and Pratt (2005). The conservative vanpool adoption rate (3.7%) is simply half of this number; the optimistic rate (11.2%) was calculated using the Evans and Pratt data by excluding all employers with more than 1000 employees; and the very optimistic rate (20%) was selected from the same dataset as a typical example of a highly successful vanpool program.

Multiplied together, the market sizes and adoption rates yielded a matrix of possible outcomes (see Table 4) for a vanpool program, ranging from very limited adoption of vanpooling (21 employees in 3 vans) to widespread use (376 employees in about 28 vans). In the middle area of the matrix lies the most likely range of adoption: 69 to 135 employees occupying 7 to 14 vans. This would lead to an increase in vanpool mode share from about 0.1% to 0.3%-0.5%.The potential effects of vanpooling on mode shares in the Gorge are outlined in Table 5.

TABLE 4: VANPOOL MARKET ANALYSIS RESULTS

Expected Vanpool Participants	Participation Rate	Yes - Survey Responses	Yes + 'I don't know.' - Survey Responses	Yes - Total Market Estimate	Yes + 'I don't know.' - Total Market Estimate
Maximum Possible Market Size:		572	939	1204	1880
Conservative Estimate	3.7%	***21***	34	44	69
Most Likely Estimate	7.3%	42	***69***	88	137
Optimistic Estimate	11.2%	64	105	***135***	211
Very Optimistic Estimate	20.0%	114	188	241	***376***

Expected # Vans	Participation Rate	Yes - Survey Responses	Yes + 'I don't know.' - Survey Responses	Yes - Total Market Estimate	Yes + 'I don't know.' - Total Market Estimate
Van Occupancy Rate:		8	10	10	14
Conservative Estimate	3.7%	***3***	3	4	5
Most Likely Estimate	7.3%	5	***7***	9	10
Optimistic Estimate	11.2%	8	11	***14***	16
Very Optimistic Estimate	20.0%	14	19	24	***28***

TABLE 5: POTENTIAL COMMUTE PATTERNS IN THE GORGE, WITH VANPOOLING

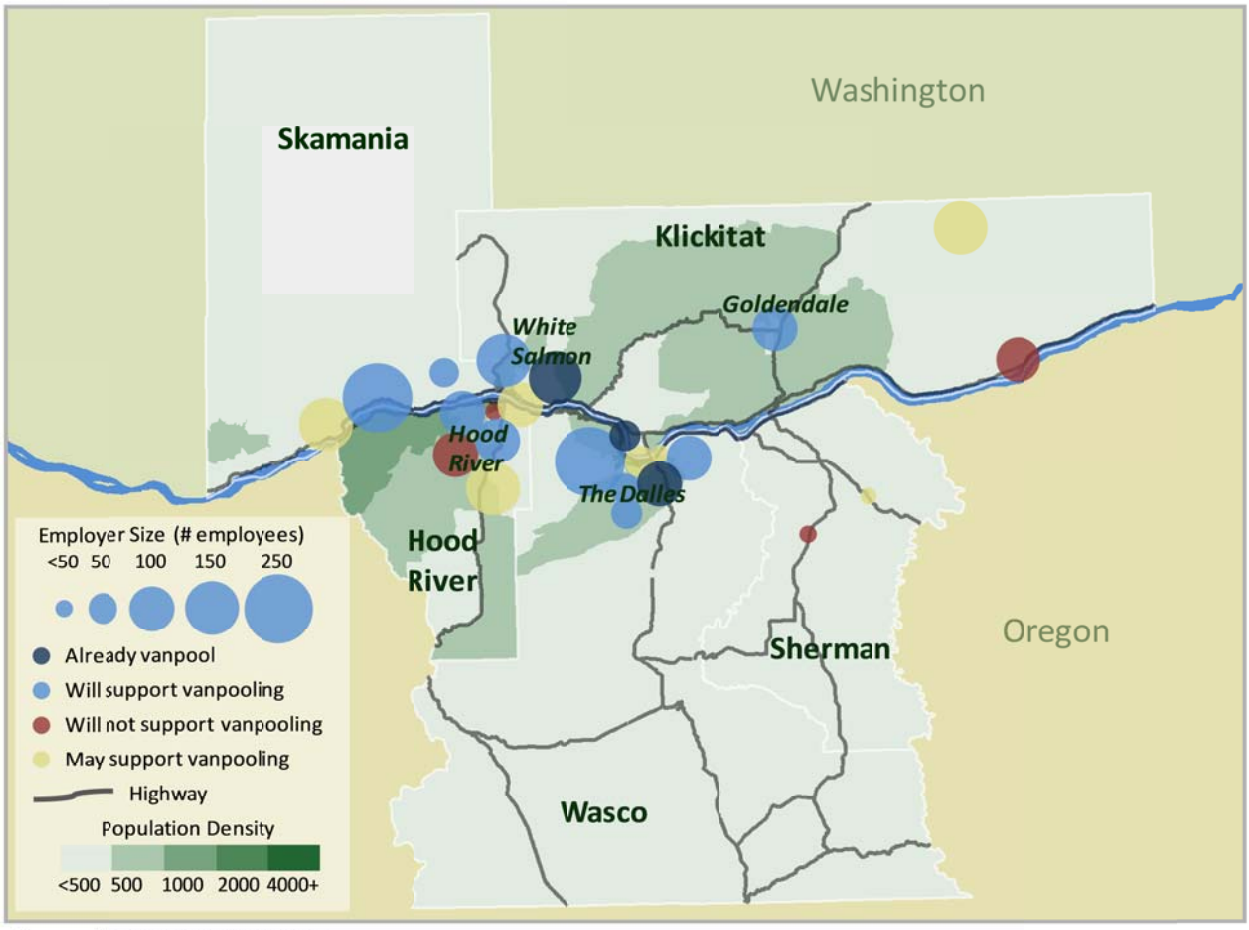
	Conservative	Most Likely	Optimistic	Very Optimistic
Potential New Vanpoolers	21	69	135	376
SOV Commuters	25,330	25,282	25,216	24,975
Vanpool Commuters	68	116	182	423
SOV Mode Share	73.6%	73.4%	73.2%	72.5%
Potential Vanpool Mode Share	***0.2%***	***0.3%***	***0.5%***	***1.2%***

GIS Analysis

Spatial characteristics play a major role in the success of any transportation system and vanpooling is no exception. Therefore, Geographic Information Systems (GIS) software was used to assess the spatial characteristics of employment in the Gorge as it relates to vanpooling.

Map 1 shows the Gorge and all of the employers in the area that responded to the survey. The size of each dot indicates the number of people employed at that site, and the color of each dot indicates the response of the employer to the question "Would you promote vanpooling?" This map confirms what has already been established: that most of the responses came from employers located in The Dalles or Hood River.

MAP 1: MID-COLUMBIA RIVER GORGE EMPLOYER SURVEY RESPONDENTS

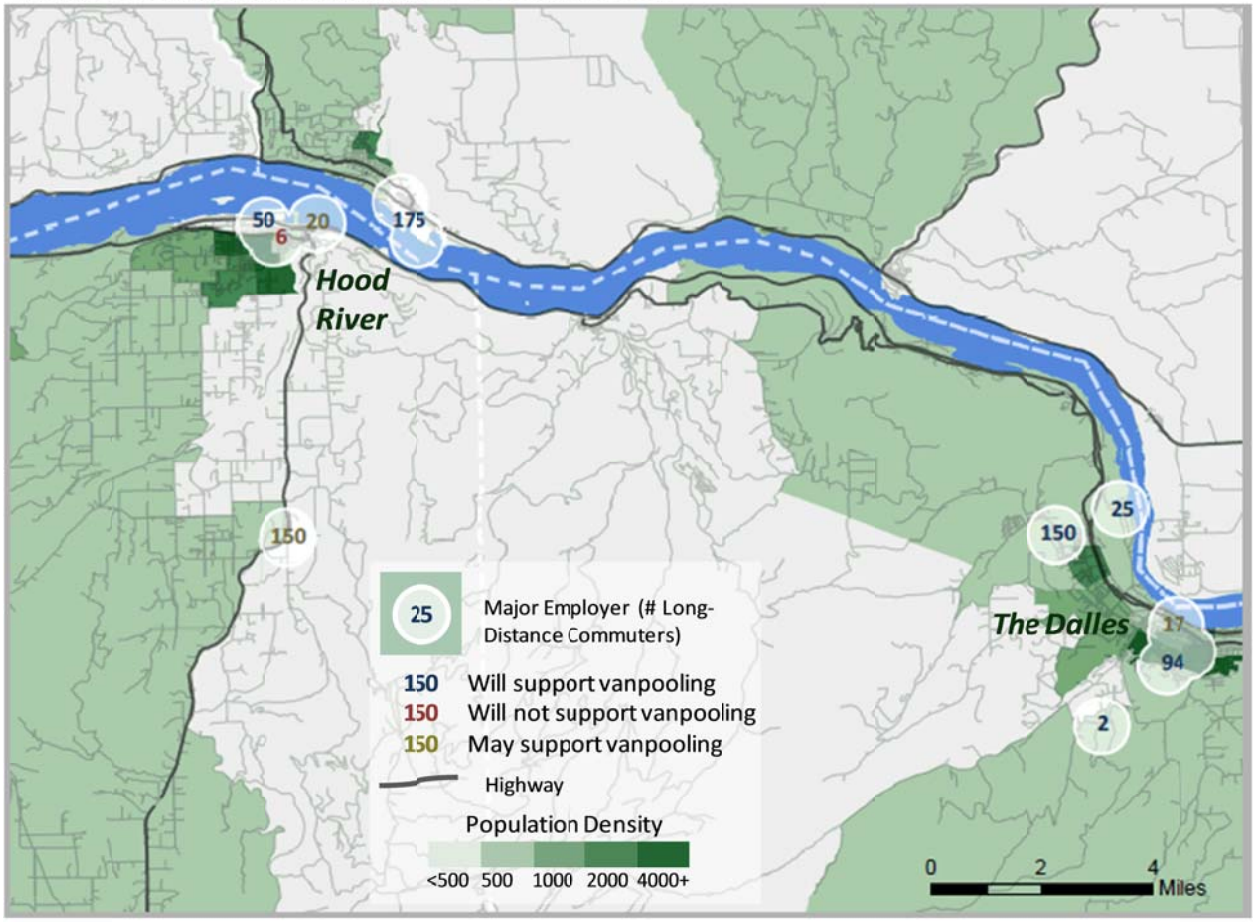


Source: U.S. Census Bureau 2010

Map 2 provides a close-up view of the Hood River-The Dalles area, and identifies some of the employment clusters in the Gorge most suitable for vanpooling. Multi-employer vanpooling has been shown to be successful, but difficulties arise when employers are more than one mile away from one another.[53] Each employment site was surrounded with a half-mile buffer. Sites whose buffers intersect are within one mile of each other, forming a cluster of employment suitable to vanpooling. Each cluster is labeled with the number of employees in that cluster that commute more than 15 miles each way, broken down by how their employer responded to the question "Would you promote vanpooling?"

As Map 2 shows, there are several clusters of employment with the potential to be served by vanpooling. These clusters should be the highest priority targets for a vanpool program, because they are the most likely to yield significant ridership.

MAP 2: HIGH-POTENTIAL VANPOOL SITES IN THE MID-COLUMBIA RIVER GORGE



Source: U.S. Census Bureau 2010

Of course, the eventual level of vanpooling will depend greatly on the home addresses of the commuters employed in these clusters. A detailed survey of residential clusters was beyond the scope of this study, but as Maps 1 and 2 show population density is clustered in the Gorge's urban areas: Hood River, White Salmon/Bingen, The Dalles, etc. This suggests that there is the potential for vanpooling in

[53] Weisbrod 1981

situations where residents of one urban area are commuting to another location for work. Commuters from outside urban areas may not live close enough to others to make vanpooling viable.

Taken together, the market analysis and GIS analysis suggest that vanpooling has significant potential for success in the Gorge, but also significant barriers related to its geography and employment patterns. This is in keeping with previous experience from the literature; for example, the Palouse Rideshare program in Idaho (see sidebar) is an example of a rural rideshare program that is successful but limited in scope due to its geographic context.

PALOUSE RIDESHARE, IDAHO

Palouse Rideshare is an online rideshare matching program operating in rural Idaho and parts of Washington. The program initiated and managed a vanpool between the town of Lewiston and the University of Idaho (a distance of about 32 miles). Jurisdiction of this program transferred to the City of Moscow (where the University of located) in 2010.

Idaho is one of the least-dense states in the U.S., ranking 44th for population density. So, as Kay (2010) suggests, "the success of this rideshare program demonstrates that ridesharing can thrive in even the most rural of places."

However, it is important to note that the program has thus far only led to the organization of one vanpool, carrying twelve daily riders. Data on the carpool aspect of Palouse Rideshare's program does not exist, but perhaps carpooling has gained wider adoption in the region. *(Source: Kay 2010)*

Financial Feasibility Assessment

To determine the financial feasibility of vanpooling in the Gorge, a detailed vanpool lifetime profit and loss statement was taken from Herk (1981) and updated using 2010 input costs and fuel efficiency levels.[54] Three analyses were completed: a conservative, a mid-range, and an optimistic assessment of the cost of vanpool operation based on different assumptions about the price of fuel, average van occupancy, trip length, and other factors.

The primary output of this model was a minimum monthly per-passenger fare rate required for the vanpool program to break even within the first year, though the model predicted a gradually increasing level of profitability over the lifetime of the van. This breakeven fare point ranged from $72/month for the optimistic model to $186/month for the pessimistic model. The mid-range model predicted a break-even fare of $123/month.

The model also calculated the annual net operating expenses per van of a vanpool program. These were projected to range from about $11,000 to almost $17,000, with the mid-range estimate lying at $13,333 per year. These calculations are presented in Table 6. The details of the financial feasibility analysis are presented in Appendix B.

The results of the financial feasibility assessment are roughly in line with contemporary vanpooling costs[55]. The actual costs will depend on a number of factors specific to the vanpool program itself, and may be lower if employer or government subsidies can be secured.

TABLE 6: VANPOOL FEASIBILITY ASSESSMENT RESULTS

	Conservative	***Most Likely***	Optimistic
Year 1 Break-Even Monthly Fare per Passenger	$ 186	***$ 123***	$ 72
Year 1 Net Annual Operating Cost	$ 16,744	***$ 13,333***	$ 10,770

[54] Herk 1981
[55] Valley Vanpool 2009, Kay 2010

Benefit-Cost Analysis

The potential benefits and costs of vanpooling in the Gorge were calculated using the range of estimated vanpool adoption levels from the market analysis, and data from the literature estimating the private and social costs of automobile use. These calculations included private savings in the form of reduced fuel consumption – benefits that accrue to individual commuters – as well as public savings such as reductions in emissions and the reduced cost of externalities. These externalities are difficult to account for because they affect a broad range of parties, from the local to the global. They include automobile collisions (affecting only those involved in the accident), congestion (a cost borne by all commuters), parking construction (paid for by the employer or the local municipality), local pollution (affecting all Gorge residents), oil dependency (affecting the entire nation), and climate change (affecting the global population). The results are presented in Table 7.

The total net benefits of vanpooling in the mid-range, "most-likely" case added up to about $140,000 per year. This amount consisted of $107,000 in fuel savings and $117,000 in reduced external costs from SOVs, from which was subtracted $83,000 in total vanpool operating costs. This translates to a benefit-cost ratio of 2.7 for vanpooling in the Gorge.

The slightly more optimistic scenario estimated a net benefit of $276,000 per year, also with a benefit-cost ratio of 2.7. In contrast, the conservative scenario found the costs of vanpool promotion to be slightly greater than the benefits, for a loss of about $1,400/year and a benefit-cost ratio of 0.96.

Finally, to set an upper bound on the possible benefits of vanpooling, a highly-optimistic, wide-scale adoption scenario was calculated. The net benefits of such a scenario were much higher – over $2 million per year, with the benefits outweighing the costs by a factor of almost 8 to 1.

In the most likely scenario, vanpooling reduced CO_2 emissions by 259 tons per year—a significant reduction, but less than one tenth of one percent of the Gorge's total transportation CO_2 emissions, as estimated using national per capita VMT and fuel usage data[56].

Emissions reductions estimates for local pollutants were slightly higher, but also very small. Even in the very optimistic scenario, emissions reductions for CO_2 and local pollutants were each only about 0.6%.

In terms of monetized benefits, reduced fuel costs accounted for slightly less than half in each scenario. Following these private benefits in decreasing order of magnitude were the social costs of parking infrastructure, congestion, accidents, local pollution, oil dependency, and finally climate change. These numbers are at best rough approximations, however. As discussed above, congestion is not a major concern in the Gorge, and typical CO_2 emissions valuations are arguably a gross underestimate of the costs of climate change.[57]

[56] US DOE 2011
[57] Weitzman 2009

The results of this benefit-cost analysis are in keeping with the national experience with vanpooling: there are significant benefits and vanpooling is very cost-effective – but its effects are fairly small relative to the size of the transportation system.

TABLE 7: VANPOOL BENEFIT-COST ANALYSIS RESULTS

Estimated Annual Benefits of Vanpooling in the Gorge

	Conservative	Most Likely	Optimistic	Very Optimistic
Potential Vanpooling				
# Vanpoolers	21	69	135	376
# Vans	3	7	14	28
First-Order Effects of Vanpooling				
VMT Reduction (VMT)	148,941	637,611	1,247,500	4,320,101
Fuel Conservation (gal)	5,705	26,718	52,273	189,581
Fuel Cost Savings ($)	***$ 17,115***	***$ 106,870***	***$ 209,094***	***$ 947,903***
Emissions Reductions				
Carbon Emissions Reduction (%)	0.016%	0.076%	0.149%	0.539%
CO Emissions Reduction (%)	0.022%	0.093%	0.182%	0.620%
HC Exhaust Emissions Reduction (%)	0.022%	0.092%	0.180%	0.615%
NOx Emissions Reduction (%)	0.021%	0.091%	0.178%	0.610%
External Cost Reductions				
Climate Change	$ 300	$ 3,366	$ 6,586	$ 143,323
Dependence on Foreign Oil	$ 449	$ 3,366	$ 6,586	$ 99,530
Local Pollution	$ 3,128	$ 13,390	$ 26,197	$ 90,722
Congestion	$ 5,474	$ 33,475	$ 65,494	$ 294,847
Accidents	$ 3,128	$ 20,085	$ 39,296	$ 317,527
Parking	$ 4,692	$ 43,517	$ 85,142	$ 453,611
Total External Cost Reduction	***$ 17,170***	***$ 117,199***	***$ 229,302***	***$ 1,399,560***
Total Monetized Benefits	***$ 34,285***	***$ 224,069***	***$ 438,396***	***$ 2,347,463***
Operating Costs				
Operating Cost per Van ($)	$ 13,588	$ 12,020	$ 12,020	$ 10,770
Total Operating Costs	***$ 35,669***	***$ 82,935***	***$ 162,263***	***$ 299,976***
Net Benefits ($)	***$ (1,384)***	***$ 141,134***	***$ 276,133***	***$ 2,047,487***
Benefit-Cost Ratio	***0.96***	***2.70***	***2.70***	***7.83***

Employer Preferences Survey

Prompted by the lack of research about what might make a vanpool program more or less attractive to employers, this survey of Gorge employers posed a number of questions about employers' perception of vanpooling. The results of this portion of the survey are outlined here, with a section for each question.

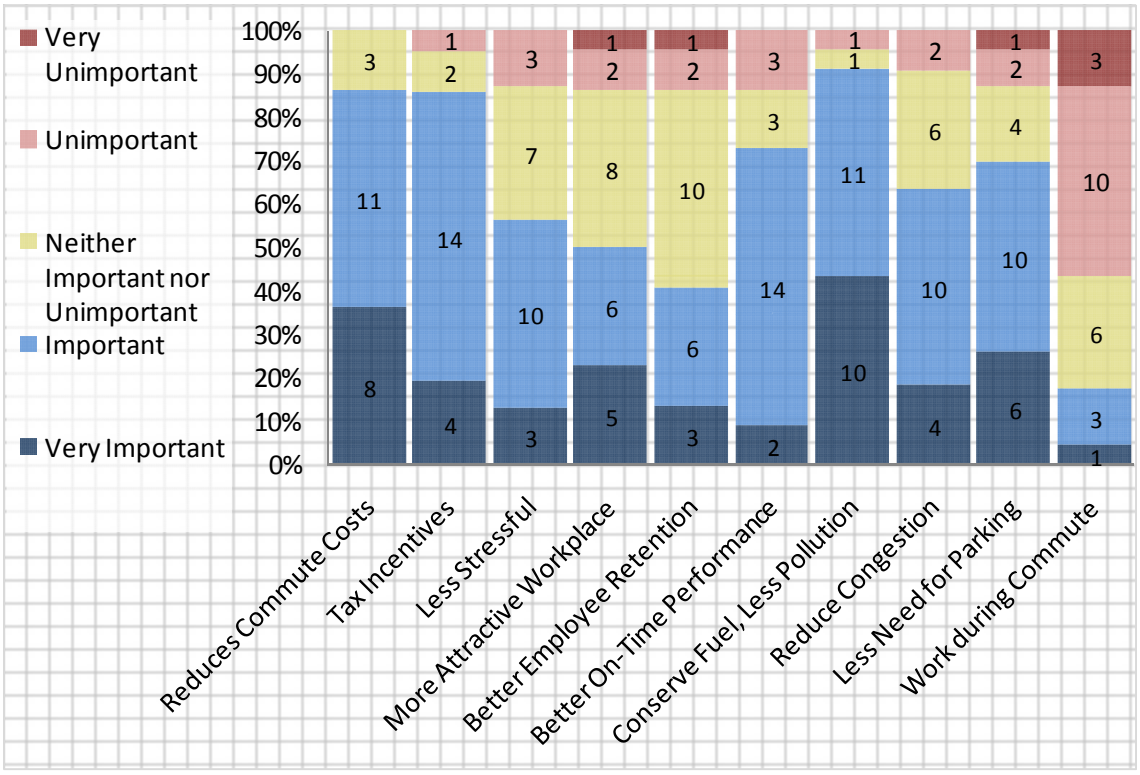
Benefits of Vanpooling

When asked about the importance of vanpooling's potential benefits, most employers highlighted those benefits with an easily quantifiable monetary value: about 85% said reduced commute costs and tax incentives were "Important" or "Very Important".

Somewhat surprisingly, however, fuel conservation/decreased pollution was even more important – over 90% of employers identified it as important or very important. It is unclear whether employers were reacting to the public benefits of reduced fuel use, the cost savings of fuel conservation, or both.

Employers felt less strongly about the remaining benefits, most of which were less tangible. Among these, the ones rated most important were those the employer had a direct financial stake in – better on-time performance and less need for parking. The only benefit that had almost no support at all was the possibility of employees working during their commute. This may be due to the nature of the work at the respondents' companies, or simply because it was not an arrangement they had experience with.

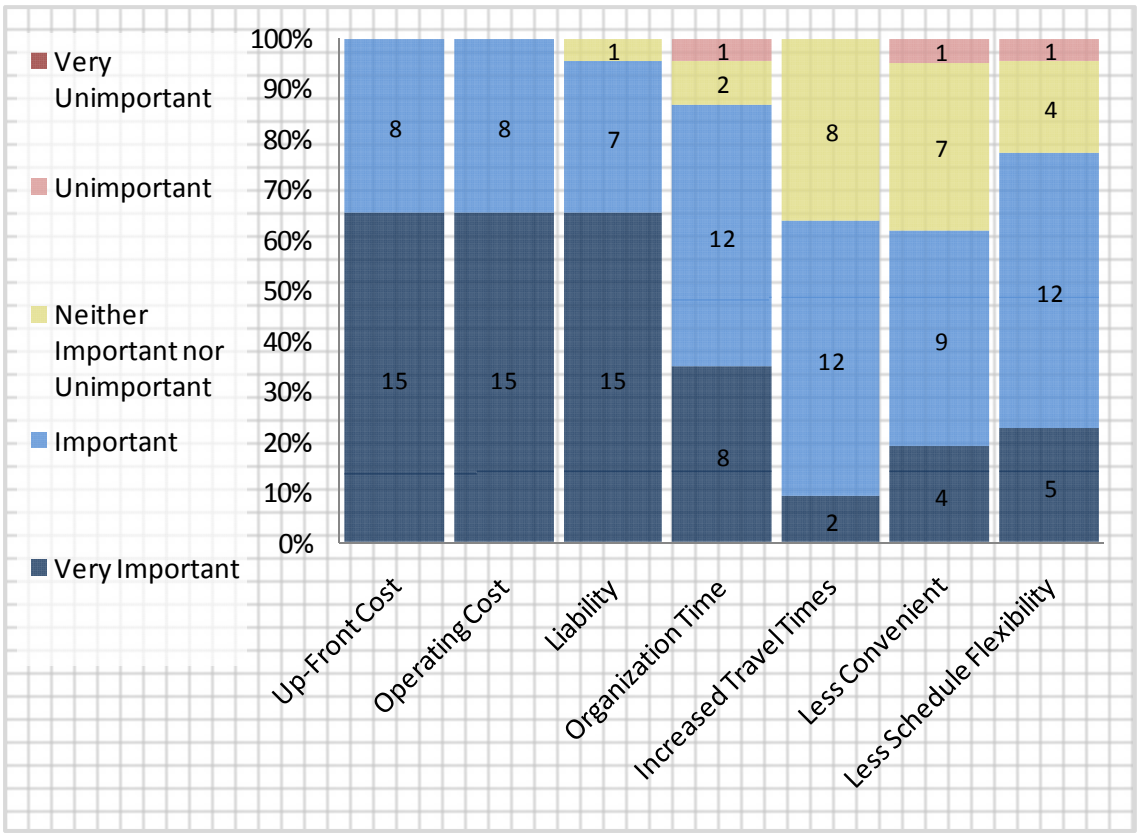
FIGURE 8: EMPLOYER PERCEPTION OF VANPOOL BENEFITS



Concerns about Vanpooling

The most important concerns for employers were those that directly affected their bottom line, while concerns affecting employees were generally seen as less important. Up-front cost, operating cost, and liability were the most important, with 95%-100% of respondents identifying them as at least "Important" and 65% identifying them as "Very Important". All of the other concerns presented were listed as "Important" or "Very Important" by over 60% of respondents.

FIGURE 9: EMPLOYER CONCERNS ABOUT VANPOOLING



Vanpool Program Structures

Of the three ownership schemes presented, third-party-operated vanpooling was by far the most acceptable to respondents – unsurprising because it is the structure that requires the least administrative effort, financial risk, or legal liability on the part of the employer. Over 70% responded that they were "Somewhat Likely" or "Very Likely" to participate in such a program, while less than 20% responded the same way about employer- or owner-operated models. Georgia's Coastal Regional Commission (see sidebar) is an example of a successful vanpool being operated by a private third-party contractor.

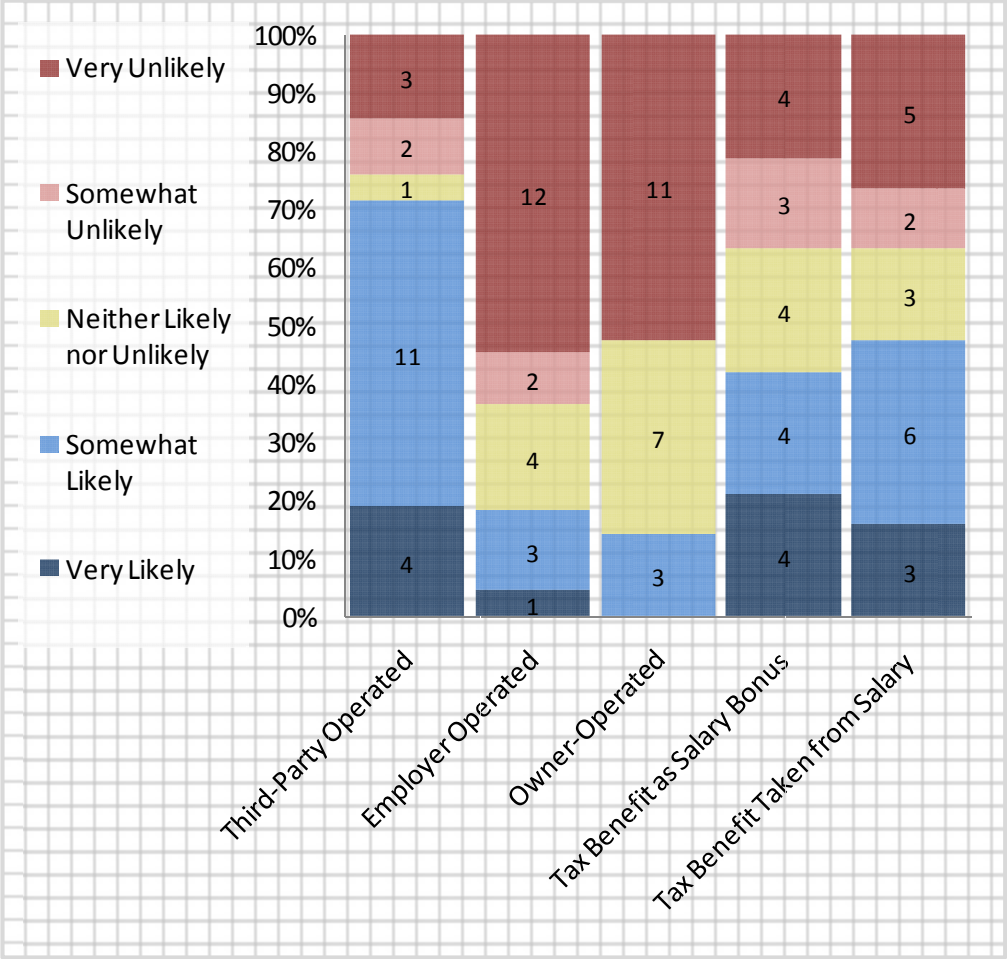
Employers were split roughly down the middle in their feelings about tax benefits, with slightly less than half saying they would be more likely to participate in vanpooling because of the Federal Commuter Choice Program incentives. This may have been in part due to confusion about the question's meaning.

COASTAL REGIONAL COMMISSION OF GEORGIA REGIONAL VANPOOL PROGRAM

Georgia's Coastal Regional Commission (CRC) provides transportation services and acts as the Economic Development District for the coastal region of Georgia, and area of 10 counties and 350 cities, covering an area of over 5,000 sq mi. The role of the CRC and the geographic nature of the region are analogous to MCEDD's role and the Gorge, though its population density is significantly higher.

A Vanpool Feasibility Study commissioned by the CRC in 2007 confirmed strong interest in ridesharing, using both employer and employee surveys. Based on the recommendations of this study, a Regional Vanpool Program was founded. Rather than being managed by the CRC directly, private vanpool operator VPSI, Inc. is contracted to operate the program. VPSI contracts with the CRC on a month-to-month basis; there is no long-term lease. The cost per commuter for the vanpool program is about $100/month. *(Source: Kay 2010, CRC 2009)*

FIGURE 10: EMPLOYER PREFERENCE FOR VANPOOL PROGRAM STRUCTURES

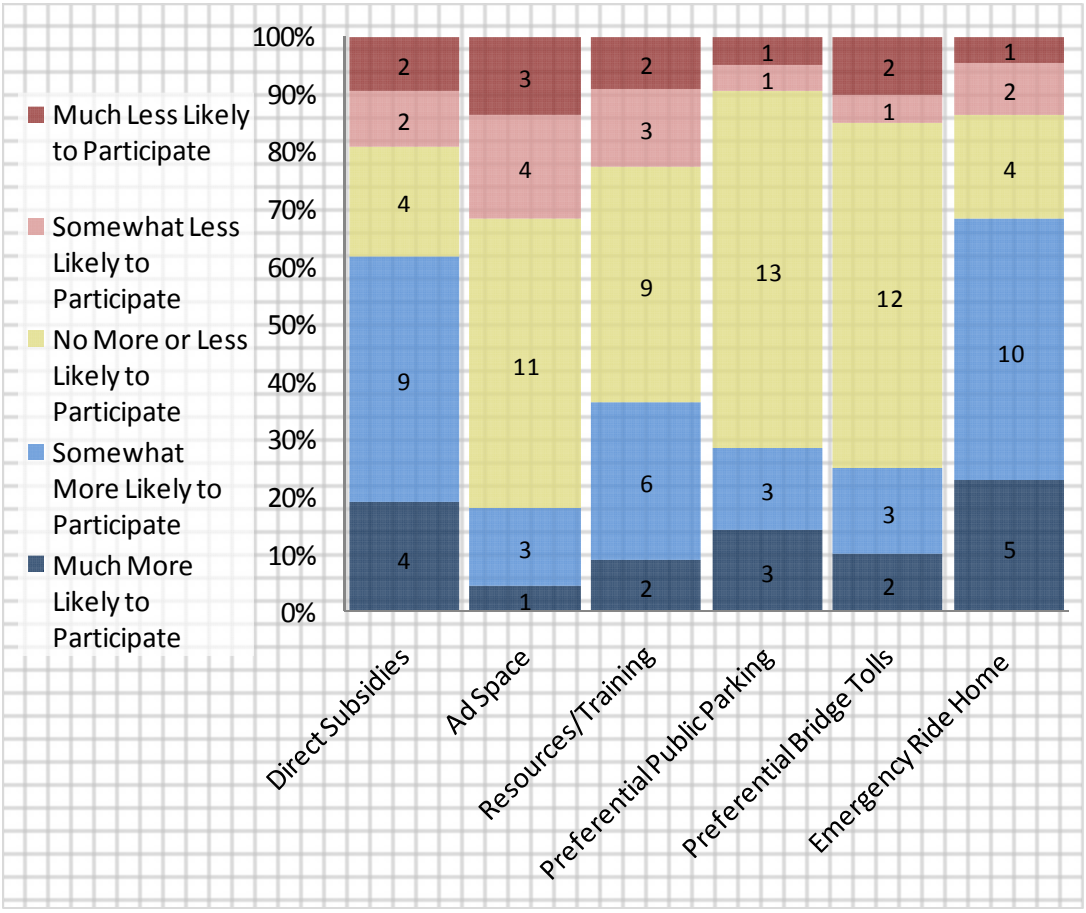


Employer Incentives

The most popular employer incentives seemed to be those with the greatest financial value – direct subsidies, and publicly-funded emergency ride home services. Over 60% of respondents identified them as incentives that would make them "Somewhat More Likely" or "Much More Likely" to participate in vanpooling. Resources and training support was also fairly popular and were identified by about a third of respondents.

The remaining three incentives—ad space on vans, preferential public parking, and preferential bridge tolls—were identified by fewer than 30% of respondents as encouraging them to participate in vanpooling. It is likely that the respondents simply saw these incentives as having little value for their organization. However, for each of these incentives there was at least one organization that said it would be "Much More Likely to Participate" if that incentive was provided.

FIGURE 11: EMPLOYER PREFERENCE FOR EMPLOYER VANPOOL INCENTIVES



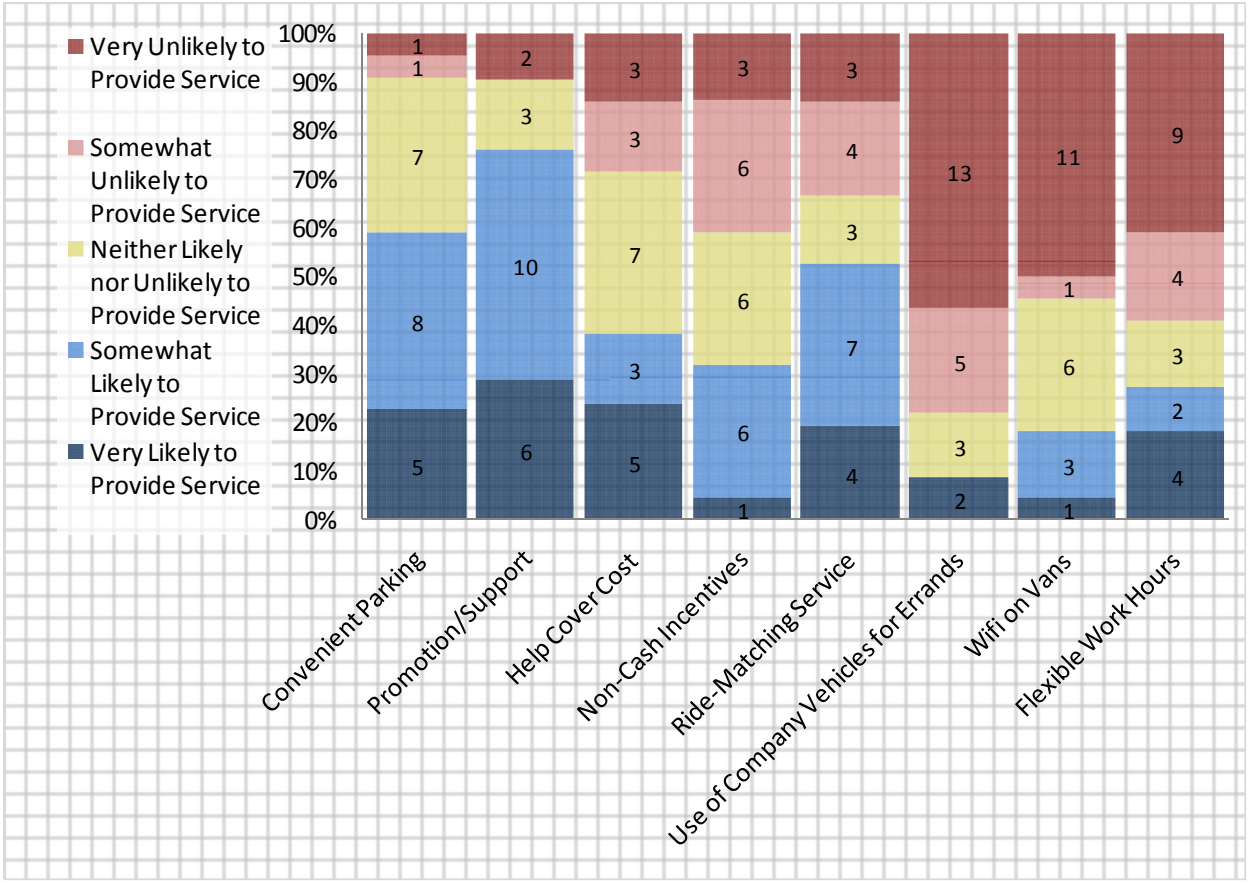
Commuter Incentives

The commuter incentives employers were most likely to provide were not necessarily the ones with the lowest financial cost. Rather, there seemed to be a tendency for employers to pick those incentives that could be provided with existing resources and which entailed minimal change in their current scope of operations.

Promotion/support was the only widely popular service; about 75% said they were likely or better to provide the service. Other popular services were convenient parking and ride-matching services, both with 50%-60% support. All three of these services could be provided using existing company resources.

In contrast, all of the other commuter incentives were offered by fewer than 40% of employers. They all required new financial contributions or some sort of change in current operating procedures. Nonetheless, all of the responses were mixed – each of the eight incentives listed had at least one response of "Very Unlikely to Provide Service" and one of "Very Likely to Provide Service".

FIGURE 12: EMPLOYER WILLINGNESS TO PROVIDE COMMUTER INCENTIVES



Discussion and Recommendations

The market analysis and employer survey paint a mixed picture of the potential for vanpooling in the Mid-Columbia River Gorge. Its results are nonetheless in line with the existing literature's characterization of vanpooling: an effective commuting option with potential for success within a relatively limited prospective market.[58]

Accordingly, the vanpool feasibility assessment suggests that there is great enthusiasm and support for vanpooling in the Gorge among a fairly small group of employers. It is likely that a vanpool program would be successful in serving these employers, and that the accompanying economic, social, and environmental gains would be significant but modest.

The employer preferences survey suggests that employers are focused on the aspects of vanpooling with the greatest potential to create real cost savings, and would like to avoid any new costs, risks, or responsibilities.

This section will discuss the findings in more detail, acknowledge some of this study's limitations, suggest avenues for further research, and present recommendations for fostering vanpooling in the Gorge.

Vanpool Feasibility Assessment

The vanpool feasibility assessment suggests that there is significant potential for vanpooling in the Gorge among a limited percentage of commuters. Potential adoption levels could vary widely depending on a number of factors, but even in the most optimistic scenarios the vanpool mode share in the Gorge is unlikely to exceed about 1.2%.

This limited vanpool potential shouldn't be discouraging for organizations looking to promote it as a commuting strategy – vanpooling is just one piece in a larger transportation system.

Vanpooling and carpooling promotional efforts can coincide – and carpooling tends to attract a wider market than vanpooling, often by one or two orders of magnitude.[59] The Ventura Freeway Vanpool Support Program (see sidebar) is a good example of a vanpool program that was effective in promoting vanpooling while also fostering other forms of ridesharing. Furthermore, long-term trends seem to be in favor of vanpooling. Many of the factors at play in the late 1970s are on the rise: high fuel prices, concern with the environment, and economic troubles. The data on vanpool adoption rates, based on the past twenty years, may not be a good predictor of adoption rates in the coming years.

On the other hand, there are geographic factors that stand against widespread vanpooling in the Gorge. Although there is some evidence that vanpooling can work in rural areas, there are few examples of widespread vanpooling in such areas. The Palouse Rideshare case study is an example of a successful rural vanpool program – but it only consists of one van.

[58] Evans and Pratt 2005
[59] Kostyniuk 1982, Kay 2010

At the end of the day, any model predicting levels of vanpooling can only go so far, because the success of a vanpool program depends so much on the specifics of the context and of the program itself. Although there is little a local organization such as MCEDD can do to alter the context in which it operates, it can incorporate the many best practices identified in the literature review – practices such as employer promotion, direct follow-up with commuters, flat fare structure, and ERH service – to help ensure that it gets the most out of its time and money when working to foster vanpooling.

VENTURA FREEWAY VANPOOL SUPPORT PROGRAM

The Ventura Freeway Vanpool Support Program (VSP) in southern California is a good example of a subsidy program designed to increase vanpool ridership. Administered by Caltrans (the California Department of Transportation) and promoted by the local rideshare agency Commuter Transportation Services (CTS), this reduced-fare vanpool program was founded to relieve congestion during construction work on a busy freeway in California.

The VSP provided fare discounts for new vanpool customers, starting at 50% off and ramping down over 6 months. The program was highly successful: 673 people were converted to vanpooling over the course of 16 months, and 618 continued on after the program ended. This 92% retention rate confirms effectiveness of VSP strategy. Mean trip length for participants was 43 miles.

Promotional materials included posters, brochures, and a program info manual. At first workshops and conversations with employers were used, but they were discontinued after generating little interest. However, it was later discovered that phone calls to employee transportation coordinators were a very effective promotion strategy.

Some other lessons learned from the program include that:

- Ease of use is very important in encouraging ridesharing;
- The vanpool-focused promotional efforts of the VSP had the side benefit of generated carpool placements for those for whom vanpooling was unfeasible; and
- Although the program provided incentives to new vanpoolers for 6 months, 4 months of financial support is likely sufficient to establish a habit of vanpooling.

(Source: Kodama 1991)

Employer Preferences Survey

The employer preferences survey found that employers, unsurprisingly, were primarily concerned with their bottom line. They highlighted cost savings as an important benefit of vanpooling, and cost, liability and staff time for program organization were the greatest employer concerns. When asked what employer incentives they would respond best to, they cited direct financial subsidies, and overwhelmingly preferred the possibility of a third-party-operated vanpool program to one operated in-house. They reported being most willing to provide commuter incentives that were perceived as cost-effective and made use of existing resources and capacities.

These results are not surprising, but a closer look finds some interesting nuances and anomalies. For example, fuel conservation/pollution reduction was the most important benefit of vanpooling according to employers. This may have been caused by a biased sample – those employers concerned with the environment were more likely to respond to a vanpooling survey in the first place. However, this result may also suggest a growing awareness of the importance of fuel conservation in the face of rising gas prices—paralleling what happened in the 1970s, when vanpooling first arose.

Beyond simple financial considerations, there is also evidence of an employer preference for the status quo and against uncertainty or new areas of responsibility. The least popular commuter incentives were not necessarily the most expensive: non-cash incentives, wifi on vans, use of company vehicles for errands, and flexible work hours. Rather, these incentives are simply different from what the employer

typically provides. Meanwhile, almost a quarter of employers said they were “Very Likely” to help cover the costs of vanpooling, even though this money would come straight out of their bottom line.

Similarly, the employer preference for a third-party-operated vanpool and ambivalent reactions to the Federal Commuter Choice program tax incentives suggest more of an unwillingness to take on new and uncertain responsibilities than strictly a drive to minimize expected costs. Given the limits on staff time and the uncertainty in the current economy, this wariness of change is unsurprising. When promoting vanpooling, governments and non-profits should be aware of this and attempt to mitigate it by emphasizing the simplicity and well-established nature of vanpooling as a transportation strategy.

Limitations

This study’s vanpool market model was unable to account for many significant factors affecting vanpool ridership, both because these variables are difficult or impossible to predict, or because the effects of these variables are uncertain. Variables that could affect the success of a vanpool program but which were not incorporated into the market analysis include:

- Overall program cost and its effect on vanpool adoption level;
- Availability of funding for incentives;
- Fuel prices and their effect on commuter behavior;
- Shifting culture and commuter preferences;
- National and state legislation; and
- Economic trends and level of employment.

To incorporate all of these variables would require a degree of further research and model complexity beyond the scope of this study.

Furthermore, only about half of the employers contacted responded to the survey, and the sample size was quite small (24 organizations). An attempt was made to account for the remaining employers, but any such attempt is fraught with difficulty. The non-responding employers may simply not have had the time to fill out the survey, but it is also likely that their lack of response stemmed from a lack of interest in vanpooling. This makes it difficult to know what proportion of non-respondent employers (if any) would be willing to support vanpooling.

The financial feasibility analysis was based on a model from 1981. The model variables were updated to reflect contemporary costs and technologies, but the age of the model nonetheless raises questions about its validity. For example, the cost of organizing a vanpool may be lower today due to the widespread availability of computers and the internet.

The benefit-cost analysis was based in part on estimates of the value of non-monetary benefits that are controversial at best. The value of goods such as reduced climate change and dependence on foreign oil are highly subjective – different beliefs about the value of these goods would lead to significantly different benefit-cost analysis outcomes.

The employer preferences survey attempted to analyze a complex issue through the use of an online survey. Although the survey was designed to provide enough explanation and detail to ensure full understanding and accurate responses from the survey respondents, a more rich and detailed picture could be obtained through interviews or focus groups. Furthermore, asking employers how they will act is not the same as observing them making real economic decisions. A much greater degree of certainty could be achieved through real-world observation of employers' vanpooling activity.

Suggestions for Further Research

Vanpooling is a subject ripe for new research, as most of the important studies in the field were carried out in the 1980s. In terms of employer preferences, it would be beneficial to conduct a survey similar to the one in this study but with a much larger sample size of employers from around the country. To address some of the uncertainties around the reliability of this survey data, such a study could be conducted concurrently with or be followed up by an observational study of how employers actually act with respect to vanpooling.

Finally, the literature would benefit from more research quantifying the effects of various success factors on vanpool adoption rate. Such research would make it much easier to model and predict the success of vanpooling in new areas, and would help interested parties design and implement successful vanpool programs.

Recommendations

Based on the research and analysis conducted in this study, a set of recommendations emerges for how MCEDD or another organization could encourage vanpooling the Gorge or another rural area. Every place is different, but rural areas face many of the same transportation challenges; the recommendations outlined here would likely apply to other rural areas as well.

MCEDD should start by working with the largest clusters of employers that expressed interest in vanpooling to set up a vanpool pilot program. Since most employers expressed an unwillingness to operate such a program in-house, MCEDD should investigate the possibility of contracting with a private company (e.g. VPSI, Inc.)[60], a transit agency, itself, or some other third-party organization to run the vanpool program. This would help to allay employers' primary concerns about vanpooling: cost, liability, and organization time.

MCEDD should also ensure that this vanpool program is successful by leveraging proven success factors shown to increase vanpool adoption, including:

- First-time vanpooler financial incentives during the first 4-6 months to help form commuter habits[61];
- Provision of emergency ride home services to decrease the perceived barriers to vanpooling[62];
- Active promotion of and education about vanpooling by MCEDD and participating employers[63];

[60] From Georgia CRC Case Study
[61] From Ventura VSP Case Study
[62] Kadesh 1989, Zupan 1992

- Resource and training assistance to employers to help them promote vanpooling[64];
- Direct follow-up with potential and active vanpoolers to minimize attrition rates[65];
- A fare structure based on distance and gas prices rather than on the number of people in a van[66]; and
- Promotion of vanpooling and carpooling together as part of a larger effort to promote ridesharing – although vanpooling has a greater impact per rider, carpooling is more flexible and requires less commitment.[67]

All of these strategies have the potential to increase the number of people vanpooling in the Gorge. However, as this study's analysis suggests, widespread adoption is far from certain; MCEDD should not expect vanpooling to be a "silver bullet", solving all of the Gorge's transportation problems. Nonetheless, there is reason for optimism – today's surging gas prices and increasing environmental awareness mirror the backdrop in the 1970s that gave rise to vanpooling in the first place. If MCEDD and Gorge employers can begin to foster vanpooling now, the region will be well situated to take advantage of these economic and cultural shifts as they occur.

[63] Chun 1993
[64] Ungemah 2009
[65] Hekimian 1981, Chambers 1981, Hershey and Hekimian 1983
[66] Ungemah 2005
[67] From Ventura VSP Case Study

Conclusions

This study found that vanpooling is a promising commute strategy for the Mid-Columbia River Gorge, but that it will not solve the Gorge's transportation challenges. The results of the feasibility assessment suggest that there is enthusiasm about vanpooling among many employers. However, the geographic and employment characteristics of the Gorge make it unlikely that vanpooling will amount to more than 1% of commute trips, at least under current conditions. That said, there are signs that the coming years will see greater interest in vanpooling due to higher gas prices, continued economic difficulty, and growing concern with climate change.

Employer support for vanpooling is an important factor in a program's success. The employer preferences survey aimed to understand what makes employers willing to promote vanpooling. This survey painted a picture of employers who, unsurprisingly, are concerned first and foremost with the financial health of their business or organization. Nonetheless, the responses to this survey suggest strategies for encouraging employers to support vanpooling: contracting with a third-party operator, providing emergency ride home services and other incentives, and making it as simple as possible for employers to participate.

In conclusion, this study recommends that MCEDD act to promote vanpooling in the Gorge, but not to the exclusion of other transportation strategies. Rural areas face difficult transportation challenges, and it will take a whole toolbox of strategies to address them. Vanpooling is one of those tools, and this report aims to show how it could become an important and effective part of transportation in a rural area like the Gorge.

References

AAA. (2008). Your Driving Costs: How much are you really paying to drive? In AAA (Ed.). Heathrow, FL: AAA Association Communication.

Bailey, J. M. (1983). Market for Vanpooling in the Baltimore Region.*Transportation Research Record*(914).

Barone, C. S., & Jain, R. (1986). Interest-Free Vanpool Program: Experience in Connecticut. (1082).

Chambers, C. (1981). Role of the Transportation Broker at Children's Hospital of San Francisco: A Case Study. *Transportation Research Record*(823).

Chun, D. (1993). Ridesharing and the Consumer: A Tale of Two Marketing Strategies. *Transportation Research Record*(1390), 60 - 65.

Coastal Regional Commission. (2009). Coastal Georgia Regional Transportation Assessment. Atlanta, GA.

Concas, S., Winters, P., & Wambalaba, F. (2005). Fare Pricing Elasticity, Subsidies, and Demand for Vanpool Services. [10.3141/1924-27].*Transportation Research Record: Journal of the Transportation Research Board, 1924*(-1), 215-223.

Delucchi, M. A. (1998). The Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991: Summary of Theory, Data, Methods, and Results *The Annualized Social Cost of Motor-Vehicle Use in the United States, based on 1990-1991 Data* (Vol. 1). Davis, CA: University of California, Davis.

Delucchi, M. A. (2003). A Lifecycle Emissions Model (LEM): Lifecycle Emissions from Transportation Fuels, Motor Vehicles, Transportation Modes, Electricity Use, Heating and Cooking Fuels, and Materials. Davis, CA: Institute of Transportation Studie.

Energy - Definitions, 420 C.F.R. § 2 (1997).

Eriksson, L., Nordlund, A. M., & Garvill, J. (2010). Expected Car Use Reduction in Response to Structural Travel Demand Management Measures.*Transportation Research Part F, 13*.

Evans IV, J. E., & Pratt, R. H. (2005). Chapter 5 - Vanpools and Buspools *TCRP Report 95 - Traveler Response to Transportation System Changes*. Washington, DC: Transportation Research Board.

Evans, J. R., Jackson, W. K., Westerbeck, G. J., & Thomas, M. P. (1984). A methodology for the assessment of ridesharing program benefits and impacts. *Socio-Economic Planning Sciences, 18*(4), 241-246.

Friedman, S. M. (2010). The Inflation Calculator Retrieved May 18, 2011, fromhttp://www.westegg.com/inflation/

Hekimian, A. J., & Hershey, W. R. (1981). Personalized Approach for Ridesharing Projects: Experience of Share-A-Ride in Silver Spring, Maryland.*Transportation Research Record*(823).

Herk, L. F., Jr. (1981). Business Plan for a Commercial, Third-Party Vanpool Operation. *Transportation Research Record*(823).

Hershey, W. R., & Hekimian, A. J. (1983). Measuring the Effectiveness of Personalized Ridesharing Assistance. *Transportation Research Record*(914).

Hoey, A. (2010). [Personal E-mail: "Re: Question"].

iTrans Consulting. (2007). Vanpool Program Feasibility Study Final Report. Toronto, ON: Smart Commute Association - Greater Toronto Area and Hamilton.

Kadesh, E., & Elder, L. (1989). Emergency ride home: An Insurance Program for HOV Users. *Transportation Research Record*(1212).

Kay, M., & Lyons, W. (2010). Ridesharing Options Analysis and Practitioners' Toolkit. Cambridge, MA: Volpe National Transportation Systems Center.

Kodama, M. R., Pankratz, J. J., & Moilov, M. (1991). Ventura Freeway Vanpool Support Program. *Transportation Research Record*(1321), 21-25.

Kostyniuk, L. P. (1981). Demand Analysis for Ridesharing: State-of-the-Art Review. *Transportation Research Record*(876).

Maxwell, D. A., & McIntyre, J. P. (1979). Economics of Vanpooling.*Transportation Research Record*(724).

MCEDD. (2010). 2010-11 Comprehensive Economic Development Strategy.

Mielke, J. (2006). Vanpooling in North Dakota: Feasibility and Operating Scenarios. Fargo, ND: Small Urban & Rural Transit Center - North Dakota State University.

Parry, I. W. H., Walls, M., & Harrington, W. (2007). Automobile Externalities and Policies. *Journal of Economic Literature, 45*(June).

Polena, C., & Glazer, L. J. (1991). Examination Of 11 Emergency ride home Programs Nationwide. *Transportation Research Record*.

U.S. Bureau of Transportation Statistics. (2001). National Household Travel Survey Daily Travel Quick Facts, from http://www.bts.gov/programs/national_household_travel_survey/daily_travel.html

U.S. Bureau of Transportation Statistics. (2002). National Household Travel Survey. from Bureau of Transportation Statistics http://www.bts.gov/programs/national_household_travel_survey/

U.S. Bureau of Transportation Statistics. (2007). Table 4-3: Passenger-Miles. from Research and Innovative Technology Administration http://www.bts.gov/publications/pocket_guide_to_transportation/2008/html/table_04_03.html

U.S. Bureau of Transportation Statistics. (2009). Table 1-1: System Mileage within the United States. from Research and Innovative Technology Administration http://www.bts.gov/publications/national_transportation_statistics/html/table_01_01.html

U.S. Bureau of Transportation Statistics. (2010). National Transportation Statistics. http://www.bts.gov/publications/national_transportation_statistics/#chapter_1

U.S. Census Bureau (2009). American Factfinder Survey. from U.S. Census Bureau

U.S. Department of Energy (2011). U.S. Light-Duty Fuel Consumption and Vehicle Miles Traveled (VMT) Retrieved May 6, 2011, from http://www.afdc.energy.gov/afdc/data/docs/ldv_consumption_vmt.xls

U.S. Energy Information Administration. (2009). Emissions of Greenhouse Gases Report Retrieved April 20, 2011, from http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html#transportation

U.S. Environmental Protection Agency. (2010). Light Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (2010). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2008. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (2011). Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel Retrieved April 30, 2011, from http://www.epa.gov/oms/climate/420f05001.htm

Strochlic, R. (2009). An Assessment of the Demand for a Vanpool Program Serving Agricultural Workers in Napa Valley. Davis, CA: California Institute for Rural Studies.

Torluemke, D. A., & Roseman, D. (1989). Vanpools: Pricing and Market Penetration. *Transportation Research Record*(1212), 83-87.

U.S. Census Bureau. (2009). American Factfinder: New York City, New York Population Estimates. from U.S. Census Bureau http://factfinder.census.gov/servlet/DTTable?_bm=y&-context=dt&-ds_name=PEP_2009_EST&-mt_name=PEP_2009_EST_G2009_T001&-mt_name=PEP_2009_EST_G2009_T002&-mt_name=PEP_2009_EST_G2009_T003_2009&-mt_name=PEP_2009_EST_G2009_T004_2009&-mt_name=PEP_2009_EST_G2009_T005_2009&-mt_name=PEP_2009_EST_G2009_T006_2009&-mt_name=PEP_2009_EST_G2009_T007_2009&-mt_name=PEP_2009_EST_G2009_T008_2009&-CONTEXT=dt&-tree_id=809&-all_geo_types=N&-geo_id=16000US3651000&-search_results=16000US3651000&-format=&-_lang=en

Ungemah, D., & Dusza, C. (2009). Transportation Demand Management Benchmark. *Transportation Research Record, 2118*.

Ungemah, D., Rivers, M., & Anderson, S. (2005). The World Can Be Flat: Case Study of Flat-Rate Pricing for Vanpool Operations. *Transportation Research Record, 1956*.

Valley Vanpool. (2009). Vanpool Routes Retrieved May 22, 2011, from http://www.valleyvanpool.info/vanpool_routes.htm

VPSI, Inc. (2011). Our Roots (Corporate History) Retrieved April 23, 2011, from http://www.vpsi.org/mysitecaddy/site3/aboutroots.htm

Wambalaba, F., Concas, S., & Chavarria, M. (2004). Price Elasticity of Rideshare: Commuter Fringe Benefits of Vanpools. Tampa, FL: National Center for Transportation Research.

Wegmann, F. J. (1989). Cost-Effectiveness of Private Employer Ridesharing Programs: An Employer's Assessment. *Transportation Research Record*(1212).

Weisbrod, G. E., & Eder, E. S. (1981). Multiemployer Ridesharing Brokerage: Findings from Minneapolis Commuter Services Demonstration.*Transportation Research Record*(823).

Weitzman, M. L. (2009). On Modeling and Interpreting the Economics of Catastrophic Climate Change. *The Review of Economics and Statistics, 91*(1).

Wiersig, D. W. (1981). Planning Guidelines for Selecting Ridesharing Strategies.*Transportation Research Record*(876).

Wiersig, D. W. (1985). Estimating Ridesharing Levels for Reductions in VMT.*Transportation Research Record*(1018).

Zupan, J. M. (1992). Transportation Demand Management: A Cautious Look.*Transportation Research Record*(1346), 1-9.

Appendix A: Employer Survey Text

Columbia Gorge Vanpool Survey

1. Welcome

Hello –
We invite you to participate in a research study about the potential for vanpool commuting in the Columbia River Gorge region. You are eligible to be in this study because you are an employer in the Gorge. This survey is being conducted by a partnership of the Mid-Columbia Economic Development District (MCEDD) and the University of Oregon.

What is a Vanpool?
A vanpool is a ridesharing arrangement in which five or more individuals ride together to work in a minivan, full-sized van, or small bus. Vanpools differ from car pools not only in that they carry more people, but also in that they tend to be more formally organized, often with a more consistent schedule, route, and driver. Vanpool programs are most commonly operated by third-party organizations such as private firms or governments, but they may also be operated by individual employees or by the companies they serve.

Why Vanpooling?
Vanpooling is a commuting option with many potential benefits for employers, employees, and the community, including:

- Reduced employee commuting costs;
- Improved employee morale and on-time performance;
- Reduced traffic and parking congestion;
- Reduced pollution and fuel use; and
- Tax benefits for employers and employees.

For these reasons, a number of organizations, including the U.S. government, are doing what they can to promote vanpooling. The Federal Commuter Choice program allows employers and employees to avoid paying taxes on vanpool expenses up to $265/month per employee. This money can either come out of the employee's pay check before taxes and be used to cover vanpool expenses, or it can be paid to employees as a tax-free benefit in addition to their normal salary.

Purpose of Survey
The purpose of this survey is to assess your interest in vanpooling as well as the factors that may make vanpooling feasible or unfeasible for your workplace. If you express interest in vanpooling, your name and contact information may be passed on to staff at MCEDD to aid in their attempts to coordinate a vanpool program. For this reason, I cannot guarantee confidentiality.

This survey is completely voluntary. You can choose to be in the study or not, and you can stop at any time or choose not to answer any questions you'd like. The survey should take approximately 15 minutes to complete. By completing this survey you are agreeing to participate in the study; if you would not like to participate, please do not complete the survey.

If you have any questions regarding this research, contact Nicolas Garcia at nog@uoregon.edu or (541) 346-3651. If you have any questions regarding your rights as a research subject, please contact the Office for Protection of Human Subjects at the University of Oregon, (541) 346-2510. Thank you for your participation.

Would you like to continue with this survey?

- ○ Yes, I agree to participate.
- ○ No, I do not agree to participate.

Columbia Gorge Vanpool Survey

2. Employee Information

Note: Vanpooling works best where there is a high concentration of workers in one location. If you have multiple locations in the Gorge, please answer the following questions based on your location that has the most employees.

How many people does your business or organization employ full-time in the Mid-Columbia River Gorge? (The Mid-Columbia River Gorge is defined as Hood River, Wasco, and Sherman Counties in Oregon and Skamania and Klickitat Counties in Washington.)

Number of full-time employees

Please indicate approximately how many of your employees commute at least 15 miles to work each way (for a total of 30 or more miles per day). If you are unsure about exact numbers, please make your best guess.

Number of employees commuting 15+ mi.

Columbia Gorge Vanpool Survey

3. Experience with Vanpooling

What is your company or organization's current and past involvement in vanpooling? Please check all that apply to your organization, currently and at any point in the past.

	Currently	At some point in the past	I dont know
We own and operate a vanpool program for use by our employees.	☐	☐	☐
One or more of our employees privately owns and operates a vanpool service.	☐	☐	☐
One or more of our employees participates in a vanpool program operated by a third party.	☐	☐	☐
We promote or encourage vanpooling by our employees through the use of educational, publicity, incentive programs, etc.	☐	☐	☐

If you used to be involved in some sort of vanpool program but are not anymore, please briefly explain why the program ended.

4. Attitudes towards Vanpooling - The next few questions are aimed at assessing your attitude toward vanpooling generally, and more specifically at assessing how different types of vanpool programs might be more or less useful and feasible for your organization.

Columbia Gorge Vanpool Survey

5. Benefits of Vanpooling

Below is a list of the potential benefits of vanpooling. Please indicate how important or unimportant each benefit is to your organization in deciding whether or not to participate in a vanpool program.

	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant	I Don't Know
Vanpooling reduces employee commute costs.	○	○	○	○	○	○
Up to $230/month of vanpool expenses may be paid for with pre-tax income through the Federal Commuter Choice program.	○	○	○	○	○	○
Riding to work in a van is less stressful for employees than driving.	○	○	○	○	○	○
Having a vanpool option makes your organization more attractive to potential employees.	○	○	○	○	○	○
Having a vanpool option improves your organization's retention of current employees.	○	○	○	○	○	○
Vanpool riders have better on-time performance.	○	○	○	○	○	○
Vanpools conserve fuel and create less pollution.	○	○	○	○	○	○
Vanpools reduce traffic congestion.	○	○	○	○	○	○
Vanpools reduce the need for employee parking.	○	○	○	○	○	○
Vanpool riders can do work during commute time.	○	○	○	○	○	○

Other (please specify)

Columbia Gorge Vanpool Survey

6. Concerns about Vanpooling

Below is a list of possible concerns about vanpooling. Please indicate how important or unimportant each concern is to your organization in deciding whether or not to participate in a vanpool program.

	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant	I Don't Know
There is a high up-front capital cost of purchasing vans (for an employer-run program).	○	○	○	○	○	○
There are high operating costs (for an employer-run program).	○	○	○	○	○	○
Employers might be liable in the case of an accident involving a vanpool van.	○	○	○	○	○	○
Valuable administrative time must be spent on organizing or promoting a vanpool program.	○	○	○	○	○	○
Vanpooling would increase employee travel times.	○	○	○	○	○	○
Vanpooling is less convenient for employees than travel via personal car.	○	○	○	○	○	○
Vanpools allow employees less schedule flexibility.	○	○	○	○	○	○

Other (please specify)

Columbia Gorge Vanpool Survey

7. Vanpool Program Types

Below is a list of different ways in which a vanpool program might be organized. Please indicate how likely or unlikely your organization would be to participate in a vanpool program organized in each of the following ways.

	Very Likely	Somewhat Likely	Neither Likely nor Unlikely	Somewhat Unlikely	Very Unlikely	I Don't Know
The vanpool program is owned and operated by a third party company or organization.	○	○	○	○	○	○
The vanpool program is owned and operated by your company or organization, which absorbs all of the costs and revenues.	○	○	○	○	○	○
The vanpool program is owned and operated by a private employee of your organization.	○	○	○	○	○	○
The cost of vanpooling is paid for through the Federal Commuter Choice program in the form of a tax-free transit benefit paid by your organization to your employees in addition to their standard wages.	○	○	○	○	○	○
The cost of vanpooling is paid for through the Federal Commuter Choice program in the form of a pre-tax transit benefit taken out of employees' salaries before taxes are applied and used to cover vanpool costs.	○	○	○	○	○	○

Other (please specify)

Columbia Gorge Vanpool Survey

8. Vanpool Incentives

Below is a list of some ways in which your organization might be encouraged to participate in a vanpool program. Please indicate how much each incentive would affect your organization's likelihood of participating in a vanpool program.

	Much More Likely to Participate	Somewhat More Likely to Participate	No More or Less Likely to Participate	Somewhat Less Likely to Participate	Much Less Likely to Participate	I Don't Know
Direct subsidies are provided to help cover the cost of new vanpools.	○	○	○	○	○	○
Advertising space on the vans is made available to your organization, for free or at minimal cost.	○	○	○	○	○	○
Resources, training and/or informational materials are provided free of charge to help your staff organize or promote a vanpool program.	○	○	○	○	○	○
Preferential public parking (on-street or in lots) is provided for vanpool vans.	○	○	○	○	○	○
Preferential toll lanes at bridges allow vanpool vans to cross the river more quickly.	○	○	○	○	○	○
Emergency Ride Home (ERH) services are available for employees in case they miss their scheduled vanpool ride home, or who experience a household emergency or family illness.	○	○	○	○	○	○

Other (please specify)

Columbia Gorge Vanpool Survey

9. Vanpool Program Components

Below is a list of ways in which an employer might promote or encourage vanpooling by its employees. Please indicate how likely you would be to provide each of these services for your employees, if you were participating in a vanpool program.

	Very Likely to Provide Service	Somewhat Likely to Provide Service	Neither Likely nor Unlikely to Provide Service	Somewhat Unlikely to Provide Service	Very Unlikely to Provide Service	I Don't Know
Provide convenient parking spots for vanpool vans.	○	○	○	○	○	○
Engage in a vanpool recognition/support effort, advertising vanpool services to employees and providing them with informational materials.	○	○	○	○	○	○
Help employees cover part of the cost of vanpooling to encourage participation (can be tax-free under the Federal Commuter Choice Program).	○	○	○	○	○	○
Provide non-cash incentives to employees to participate in vanpooling (gift cards, raffles, etc.)	○	○	○	○	○	○
Host a ride-matching service to make it easier for employees to find a convenient vanpool route.	○	○	○	○	○	○
Allow vanpooling employees to use company vehicles to run errands during their lunch hour.	○	○	○	○	○	○
Sponsor wifi on vans so that employees can work during their commute.	○	○	○	○	○	○
Allow flexible work hours so that employees can find commute times that work for everyone.	○	○	○	○	○	○

Other (please specify)

Columbia Gorge Vanpool Survey

10. Vanpool Promotion

Would your organization be interested in promoting vanpooling to your employees? (Checking yes here will not commit you to participating in any sort of vanpool program—it will just let us know that you're interested in getting more information.)

- ○ Yes.
- ○ No.
- ○ I don't know.

Columbia Gorge Vanpool Survey

11. Vanpool Promotion - Reasons for Not Promoting

If you answered "No" or "I don't know" to the previous question, please help us understand why by briefly explaining your answer.

Columbia Gorge Vanpool Survey

12. Information about your Business or Organization

Please record your name, contact information, and the name of the company or organization you represent. If your company or organization has multiple locations in the area, please record the address of the location with the most employees.

Name:	
Company:	
Address:	
Address 2:	
City/Town:	
State:	
ZIP:	
Country:	
Email Address:	
Phone Number:	

Appendix B: Financial Feasibility Analysis Calculations

Lifetime Profit & Loss Statement for a 15-Passenger Van (Conservative Scenario)

Herk (1981)

Constants	
# Work Days	253
"Full" Van	14.5
General Inflation Multiplier	2.37
Price Factor	0.9

Vanpool Characteristics	
Payload (driver excl.)	7.5
Line Haul Miles (one way)	30
Pickup/Dropoff Miles (one way)	4.5
Total Daily Pool Miles	**69**
Annual Pool Miles	17,457
Annual Personal Miles	2,400
Gross Annual Miles	**19,857**

Van Value	
Purchase Price	$ 33,095
Sales Tax at 0% (Oregon	$ -
Total Purchase Cost	$ 33,095
Immediate Depreciation	$ 712
Net Value (new)	$ 32,383
Value after 7 yrs. (9.5%)	$ 3,076
Value for Depreciation	$ 29,307
Annual Depreciation	$ 4,187

		Year 1	Year 2	Year 3	Year 4	Year 5
Odometer @ Year End		19,857	39,714	59,571	79,428	99,285
Book Value @ Mid Year		$ 30,290	$ 26,103	$ 21,917	$ 17,730	$ 13,543
Direct Van Costs						
Van Depreciation		$ 4,187	$ 4,187	$ 4,187	$ 4,187	$ 4,187
Liability Insurance		$ 597	$ 597	$ 597	$ 597	$ 597
License Tabs		$ 102	$ 92	$ 82	$ 72	$ 62
Operating Cost Less Tires & Gas						
at Cost Per Mile:	$ 0.199	$ 3,953	$ 3,953	$ 3,953	$ 3,953	$ 3,953
Tires						
at Cost for Tires:	$ 600.00					
at Cost per Mile:	$ 0.036	$ 1,306	$ 706	$ 706	$ 706	$ 706
Gasoline @ Cost per Gal:	$ 4.00					
@ MPG	13.00	$ 6,110	$ 6,110	$ 6,110	$ 6,110	$ 6,110
Total Direct Van Cost		***$ 16,255***	***$ 15,645***	***$ 15,635***	***$ 15,625***	***$ 15,615***

VANPOOL PROFIT AND LOSS STATEMENT, CONSERVATIVE SCENARIO (CONT.)

Payment for Personal Miles						
at Cost per Mile	$ 0.50	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
Net Direct Van Cost		***$ 15,055***	***$ 14,445***	***$ 14,435***	***$ 14,425***	***$ 14,415***
Marketing/Sales Cost		$ 593	$ 593	$ 593	$ 593	$ 593
Operational Administration						
at Cost per Month	$ 83	$ 995	$ 995	$ 995	$ 995	$ 995
General Administration						
as % of Passenger Revenue	1.50%	$ 101	$ 101	$ 101	$ 101	$ 101
Total Operating Cost		***$ 16,744***	***$ 16,134***	***$ 16,124***	***$ 16,114***	***$ 16,104***
Employer Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Government Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Total Subsidies		***$ -***	***$ -***	***$ -***	***$ -***	***$ -***
Net Operating Expenses		***$ 16,744***	***$ 16,134***	***$ 16,124***	***$ 16,114***	***$ 16,104***
Revenue						
at Amt. per Passenger-Mo.	$ 75.00	$ 6,750	$ 6,750	$ 6,750	$ 6,750	$ 6,750
at Amt. per Passenger-Mo.	$ 100.00	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000
at Amt. per Passenger-Mo.	$ 125.00	$ 11,250	$ 11,250	$ 11,250	$ 11,250	$ 11,250
Year 1 Breakeven Fare/Mo.	**$ 186.04**	**$ 16,744**	**$ 16,744**	**$ 16,744**	**$ 16,744**	**$ 16,744**
Annual Profit						
at Amt. per Passenger-Mo.	$ 75	$ (9,994)	$ (9,384)	$ (9,374)	$ (9,364)	$ (9,354)
at Amt. per Passenger-Mo.	$ 100	$ (7,744)	$ (7,134)	$ (7,124)	$ (7,114)	$ (7,104)
at Amt. per Passenger-Mo.	$ 125	$ (5,494)	$ (4,884)	$ (4,874)	$ (4,864)	$ (4,854)
at Amt. per Passenger-Mo.	**$ 186**	**$ -**	**$ 610**	**$ 620**	**$ 630**	**$ 640**
Profit as % of Revenue						
at Amt. per Passenger-Mo.	$ 75	-148.1%	-139.0%	-138.9%	-138.7%	-138.6%
at Amt. per Passenger-Mo.	$ 100	-86.0%	-79.3%	-79.2%	-79.0%	-78.9%
at Amt. per Passenger-Mo.	$ 125	-48.8%	-43.4%	-43.3%	-43.2%	-43.1%
at Amt. per Passenger-Mo.	**$ 186**	**0.0%**	**3.6%**	**3.7%**	**3.8%**	**3.8%**

Lifetime Profit & Loss Statement for a 15-Passenger Van (Most Likely Scenario)

Herk (1981)

Constants	
# Work Days	253
"Full" Van	14.5
General Inflation Multiplier	2.37
Price Factor	0.9

Vanpool Characteristics	
Payload (driver excl.)	9
Line Haul Miles (one way)	25
Pickup/Dropoff Miles (one way)	1.775
Total Daily Pool Miles	**53.55**
Annual Pool Miles	13,548
Annual Personal Miles	2,400
Gross Annual Miles	**15,948**

Van Value	
Purchase Price	$ 30,000
Sales Tax at 0% (Oregon	$ -
Total Purchase Cost	$ 30,000
Immediate Depreciation	$ 645
Net Value (new)	$ 29,355
Value after 7 yrs. (9.5%)	$ 2,789
Value for Depreciation	$ 26,566
Annual Depreciation	$ 3,795

		Year 1	Year 2	Year 3	Year 4	Year 5
Odometer @ Year End		15,948	31,896	47,844	63,793	79,741
Book Value @ Mid Year		$ 27,457	$ 23,662	$ 19,867	$ 16,072	$ 12,277
Direct Van Costs						
Van Depreciation		$ 3,795	$ 3,795	$ 3,795	$ 3,795	$ 3,795
Liability Insurance		$ 597	$ 597	$ 597	$ 597	$ 597
License Tabs		$ 102	$ 92	$ 82	$ 72	$ 62
Operating Cost Less Tires & Gas						
at Cost Per Mile:	$ 0.199	$ 3,175	$ 3,175	$ 3,175	$ 3,175	$ 3,175
Tires						
at Cost for Tires:	$ 600.00					
at Cost per Mile:	$ 0.036	$ 1,167	$ 567	$ 567	$ 567	$ 567
Gasoline @ Cost per Gal:	$ 4.00					
@ MPG	16.00	$ 3,987	$ 3,987	$ 3,987	$ 3,987	$ 3,987
Total Direct Van Cost		***$ 12,823***	***$ 12,213***	***$ 12,203***	***$ 12,193***	***$ 12,183***

VANPOOL PROFIT AND LOSS STATEMENT, MOST LIKELY SCENARIO (CONT.)

Payment for Personal Miles						
at Cost per Mile	$ 0.50	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
Net Direct Van Cost		***$ 11,623***	***$ 11,013***	***$ 11,003***	***$ 10,993***	***$ 10,983***
Marketing/Sales Cost		$ 593	$ 593	$ 593	$ 593	$ 593
Operational Administration						
at Cost per Month	$ 83	$ 995	$ 995	$ 995	$ 995	$ 995
General Administration						
as % of Passenger Revenue	1.50%	$ 122	$ 122	$ 122	$ 122	$ 122
Total Operating Cost		***$ 13,333***	***$ 12,723***	***$ 12,713***	***$ 12,703***	***$ 12,693***
Employer Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Government Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Total Subsidies		***$ -***	***$ -***	***$ -***	***$ -***	***$ -***
Net Operating Expenses		***$ 13,333***	***$ 12,723***	***$ 12,713***	***$ 12,703***	***$ 12,693***
Revenue						
at Amt. per Passenger-Mo.	$ 75.00	$ 8,100	$ 8,100	$ 8,100	$ 8,100	$ 8,100
at Amt. per Passenger-Mo.	$ 100.00	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
at Amt. per Passenger-Mo.	$ 125.00	$ 13,500	$ 13,500	$ 13,500	$ 13,500	$ 13,500
Year 1 Breakeven Fare/Mo.	**$ 123.45**	**$ 13,333**	**$ 13,333**	**$ 13,333**	**$ 13,333**	**$ 13,333**
Annual Profit						
at Amt. per Passenger-Mo.	$ 75	$ (5,233)	$ (4,623)	$ (4,613)	$ (4,603)	$ (4,593)
at Amt. per Passenger-Mo.	$ 100	$ (2,533)	$ (1,923)	$ (1,913)	$ (1,903)	$ (1,893)
at Amt. per Passenger-Mo.	$ 125	$ 167	$ 777	$ 787	$ 797	$ 807
at Amt. per Passenger-Mo.	**$ 123**	**$ -**	**$ 610**	**$ 620**	**$ 630**	**$ 640**
Profit as % of Revenue						
at Amt. per Passenger-Mo.	$ 75	-64.6%	-57.1%	-56.9%	-56.8%	-56.7%
at Amt. per Passenger-Mo.	$ 100	-23.5%	-17.8%	-17.7%	-17.6%	-17.5%
at Amt. per Passenger-Mo.	$ 125	1.2%	5.8%	5.8%	5.9%	6.0%
at Amt. per Passenger-Mo.	**$ 123**	**0.0%**	**4.6%**	**4.7%**	**4.7%**	**4.8%**

Lifetime Profit & Loss Statement for a 15-Passenger Van (Optimistic Scenario)

Herk (1981)

Constants	
# Work Days	253
"Full" Van	14.5
General Inflation Multiplier	2.37
Price Factor	0.9

Vanpool Characteristics	
Payload (driver excl.)	12.5
Line Haul Miles (one way)	20
Pickup/Dropoff Miles (one way)	1.42
Total Daily Pool Miles	**42.84**
Annual Pool Miles	10,839
Annual Personal Miles	2,400
Gross Annual Miles	**13,239**

Van Value	
Purchase Price	$ 24,985
Sales Tax at 0% (Oregon)	$ -
Total Purchase Cost	$ 24,985
Immediate Depreciation (2.15%)	$ 537
Net Value (new)	$ 24,448
Value after 7 yrs. (9.5%)	$ 2,323
Value for Depreciation	$ 22,125
Annual Depreciation	$ 3,161

		Year 1	Year 2	Year 3	Year 4	Year 5
Odometer @ Year End		13,239	26,477	39,716	52,954	66,193
Book Value @ Mid Year		$ 22,867	$ 19,707	$ 16,546	$ 13,385	$ 10,224
Direct Van Costs						
Van Depreciation		$ 3,161	$ 3,161	$ 3,161	$ 3,161	$ 3,161
Liability Insurance		$ 597	$ 597	$ 597	$ 597	$ 597
License Tabs		$ 102	$ 92	$ 82	$ 72	$ 62
Operating Cost Less Tires & Gas						
at Cost Per Mile:	$ 0.199	$ 2,636	$ 2,636	$ 2,636	$ 2,636	$ 2,636
Tires						
at Cost for Tires:	$ 600.00					
at Cost per Mile:	$ 0.036	$ 1,071	$ 471	$ 471	$ 471	$ 471
Gasoline @ Cost per Gal:	$ 4.00					
@ MPG	20.00	$ 2,648	$ 2,648	$ 2,648	$ 2,648	$ 2,648
Total Direct Van Cost		***$ 10,214***	***$ 9,604***	***$ 9,594***	***$ 9,584***	***$ 9,574***

VANPOOL PROFIT AND LOSS STATEMENT, OPTIMISTIC SCENARIO (CONT.)

Payment for Personal Miles						
at Cost per Mile	$ 0.50	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
Net Direct Van Cost		***$ 9,014***	***$ 8,404***	***$ 8,394***	***$ 8,384***	***$ 8,374***
Marketing/Sales Cost		$ 593	$ 593	$ 593	$ 593	$ 593
Operational Administration						
at Cost per Month	$ 83	$ 995	$ 995	$ 995	$ 995	$ 995
General Administration						
as % of Passenger Revenue	1.50%	$ 169	$ 169	$ 169	$ 169	$ 169
Total Operating Cost		***$ 10,770***	***$ 10,160***	***$ 10,150***	***$ 10,140***	***$ 10,130***
Employer Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Government Subsidy						
at Cost per Passenger Trip	$ -	$ -	$ -	$ -	$ -	$ -
Total Subsidies		***$ -***	***$ -***	***$ -***	***$ -***	***$ -***
Net Operating Expenses		***$ 10,770***	***$ 10,160***	***$ 10,150***	***$ 10,140***	***$ 10,130***
Revenue						
at Amt. per Passenger-Mo.	$ 75.00	$ 11,250	$ 11,250	$ 11,250	$ 11,250	$ 11,250
at Amt. per Passenger-Mo.	$ 100.00	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
at Amt. per Passenger-Mo.	$ 125.00	$ 18,750	$ 18,750	$ 18,750	$ 18,750	$ 18,750
Year 1 Breakeven Fare/Mo.	**$ 71.80**	**$ 10,770**	**$ 10,770**	**$ 10,770**	**$ 10,770**	**$ 10,770**
Annual Profit						
at Amt. per Passenger-Mo.	$ 75	$ 480	$ 1,090	$ 1,100	$ 1,110	$ 1,120
at Amt. per Passenger-Mo.	$ 100	$ 4,230	$ 4,840	$ 4,850	$ 4,860	$ 4,870
at Amt. per Passenger-Mo.	$ 125	$ 7,980	$ 8,590	$ 8,600	$ 8,610	$ 8,620
at Amt. per Passenger-Mo.	**$ 72**	**$ -**	**$ 610**	**$ 620**	**$ 630**	**$ 640**
Profit as % of Revenue						
at Amt. per Passenger-Mo.	$ 75	4.3%	9.7%	9.8%	9.9%	10.0%
at Amt. per Passenger-Mo.	$ 100	28.2%	32.3%	32.3%	32.4%	32.5%
at Amt. per Passenger-Mo.	$ 125	42.6%	45.8%	45.9%	45.9%	46.0%
at Amt. per Passenger-Mo.	**$ 72**	**0.0%**	**5.7%**	**5.8%**	**5.8%**	**5.9%**

Appendix C: Benefit-Cost Analysis Calculations

VMT AND FUEL USE REDUCTION CALCULATIONS

Conservative	
VMT Calculations	
Avg. 1-way Trip Length in Miles	20
Trip Circuity Factor	0.15
Avg. Trip Circuity	3
Previous Avg. Vehicle Occupancy	1.2
Avg. Vanpool Occupancy	8
Daily SOV VMT Reduction per NVP	33.33333
Daily Van VMT Increase per NVP	5.3
Daily Vehicle Miles Travelled Savings per New Vanpooler	28.0
# New Vanpoolers	21
Total Daily VMT Savings	588.7
# Work Days per Year	253
Total Annual VMT Savings	**148,941**
Fuel Use Calculations	
Avg. Private Vehicle Fuel Efficiency in mpg	22.5
Avg. Van Fuel Efficiency in mpg	13
Prior Fuel Use per person per day	1.48
New Fuel Use per person per day	0.41
Total Annual Prior Fuel Use	7,871
Total Annual New Fuel Use	2,166
Fuel Use Savings in gallons	**5,705**
Price of Fuel ($/gal)	$ 3.00
Cost Savings from Fuel Conservation	$17,115

Most Likely	
VMT Calculations	
Avg. 1-way Trip Length in Miles	25
Trip Circuity Factor	0.071
Avg. Trip Circuity	1.775
Previous Avg. Vehicle Occupancy	1.2
Avg. Vanpool Occupancy	10
Daily SOV VMT Reduction per NVP	41.66666667
Daily Van VMT Increase per NVP	5.142
Daily Vehicle Miles Travelled Savings per New Vanpooler	36.5
# New Vanpoolers	69
Total Daily VMT Savings	2520.2
# Work Days per Year	253
Total Annual VMT Savings	**637,611**
Fuel Use Calculations	
Avg. Private Vehicle Fuel Efficiency in mpg	22.5
Avg. Van Fuel Efficiency in mpg	16
Prior Fuel Use per person per day	1.85
New Fuel Use per person per day	0.32
Total Annual Prior Fuel Use	32,328
Total Annual New Fuel Use	5,610
Fuel Use Savings in gallons	**26,718**
Price of Fuel ($/gal)	$ 4.00
Cost Savings from Fuel Conservation	$ 106,870

VMT AND FUEL USE REDUCTION CALCULATIONS (CONT.)

Optimistic

VMT Calculations

Avg. 1-way Trip Length in Miles	25
Trip Circuity Factor	0.071
Avg. Trip Circuity	1.775
Previous Avg. Vehicle Occupancy	1.2
Avg. Vanpool Occupancy	10
Daily SOV VMT Reduction per NVP	41.66666667
Daily Van VMT Increase per NVP	5.142
Daily Vehicle Miles Travelled Savings per New Vanpooler	36.5
# New Vanpoolers	135
Total Daily VMT Savings	4930.8
# Work Days per Year	253
Total Annual VMT Savings	**1,247,500**

Fuel Use Calculations

Avg. Private Vehicle Fuel Efficiency in mpg	22.5
Avg. Van Fuel Efficiency in mpg	16
Prior Fuel Use per person per day	1.85
New Fuel Use per person per day	0.32
Total Annual Prior Fuel Use	63,250
Total Annual New Fuel Use	10,977
Fuel Use Savings in gallons	**52,273**
Price of Fuel ($/gal)	$ 4.00
Cost Savings from Fuel Conservation	$ 209,094

Very Optimistic

VMT Calculations

Avg. 1-way Trip Length in Miles	30
Trip Circuity Factor	0.071
Avg. Trip Circuity	2.13
Previous Avg. Vehicle Occupancy	1.2
Avg. Vanpool Occupancy	13.5
Daily SOV VMT Reduction per NVP	50
Daily Van VMT Increase per NVP	4.586444444
Daily Vehicle Miles Travelled Savings per New Vanpooler	45.4
# New Vanpoolers	376
Total Daily VMT Savings	17075.5
# Work Days per Year	253
Total Annual VMT Savings	**4,320,101**

Fuel Use Calculations

Avg. Private Vehicle Fuel Efficiency in mpg	22.5
Avg. Van Fuel Efficiency in mpg	20
Prior Fuel Use per person per day	2.22
New Fuel Use per person per day	0.23
Total Annual Prior Fuel Use	211,396
Total Annual New Fuel Use	21,815
Fuel Use Savings in gallons	**189,581**
Price of Fuel ($/gal)	$ 5.00
Cost Savings from Fuel Conservation	$ 947,903

EMISSIONS CALCULATIONS

Conservative

Emissions Calculations

Total Gasoline Use Reduction (gal)	5,705		
CO2 per gallon of gas (lbs/gal)	19.4		
VMT Reduction from SOVs	177,100		
VMT Increase from Vanpools	28,159		
		g -> lbs	
CO Emissions Factor 2000 (g/mi)	10.6	0.02337	
HC Exhaust Emissions Factor 2000 (g/mi)	0.8	0.00176	
NOx Emissions Factor 2000 (g/mi)	1	0.00220	
CO Emissions Factor 2010 (g/mi)	4.4	0.00970	
HC Exhaust Emissions Factor 2010 (g/mi)	0.4	0.00088	
NOx Emissions Factor 2010 (g/mi)	0.6	0.00132	
CO Emissions Factor 2005avg (g/mi)	7.5	0.01653	
HC Exhaust Emissions Factor 2005avg (g/mi)	0.6	0.00132	
NOx Emissions Factor 2005avg (g/mi)	0.8	0.00176	
Carbon Emissions Reduction (lbs)	**110,678**		
CO Emissions Reduction (lbs)	**2,655.14**		
HC Exhaust Emissions Reduction (lbs)	**209.43**		
NOx Emissions Reduction (lbs)	**275.10**		
MCRG Population	80,708		
Total MCRG VMT	726,256,227		
Total MCRG Fuel Use	35,185,656		
Total MCRG Carbon Emissions (lbs)	682,601,735		
Total MCRG CO Emissions (lbs)	12,008,407		
Total MCRG HC Exhaust Emissions (lbs)	960,673		
Total MCRG NOx Emissions (lbs)	1,280,897		
% Reduction in Carbon Emissions	**0.016%**		
% Reduction in CO Emissions	**0.022%**		
% Reduction in HC Exhaust Emissions	**0.022%**		
% Reduction in Nox Emissions	**0.021%**		

Most Likely

Emissions Calculations

Total Gasoline Use Reduction (gal)	26,718		
CO2 per gallon of gas (lbs/gal)	19.4		
VMT Reduction from SOVs	727,375		
VMT Increase from Vanpools	89,764		
		g -> lbs	
CO Emissions Factor 2000 (g/mi)	10.6	0.02337	
HC Exhaust Emissions Factor 2000 (g/mi)	0.8	0.00176	
NOx Emissions Factor 2000 (g/mi)	1	0.00220	
CO Emissions Factor 2010 (g/mi)	4.4	0.00970	
HC Exhaust Emissions Factor 2010 (g/mi)	0.4	0.00088	
NOx Emissions Factor 2010 (g/mi)	0.6	0.00132	
CO Emissions Factor 2005avg (g/mi)	7.5	0.01653	
HC Exhaust Emissions Factor 2005avg (g/mi)	0.6	0.00132	
NOx Emissions Factor 2005avg (g/mi)	0.8	0.00176	
Carbon Emissions Reduction (lbs)	**518,320**		
CO Emissions Reduction (lbs)	**11,156.17**		
HC Exhaust Emissions Reduction (lbs)	**882.99**		
NOx Emissions Reduction (lbs)	**1,164.13**		
MCRG Population	80,708		
Total MCRG VMT	726,256,227		
Total MCRG Fuel Use	35,185,656		
Total MCRG Carbon Emissions (lbs)	682,601,735		
Total MCRG CO Emissions (lbs)	12,008,407		
Total MCRG HC Exhaust Emissions (lbs)	960,673		
Total MCRG NOx Emissions (lbs)	1,280,897		
% Reduction in Carbon Emissions	**0.076%**		
% Reduction in CO Emissions	**0.093%**		
% Reduction in HC Exhaust Emissions	**0.092%**		
% Reduction in Nox Emissions	**0.091%**		

EMISSIONS CALCULATIONS (CONT.)

Optimistic

Emissions Calculations

Total Gasoline Use Reduction (gal)	52,273	
CO2 per gallon of gas (lbs/gal)	19.4	
VMT Reduction from SOVs	1,423,125	
VMT Increase from Vanpools	175,625	
		g -> lbs
CO Emissions Factor 2000 (g/mi)	10.6	0.02337
HC Exhaust Emissions Factor 2000 (g/mi)	0.8	0.00176
NOx Emissions Factor 2000 (g/mi)	1	0.00220
CO Emissions Factor 2010 (g/mi)	4.4	0.00970
HC Exhaust Emissions Factor 2010 (g/mi)	0.4	0.00088
NOx Emissions Factor 2010 (g/mi)	0.6	0.00132
CO Emissions Factor 2005avg (g/mi)	7.5	0.01653
HC Exhaust Emissions Factor 2005avg (g/mi)	0.6	0.00132
NOx Emissions Factor 2005avg (g/mi)	0.8	0.00176
Carbon Emissions Reduction (lbs)	**1,014,105**	
CO Emissions Reduction (lbs)	**21,827.28**	
HC Exhaust Emissions Reduction (lbs)	**1,727.60**	
NOx Emissions Reduction (lbs)	**2,277.65**	
MCRG Population	80,708	
Total MCRG VMT	726,256,227	
Total MCRG Fuel Use	35,185,656	
Total MCRG Carbon Emissions (lbs)	682,601,735	
Total MCRG CO Emissions (lbs)	12,008,407	
Total MCRG HC Exhaust Emissions (lbs)	960,673	
Total MCRG NOx Emissions (lbs)	1,280,897	
% Reduction in Carbon Emissions	**0.149%**	
% Reduction in CO Emissions	**0.182%**	
% Reduction in HC Exhaust Emissions	**0.180%**	
% Reduction in Nox Emissions	**0.178%**	

Very Optimistic

Emissions Calculations

Total Gasoline Use Reduction (gal)	189,581	
CO2 per gallon of gas (lbs/gal)	19.4	
VMT Reduction from SOVs	4,756,400	
VMT Increase from Vanpools	436,299	
		g -> lbs
CO Emissions Factor 2000 (g/mi)	10.6	0.02337
HC Exhaust Emissions Factor 2000 (g/mi)	0.8	0.00176
NOx Emissions Factor 2000 (g/mi)	1	0.00220
CO Emissions Factor 2010 (g/mi)	4.4	0.00970
HC Exhaust Emissions Factor 2010 (g/mi)	0.4	0.00088
NOx Emissions Factor 2010 (g/mi)	0.6	0.00132
CO Emissions Factor 2005avg (g/mi)	7.5	0.01653
HC Exhaust Emissions Factor 2005avg (g/mi)	0.6	0.00132
NOx Emissions Factor 2005avg (g/mi)	0.8	0.00176
Carbon Emissions Reduction (lbs)	**3,677,863**	
CO Emissions Reduction (lbs)	**74,413.25**	
HC Exhaust Emissions Reduction (lbs)	**5,906.89**	
NOx Emissions Reduction (lbs)	**7,811.73**	
MCRG Population	80,708	
Total MCRG VMT	726,256,227	
Total MCRG Fuel Use	35,185,656	
Total MCRG Carbon Emissions (lbs)	682,601,735	
Total MCRG CO Emissions (lbs)	12,008,407	
Total MCRG HC Exhaust Emissions (lbs)	960,673	
Total MCRG NOx Emissions (lbs)	1,280,897	
% Reduction in Carbon Emissions	**0.539%**	
% Reduction in CO Emissions	**0.620%**	
% Reduction in HC Exhaust Emissions	**0.615%**	
% Reduction in Nox Emissions	**0.610%**	

EXTERNAL COST CALCULATIONS

Conservative

External Cost Reduction

Fuel Use Savings (gal)		5,705
VMT Reduction (mi)		148,941
Fuel-Related Externalities	*$/gal*	
Climate Change	$	0.05
Oil Dependency	$	0.08
Mileage-Related Externalities	*$/mi*	
Local Pollution	$	0.02
Congestion	$	0.04
Accidents	$	0.02
Parking	$	0.03
External Cost Reductions (2007$)		
Climate Change	$	285
Oil Dependency	$	428
Local Pollution	$	2,979
Congestion	$	5,213
Accidents	$	2,979
Parking	$	4,468
Total External Cost Reduction	**$**	**16,352**
Inflation Factor: 2007 => 2010		1.05
External Cost Reductions (2010$)		
Climate Change	$	300
Oil Dependency	$	449
Local Pollution	$	3,128
Congestion	$	5,474
Accidents	$	3,128
Parking	$	4,692
Total External Cost Reduction	**$**	**17,170**

Most Likely

External Cost Reduction

Fuel Use Savings (gal)		26,718
VMT Reduction (mi)		637,611
Fuel-Related Externalities	*$/gal*	
Climate Change	$	0.12
Oil Dependency	$	0.12
Mileage-Related Externalities	*$/mi*	
Local Pollution	$	0.02
Congestion	$	0.05
Accidents	$	0.03
Parking	$	0.07
External Cost Reductions (2007$)		
Climate Change	$	3,206
Oil Dependency	$	3,206
Local Pollution	$	12,752
Congestion	$	31,881
Accidents	$	19,128
Parking	$	41,445
Total External Cost Reduction	**$**	**111,618**
Inflation Factor: 2007 => 2010		1.05
External Cost Reductions (2010$)		
Climate Change	$	3,366
Oil Dependency	$	3,366
Local Pollution	$	13,390
Congestion	$	33,475
Accidents	$	20,085
Parking	$	43,517
Total External Cost Reduction	**$**	**117,199**

EXTERNAL COST CALCULATIONS (CONT.)

Optimistic

External Cost Reduction

Fuel Use Savings (gal)	52,273
VMT Reduction (mi)	1,247,500

Fuel-Related Externalities	*$/gal*
Climate Change	$ 0.12
Oil Dependency	$ 0.12

Mileage-Related Externalities	*$/mi*
Local Pollution	$ 0.02
Congestion	$ 0.05
Accidents	$ 0.03
Parking	$ 0.07

External Cost Reductions (2007$)	
Climate Change	$ 6,273
Oil Dependency	$ 6,273
Local Pollution	$ 24,950
Congestion	$ 62,375
Accidents	$ 37,425
Parking	$ 81,087
Total External Cost Reduction	**$ 218,383**

Inflation Factor: 2007 => 2010	1.05

External Cost Reductions (2010$)	
Climate Change	$ 6,586
Oil Dependency	$ 6,586
Local Pollution	$ 26,197
Congestion	$ 65,494
Accidents	$ 39,296
Parking	$ 85,142
Total External Cost Reduction	**$ 229,302**

Very Optimistic

External Cost Reduction

Fuel Use Savings (gal)	189,581
VMT Reduction (mi)	4,320,101

Fuel-Related Externalities	*$/gal*
Climate Change	$ 0.72
Oil Dependency	$ 0.50

Mileage-Related Externalities	*$/mi*
Local Pollution	$ 0.02
Congestion	$ 0.07
Accidents	$ 0.07
Parking	$ 0.10

External Cost Reductions (2007$)	
Climate Change	$ 136,498
Oil Dependency	$ 94,790
Local Pollution	$ 86,402
Congestion	$ 280,807
Accidents	$ 302,407
Parking	$ 432,010
Total External Cost Reduction	**$ 1,332,914**

Inflation Factor: 2007 => 2010	1.05

External Cost Reductions (2010$)	
Climate Change	$ 143,323
Oil Dependency	$ 99,530
Local Pollution	$ 90,722
Congestion	$ 294,847
Accidents	$ 317,527
Parking	$ 453,611
Total External Cost Reduction	**$ 1,399,560**