



A report by the University of Vermont Transportation Research Center

# Increasing Carpooling in Vermont: Opportunities and Obstacles

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## **UVM Transportation Research Center**

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Prepared by:  
Richard Watts

Contributions from:  
Nathan Belz  
Joseph Fraker  
Lauren Gandrud  
Jennifer Kenyon  
Melissa Meece

Transportation Research Center  
Farrell Hall  
210 Colchester Avenue  
Burlington, VT 05405

Phone: (802) 656-1312  
Website: [www.uvm.edu/trc](http://www.uvm.edu/trc)

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## 1. INTRODUCTION

Growth in car ownership, dispersed land settlement patterns, highway investments, travel behavior and socio-economic changes have all contributed to a dramatic increase in automobile use in the U.S. over the last 80 years.<sup>1</sup> The resulting health, environmental and energy impacts related to automobile dependence are of concern to policy-makers in the US and Vermont.<sup>2</sup> Proposed solutions range from increasing the use of public transportation, walking and biking, shifting vehicle fuels from petroleum to other sources or even encouraging changes in the built environment to reduce car trips.<sup>3</sup>

One proposed solution is to increase the number of people in each vehicle which does not require extensive investment of public capital, relying instead on the existing infrastructure and already owned private automobiles.<sup>4</sup> Carpooling can increase personal mobility, access to services, reduce environmental and infrastructure impacts, reduce individual transportation costs and save energy. For example, average vehicle occupancy rates in the US for work trips are about 1.1 per vehicle, down from 1.3 in 1977. Slight increases in the number of people per vehicle could provide the same energy savings as switching to an alternative fuel, without building new fueling stations or making any new additional investments.<sup>5</sup>

However, the percentage of commuters carpooling has significantly decreased since 1980 both nationally and in Vermont. Factors in that decline include increasing car ownership, decreases in household size, changes in travel behavior, the relatively low cost of energy and other socio-demographic changes. The purpose of this research is to examine potential obstacles and opportunities to increasing carpooling for the journey-to-work commute in Vermont and provide research-based information for state policy-makers regarding programs and policies designed to increase carpooling in Vermont.<sup>6</sup>

This research is jointly funded through the VTrans *Efficient Transportation Systems* project and the UVM Transportation Research Center (TRC) Signature Focus Area *Transportation Energy and System Efficiency*. In this report, we focus on the GoVermont program – a state managed rideshare matching program – as a window into the obstacles and opportunities to increasing carpooling in Vermont. We conducted an initial survey of 370 GoVermont participants and then conducted four in-depth conversations with 25 of those respondents. Researchers also reviewed GoVermont materials, previous research on carpooling and examined data from the US Census and NHTS data on travel behavior at the individual and household level.

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## 2. CARPOOL OVERVIEW – US & VERMONT

Researchers have studied carpooling as a mode choice since World War II, when oil and rubber shortages necessitated frugal personal transportation habits.<sup>7</sup> As a result of the oil crisis in the 1970s, 19.7 percent of commuters reported carpooling as their mode to work in the 1980 Census.<sup>8</sup> By 2000, however, this percentage dropped to 11.2 percent. During this same period driving alone to work increased from 64.4 percent in 1980 to 75.8 percent in 2000.<sup>9</sup> The numbers are similar for Vermont,

carpooling peaked 25 percent of work trips in 1980 and has decreased to fewer than 11 percent 2006-08.

Private automobile use is the dominant form of transportation in Vermont and the US, accounting for 84.7 % of all trips to work in Vermont.<sup>10</sup> Any examination of work trips has to start with the basic understanding that the single occupancy vehicle (SOV) is the dominant mode of transportation and alternatives such as carpooling have to be as, or more attractive than driving alone.

**Table 1 - Vermont and US carpool/driving alone for the commute to work trip 1970-2008**

	1970	1980	1990	2000	2006-08
<b>Carpool US</b>	11.7%	19.7 %	13.4%	10.6%	10.9%
<b>Carpool VT</b>	15.2%	25%	13.7	11.9%	10.9%
<b>Drove alone US</b>	66%	64.4%	73.2%	75.8%	74.3%
<b>Drove Alone VT</b>	61.8%	55.9%	76.8%	75.2%	74.30%

Source: US Census. 2006-2008 data from the American Community Survey.

## 2.1 Challenges/Historical Trends

A number of factors have been associated with the decline in carpooling and the increase in driving alone since the 1980s. In this study we focus on six factors that researchers have found to have a strong correlation between increased private automobile use and the decline in shared trips; 1) increase in car ownership, 2) decrease in household size, 3) urban form/land use and settlement patterns, 4) cost of fuel, 5) travel behavior and, 6) incentives and disincentives such as the costs of parking. We present national and Vermont data examining each of these.

**Increase in car ownership:** Researchers believe there is a strong correlation between the number of vehicles a household owns and vehicles miles traveled by each household. As vehicle ownership rates have increased, carpooling and the use of public transportation has decreased. Income and car ownership is strongly related as higher income people are more likely to own more cars. Because the majority of the fixed costs of owning a car are allocated to the purchase and maintenance of the car, gasoline costs are a relatively small portion of the cost of car ownership, typically under 10 percent.<sup>11</sup> Car owners tend to see the the cost of travel as relatively minor not accounting the fixed cost of car ownership as part of their daily travel costs. Since 1960, the number of households in the US without a vehicle has dropped from 21.5 percent to less than 9 percent (chart below).

At the same time, households with two cars have increased from 19 percent to almost 38 percent and three car households have grown 8-fold. Vermont’s car ownership rates are higher than the US average and have seen similar increases. For example, census data indicates that 5.7 percent of Vermont households are without vehicles compared to 8.8 percent nationally. Overall, in 2009, the number of vehicles registered (568,468) was slightly more than the number of registered drivers (509,317).<sup>12</sup>

**Table 2. Car ownership in the US (1960-2008)**

	2006-2008	2000	1990	1980	1970	1960
<b>No Car</b>	8.8%	10.3%	11.5%	12.9%	17.5%	21.5%
<b>1 Car</b>	33.2%	34.2%	33.7%	35.5%	47.7%	56.9%
<b>2 Cars</b>	37.9%	38.4%	37.4%	34.0%	29.3%	19.0%
<b>3 or more cars</b>	20.0%	17.1%	17.3%	17.5%	5.5%	2.5%

SOURCE: US Census Bureau; www.census.gov

**Table 3. Car ownership in Vermont (1960-2008)**

	2006-2008	2000	1990	1980
<b>No Car</b>	5.7%	6.8%	8.0%	10.3%
<b>1 Car</b>	32.9%	33.6%	34.1%	42.2%
<b>2 Cars</b>	41.8%	43.1%	42.3%	33.5%
<b>3 or more cars</b>	19.6.0%	16.4%	15.6%	14.0%

**Household size and demographics:** At the same time as car ownership has increased, household size has decreased leading to reduced opportunities for household-based carpools. Research suggests that household based carpools (sometimes called fampools) are one-third to three-quarters of all carpooling.<sup>13</sup> One study found the correlation between an increase in auto availability and a decrease in household size accounted for 38 percent of the decline in carpooling from 1970 to 1990.<sup>14</sup> Other socio-demographics factors that research has found to be related to the decrease in carpooling include increases in females in the labor force, increases in single person household and increases in average household income.

As household size decreases, carpooling rates decrease because there are less in household options for carpooling. Vermont’s declining household size and high car ownership rates present a major barrier to policy-makers seeking to increase carpooling in the state.

**Table 4. Household Size Over Time**

	2006-2008	2000	1990	1980	1970	1960
<b>Vermont</b>	2.37	2.42	2.44	2.57		
<b>US</b>	2.61	2.6	2.59	2.63	2.75	3.11

SOURCE: US Census Bureau; www.census.gov

**Cost of fuel:** As car ownership rates have increased and household size decreased, energy costs have decreased in real dollars and vehicle efficiency has increased. The decline in the real marginal cost of motor fuel and an increase in vehicle fuel economy contributed to 34 percent of the decline in carpooling between 1980 and 1990. In constant dollars, energy costs per gallon of fuel are similar to the cost of fuel in 1980. And as the cost of fuel has stayed level, vehicle efficiency has improved so that Vermonters can travel the same miles using less fuel.

**Urban form/settlement patterns (density of work, density of home):** Increased suburbanization and dispersed land use settlement patterns have also contributed to the decrease in carpooling. Because work trip carpools are destination-oriented they are most successful in employment areas with a high

number of employees and/or a high-density employee settlement at the point of origin.<sup>15</sup> Researchers have found that carpool formation and use is particularly sensitive to individual compositional characteristics (e.g. gender, age and income), residential spatial context (the accessibility of an individual to be matched to other carpool users), mobility status (number of household automobiles) and the attitudes toward cost, the environment, and the value of time.

In a previous study, TRC researchers used data from the E-911 database to identify places in Vermont with employment and residential density above the 5-7 houses per acre considered the minimum necessary for public transportation. Researchers found only 15 geographical locations (communities such as Burlington, Montpelier, St. Johnsbury, Rutland etc.) with either the employment or residential density that could support transit, and potentially by inference, carpooling.<sup>16</sup> (See TRC report)

**Travel behavior:** The change in urban form has been accompanied with a fundamental change in travel. Where the work commute trip was once the primary vehicle trip, today less than 18 percent of total trips are to work. Instead, many trips are now made from work to other places, or trips are made in a sequence that is difficult for carpooling – particularly when the destinations and employment centers are broadly dispersed.

The National Household Travel Survey (NHTS) measures travel behavior at the household level for all purposes, not just commuting. In 2001, the survey data indicated the prominence of family and personal trips and the continued decline of the work trip as a percent of total trips.

**Table 5. Distribution of trips by trip purpose**

Family/personal business	44.6%
Social/recreational	27.1%
Work and work-related	17.7%
School/church/other	10.6%
Total	100%

*Source: The 2001 National Household Travel Survey, daily trip file, US Department of Transportation.*

**Attitudes:** Studies have identified individual attitudes as an explanatory variable for why people choose to carpool or not to carpool. Carpooling requires more travel time in order to pick up the other carpool members (for external carpooling) and a convenience reduction stemming from conflicting schedules. The perceptions of carpooling (e.g. constraints on independence, social requirements and interpersonal rapport) have also been found to play a larger role than cost or convenience.<sup>17</sup>

For some, the anonymity of using transit is far more appealing than the induced social climate of carpooling. Although carpools are more spatially flexible and less time consuming than public transit options, they are often perceived to be more time consuming because of the need to pick up and deliver members which can lead to concerns about becoming involved with and dependent on strangers.<sup>18</sup> Solo drivers find carpooling less convenient due to schedule rigidity or because of irregular shift hours or work location. Commuters may also be less likely to shift their mode choice when they have established habits and associate carpooling with a loss of privacy and independence, particularly if they need a vehicle during the workday.<sup>19</sup>

In a separate study, TRC researchers looked at the role of social capital in enabling social networks that would increase carpooling. In that study researchers examined how social networks can be used by



policy-makers to make ridesharing more appealing to a greater number of people for a wider variety of trip purposes. Specifically, researchers examined three social network based ride-sharing services; Hinesburg Rides (Hinesburg, Vermont); FrontPorch Forum (Burlington, Vermont); GoLoco (University of New Hampshire, Durham, New Hampshire); and the Hour Exchange (Portland, Maine).

Social capital is, at its core a series of connections and relationships between individual members of the society. Depending upon the strength, quality, and extent of these connections and relationships, social capital enables people to build trust, establish norms, and form social networks, which can then promote shared community objectives, for example ridesharing.

Social networks are the many individual groups that our connections and relationships are organized into – including our family, our friends, our co-workers, our neighbors, our carpool group, as well as the civic, political, religious, and professional associations that we belong to. While some networks overlap – e.g. a few of our friends may also be co-workers – many are discrete – e.g. none of our neighbors are co-workers. Yet, many of them are available to us in times of need. In addition, social networks formalize the connections and relationships among and between individuals within the network, regardless of how informal or unstructured the network is. Norms within networks give people guidelines on how to act, putting pressure on people within the network to comply with the norms. Two of the most important norms from a social capital perspective are trustworthiness and reciprocity. This is because if people generally trust each other and share norms of reciprocity, then the risk of the other party acting fraudulently or defaulting on their obligations is lowered.

Researchers in that study posited that a high level of social capital could be helpful in overcoming the obstacles to ridesharing. For example, high levels of trust could help decrease the fear of getting into a stranger's car. By building bridging social capital ties – i.e. reaching out to individuals who belong to different groups – ridesharing pools could become sufficiently large enough in order to overcome the difficulties in finding suitable matches. Concern over restrictions in flexibility could be assuaged if cooperation and reciprocity between community members were considered unalterable norms.

The social networks presented in that study offered alternative models to the traditional, stand-alone ridesharing platforms. In order to attract more ridesharers, traditional platforms can be embedded into a social network or ridesharing can be added to an existing community-based social network. In that study, the TRC researchers suggested that government support neighborhood-based social networks, which in turn would facilitate ridesharing. However, in this study we are examining a traditional platform -- the State of Vermont's GoVermont Rideshare program – which is focused on increasing ridesharing in Vermont. The results from the TRC's earlier study in this area are available through contacting the TRC. We turn now to an analysis of that program and the obstacles and opportunities for increasing ridesharing in Vermont.

## **2.2 Opportunities/Reasons to Carpool**

Despite many formidable obstacles, both social and physical, many Americans still choose to carpool. Carpooling is second after driving alone as the mode of choice for traveling to work, above walking and public transportation in both the US and Vermont.

**Table 6. Choice of mode to travel to work in the US and Vermont**

	US	Vermont
<b>Drive alone</b>	75.8%	75.2%
<b>Carpool</b>	10.6%	11.9%
<b>Transit</b>	4.9%	.7%
<b>Work at home</b>	4.0%	5.7%
<b>Walk</b>	2.8%	5.6%
<b>Other</b>	1.7%	.9%

Source: US Census 2000

In general, trip mode choice is based on travel cost, travel time, convenience, and other intangible or non-travel related factors (EPA 1978), and few socio-demographic variables have been found to be reliable predictors of who will carpool for journey-to-work trips. Households with lower income, lower automobile availability, and multiple workers have been shown to be more likely to choose carpooling. Carpoolers are usually traveling significantly farther distances than those who drive alone<sup>20</sup> although trip time might be the same.<sup>21</sup> In terms of spatial factors, it is suggested that carpool users tend to travel further than SOV drivers – indicating that the choice to carpool is driven by location and destination—and that a travel distance of 10 miles is the point at which carpooling becomes appealing.<sup>22</sup> Saving money, either through reduced gas costs or reduced wear and tear on vehicles is often cited as the first reason to carpool. In one study in Texas, carpoolers were motivated primarily by the ability to save money because they could use the HOV lanes. Other motivations found in the research literature for carpooling include lack of auto availability and employer-based incentives or disincentives' (e.g. cost of parking).

Still, most researchers have found that even with apparent links between these variables and carpooling, attitudinal relationships are a strong explanatory variable for carpooling propensity. For example, researchers have found that social motivation is one attitude that fosters carpooling. Carpoolers enjoy each other's company and see the carpool conversation as a way to relax and unwind after a day at work. Researchers have also found that concerns about the environment are a second factor that causes people to be motivated to carpool.

### 2.3 Incentives to Increase Carpooling

A number of strategies have been introduced to induce commuters to carpool. These strategies include, but are not limited to, rideshare matching services, carpool parking lots, inadvertent or artificial reduction of parking and other employee promoted activities such as a carpool coordinator and the creation of a workplace environment that supports carpooling.<sup>23</sup>

Many carpool programs now operate through employers, such as the Best Workplaces for Commuters (BWC) program, a voluntary government-industry partnership whose goal is to reduce vehicle emissions and traffic congestion by encouraging employers to offer a comprehensive package of employer commuter benefits as part of employee benefit packages.<sup>24</sup> While programs such as BWC offer a suite of incentives for employees who choose a commute mode (i.e. transit, walking, bicycling) other than driving alone, some are specifically geared toward carpooling, including but not limited to parking

incentives, employee reward programs, flexible working hours, guaranteed ride home services and use of a company car during working hours.

Research is mixed on the ability of incentives to motivate employees to join carpools. One study found that carpoolers who cited saving money behind other reasons for opting to carpool were still more likely to stop carpooling without employer incentives, many of which were financial.<sup>25</sup> Before implementing a carpool program, coordinators or employers must remember that the incentives for employees to utilize a commute mode beside driving alone must offer benefits above and beyond those inherently involved in their choice, be it cycling, walking, transit, or carpool.<sup>26</sup>

Charging for parking, i.e. creating a disincentive to drive alone to work may be as effective as any incentives that employers currently offer. One study found that 20 percent of automobile drivers who now park at their employers' expense would be induced to join carpools or begin using transit for the trip to work if they were charged for the parking they now receive.<sup>27</sup> However, employers may be reluctant to change parking policies if it poses a risk to their ability to hire or retain quality employees.<sup>28</sup> Switching to carpooling is less appealing than driving alone when commuters live or work in areas with minimal congestion and where parking is inexpensive. On the other hand, combining incentives with employer based education and matching programs was found to reduce driving alone by 7-15 percent in another case study.<sup>29</sup>

However, incentive programs may only award existing behavior or switch transit commuters to carpools.<sup>30</sup> One study found that 50 percent of surveyed individuals participating in a discounted carpool-parking program were already carpooling for their commute before obtaining the carpool-parking permit.<sup>31</sup> Employees who participate in carpooling programs on a part-time basis pose an additional challenge to measuring the effectiveness of a carpooling program and its incentives.

A summary of incentive programs found that a carpool program's greatest chance for success occurs when the travel needs of both the employer *and* employees are assessed on an individual basis; employers can motivate employees to change their commuting behavior but have to address individual travel needs.<sup>32</sup>

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### **3. ANALYSIS OF VERMONT CARPOOL DATA**

We turn now to an analysis of two sets of data gathered for this project, an initial survey of GoVermont participants and in-depth conversations with 25 survey respondents. As noted earlier, carpooling in Vermont declined in the 1980s and 1990s, leveling off at about 11 percent of the work commute. Obstacles to carpooling identified in other studies are as strong or stronger in Vermont than in most other states. Car ownership rates are above national averages, household size is below the national average, the state is rural with few pockets of employment and residential density requiring a spatial arrangement of travel that makes carpooling difficult. Despite these known obstacles, Vermonters are carpooling and some sub-set of the population, based on the continued growth of the GoVermont ride-share database wants to do more.

### 3.1 GoVermont

Governor James Douglas established GoVermont in 2008, melding disparate state and local rideshare and a state vanpool subsidy program into the GoVermont network, explaining it this way in his 2008 address to the Legislature; “The miles traveled aren’t the problem; the way we traverse them is. As gas prices climb, many are taking a second look at fuel-efficient cars and trucks and alternatives to single occupancy trips. That’s why I propose GoVermont, a three-pronged approach that provides cost-effective transportation alternatives, promotes the development and availability of cleaner burning biofuels and pushes for increased vehicle emissions standards.”<sup>33</sup>

GoVermont is the state’s primary mechanism to promote alternatives to single occupancy vehicle trips.<sup>34</sup> The upgraded web site (<http://www.connectingcommuters.org/>) features information on state sponsored vanpools, ride-matching services and a calculator for measuring economic and environmental impacts of driving alone. VTrans contracted with Spike Advertising to promote the website and intends to allocate about \$350,000 to the program in the coming year.<sup>35</sup> The website is presently experiencing 3400 hits a month with about half of those clicking through to the carpooling matching service. Over the last few years, more than 2800 Vermonters have registered. Those submitting their names are matched with potential carpooling partners with identical start towns and end town destinations. The service is registering a match rate of 23 percent since October 2009. Registered carpools in the GoVermont program are allowed to use a “guaranteed ride home” service where a taxi is provided to give them a ride home if carpool difficulties arise.

In this report, we focus on the GoVermont program as a window into the obstacles and opportunities to increasing carpooling in Vermont. Carpoolers matched through the GoVermont program may represent only a small percent of ongoing carpools in Vermont, however some existing carpoolers – matched through their workplace, family or friends – are also submitting their names to take advantage of the guaranteed ride home program.<sup>36</sup> In an earlier study, TRC researchers geocoded the stated origins and destinations of 2,813 riders in the GoVermont database using the ArcGIS program. This information was useful to identify common rideshare and travel routes (See VTrans Efficiency report Phase 1). Following on that work, in this study, we submitted an electronic survey to 1809 GoVermont registrants of which 370 responded. Of those 370, 25 voluntarily participated in an in-depth conversation at one of four discussion sessions. Respondents were paid \$20.00 for participating.

**Survey Data:** A plurality of the 370 respondents was female (55%) and 45% commute on average more than 30 miles to work. Almost half of the respondents (45%) were from Chittenden and Washington, with almost two-thirds (65%) from those two counties plus Lamoille and Franklin. Employment locations were concentrated in Burlington, Essex, and Montpelier and along the I-89 corridor. The major employers cited were IBM and Vermont state government. A plurality of GoVermont registrants are from the St. Albans, Burlington and Montpelier commute shed and Chittenden, Franklin and Washington counties This was true of the survey respondents as well as the list the survey was drawn from.

**Table 7. Survey respondents by county**

County	GoVermont (1809)	Survey respondents (370)	Focus group participants (25)
<b>Chittenden</b>	27 %	26%	45%
<b>Washington</b>	17%	20%	21%
<b>Franklin</b>	10%	13%	4%
<b>Lamoille</b>	6%	6%	4%
<b>Total (of full list)</b>	65 %	65%	74%

We grouped half of the respondents into a regular carpool category to contrast their behavior with those who don't carpool. However, all of these respondents share an interest in carpooling, presumably, because they submitted their names to the GoVermont ride-matching service.

**Table 8. Survey respondents by frequency of carpool**

Frequency of carpool	Number of respondents	Rarely/Never Carpool	Regular carpoolers
<b>Never</b>	115	183	
<b>&lt; Once/month</b>	52		
<b>1-2 times per month</b>	16		
<b>Once/wk</b>	17		183
<b>2-3 times/wk</b>	61		
<b>4+ times/wk</b>	105		

**Focus group research:** Twenty-five of the survey respondents spent about two hours discussing the obstacles and opportunities for carpooling in four separate conversations in Burlington and Montpelier. The participants were a mix of carpoolers and non-carpoolers but were linked in their interest in carpooling and their willingness to spend a few hours talking about this interest. All had registered their names at the GoVermont web site. About one-third of the focus group participants' carpool 4-5 times a week, one-third from 2-3 times a week and one-third carpool less than once a week.

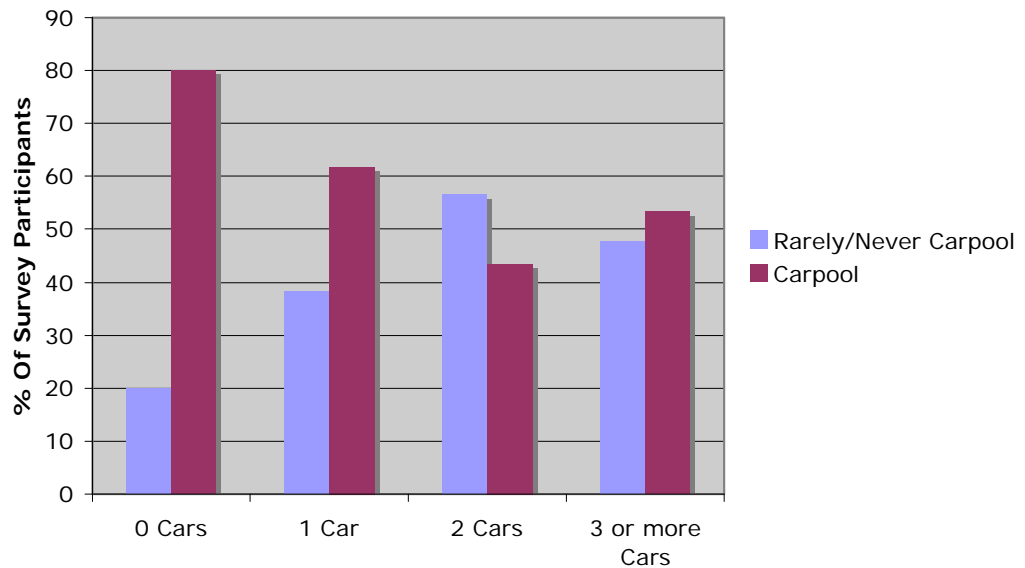
Focus groups are not representative of the population at large, or in this case the GoVermont database. But focus group research can provide insights into carpooling obstacles and opportunities through in-depth questioning on the issues identified in the survey. In the next section we examine the data from the survey and the focus groups, following again the major themes outlined in this study; car ownership, household size/demographics, energy prices, the spatial arrangement of employment and residences, attitudes towards carpooling and parking and other incentives and disincentives.

### 3.2 Challenges/Historical Trends

As noted above, similar trends and obstacles to carpooling in the US are seen in Vermont. Key obstacles identified in previous research and reviewed in this paper are trends in car ownership, household size,

spatial land use patterns, travel behavior, cost of fuel, attitudes and employer based incentives and disincentives such as the cost of parking.

**Car Ownership:** Car ownership has a strong causal relationship with single occupancy vehicle use and auto dependence. The more cars a household owns, the less likely household members are to walk, use transit or carpool. Vermonters own cars at a high rate and this presents a strong obstacle to increasing carpooling. Survey respondents with fewer cars were more likely to carpool than those with more cars.



**Figure 1. Carpool Frequency vs. Number of Cars Owned (%)**

As one respondent who shared one car with her husband said of their carpool habits.

*“My husband and I are naturally frugal. We’re cheap! ...It’s just part of our nature. We minimize our trips into town. We double up trips into town....and so this is just an extension of that. This is just an extension of our natural frugality.”*

**Urban form/settlement patterns (density of work, density of home):** Residential settlement patterns and employment centers in Vermont are dispersed, although there are employment concentrations in Burlington, Montpelier, Rutland and at large employers like the state complex in Waterbury and the IBM manufacturing plant in Essex. The number of people in the workplace (or the density of the area surrounding the workplace) and density of the town of origin is a key factor in enabling carpooling.

Carpool matches are often made at the work place. In our focus groups, carpoolers were far more likely to have met their fellow carpoolers through the workplace or through friends. Only two of the 25 found carpool matches through the state-matching program. (One other found a vanpool program through the website). One research study (Ing et al) found that only 2-8 percent of carpool matches come through public matching services. Most carpool matches are family, friend or workplace originated.

Vermont’s lack of density makes it difficult to find suitable matches. Noted one state worker who found a match through her workplace:

*“This is my first time actually carpooling in all my life...I feel very lucky...Living in a rural area though - a dirt road, a back road, and connecting with somebody to make that work is very, very hard in Vermont. It's not like everybody lives around the main drag and everybody can match up. It's a challenge.”*

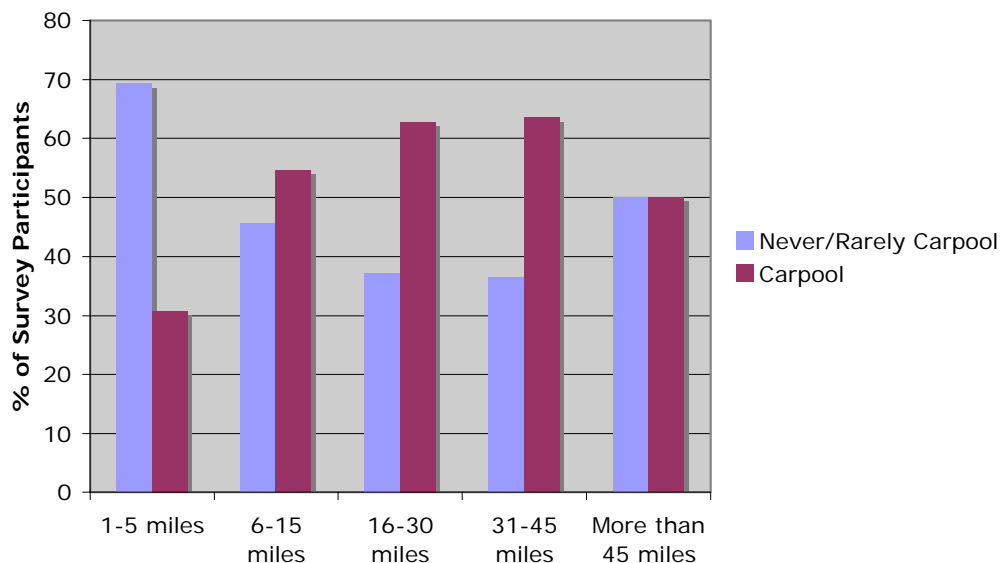
Or, said another who had recently moved to Vermont:

“The biggest issue I’ve had with moving to Vermont is it’s such a rural area that I’m not sure how big the company you work in is, but with me being in a tiny company you know my pool of people you ask is tiny and then even smaller than that is finding somebody that’s making that trip and there are so many people coming from so many different places that it’s hard finding somebody that’s on your schedule.”

The challenge of finding a match was identified by survey respondents as the second largest obstacle to carpooling. More than half (51%) of total respondents checked a box that said it was “hard to find other to carpool with from my location to my destination.” Perhaps the challenge is best represented by one participant who has been unable to find a match despite working at the state’s largest private employer and a stated willingness to be extremely flexible:

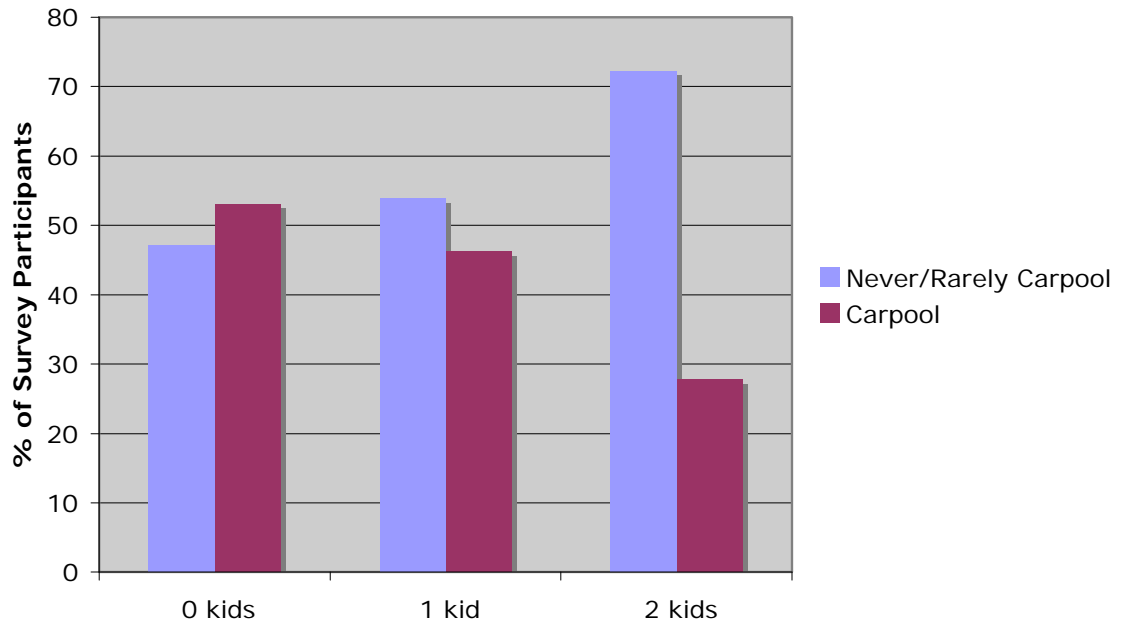
*“I’ve been on the State database for like five years and have no hits and talked to them personally a couple of times...So my experience is that I've been trying to get someone to carpool and my schedule can be kind of flexible. I can go plus or minus two hours on each end. And some days I can work at home, too, so I can be flexible that way. But I have a hard time hooking up with anyone to carpool with.”*

At the same time, the distances Vermonters travel to work may also be an incentive to carpool. Researchers have found that traveling above ten miles makes carpooling more likely. Results from the survey suggest that distance is a factor, but at above a certain distance the inability to find matches may inhibit the formation of carpools.



**Figure 2. Miles Traveled to Work vs. Carpool Frequency**

**Socio-demographics/household size/income/education:** Researchers have found the number of children and the number of adults in a household effects people’s willingness and ability to carpool. Children under 16 add to the obstacles to carpooling because of school and other children related trips. Whereas, additional adults add to carpooling options. Survey respondents with children under 18 were less likely to carpool.



**Figure 3. Number of Kids in Household vs. Carpool Frequency**

Almost 12 percent of respondents (11.7%) identified the need to drop off or pick up kids as an obstacle to carpooling.

**Travel Behavior:** Changes in travel over time, primarily the reduction in the central nature of the work trip and the increase in other trips, such as recreational and social trips have impacted carpooling. Survey respondents identified the trips they had to make during and following the workday as the major obstacle to carpooling. As mentioned above, this shows up in the responses in needing a car to run errands after the workday, to pick up and drop off children and the need for a car during the workday.

**Table 9. Reasons not to carpool chosen by respondents to survey of GoVermont participants**

Need to run errands during/at the end of the day	53.5%
Hard to find others to carpool from my location to my destination	50.9%
Easier to drive my own vehicle	31.3%
My job requires driving during the day	17.6%
Need to drop off (or pick up) kids on the way to work	11.7%
Parking is available at work	6.2%
Rather drive alone	5.5%
Don't like sharing my car with strangers	2.2%

Source: GoVermont Travel survey

Focus group participants echoed those comments:



*"If you drive into work, you feel like when you're ready...even if you do have set hours, you have the freedom to get in a little bit earlier or a little bit later. You can run out for lunch or whatever. So it's been a little bit challenging for me not having a vehicle down here."*

*"To find people that have the same schedule is just sometimes - we all lead such crazy, busy lives, you know. We have to stop at the grocery store, at the pharmacy or whatever and sometimes it stinks. It's (carpooling) not feasible."*

**Cost of fuel, cost-savings:** The decrease in energy costs has been identified as one of the reasons for the decline of carpooling in the 1980s. In Vermont, gas prices hit \$4.09 a gallon in July 2009, declined in the winter of 2009-2010 and remain well below the 2009 peak. Calls to rideshare programs increase as fuel costs increase.<sup>37</sup> Increased fuel costs were named by focus group participants as the top reason that would motivate them to carpool more.

As one respondent said:

*"If gas was five dollars per gallon, you bet I would crawl across cut glass to find a carpool partner. I would refuse to pay five dollars per gallon for gas to drive out there."*

Another said:

*"I'm thinking you have to go negative so to speak. You have to make the costs of everybody driving by him or herself higher than it is now. If you want to drive the economics, so you need to start charging parking fees. And then give the incentives to those who carpool."*

**Attitudes:** Studies have identified individual attitudes as an explanatory variable for why people choose not to carpool. However, all the participants in this study are those who have indicated a desire to carpool by submitting their name to the state matching service. Still, attitudinal issues identified in other studies did appear. For example, participants talked about needing the privacy of their own car.

*"I am really an introvert and I enjoy coffee and pop tart and my music in the morning on the way in and the thought of getting to know somebody for an hour ride in and out was just a little overwhelming personally for myself."*

Another woman not presently carpooling said:

*"I feel weirded out by meeting and getting in a car with someone I don't know and driving 45 miles outside of town. You know what I mean? Like I don't know how much people are screened and some people may have those inhibitions where that's maybe why they don't sign up for the carpool. It's just because you really just don't know who you're going to get in the car with."*

### 3.3 Opportunities/Reasons to Carpool

Previous research suggests individuals’ carpool to save money, because of limited access to a car, for the convenience over other modes, because of social and environmental attitudes and because of incentives and disincentives offered by employers. All of those reasons are apparent in the survey and focus group responses. In an analysis conducted for the GoVermont program, a marketing firm found three primary reasons Vermonters carpool; they lack access to a car either in the short-run or by choice, to save money and for the social aspects. Trailing those three reasons is to protect the environment.<sup>38</sup>

In this study, survey respondents cited saving money first and the environment second. However, focus group participants in conversation identified saving money first, social reasons second, the environment third and not wanting to drive/own a car last. Note, survey respondents were not given a social rationale to choose, other than “makes me feel good” which may explain the lower prominence of this reason among their choices.

**Table 10. Reasons to carpool chosen by respondents to survey of GoVermont participants**

Saves money	84.3%
Saves wear and tear on the vehicle	65.3%
Good for the environment	65.3%
Convenience	21.9%
Makes me feel good	21.9%
I don’t like to drive/I don’t have a car	9.2%
Limited parking at work	7.3%
Employer-based incentives	

Source: Carpool survey. N=181.

**Table 11. Reasons to carpool chosen by focus group participants in open-ended conversations**

Saves money	35.3%
Social reasons	25%
Good for the environment	20%
Not drive/use car	15%

**Saves Money:** GoVermont estimates that a consumer driving a car getting 25 mpg would save about \$2,000 a year if they carpooled on a regular basis. Saving money either through reduced gasoline costs, or wear and tear on the vehicle is the first reason people carpool, GoVermont managers believe. That perception is supported by the analysis. Saving money was named as the top reason to carpool both in the larger survey and in the focus groups discussions.<sup>39</sup>

Said one participant:

*“Gas is not cheap and I have a gas-guzzler, which I love and I’m not ready to get rid of it. And the wear and tear on your car - that’s another thing.”*

Added another: “I like carpooling. It’s helped the wear and tear on my car as well saving gas.”

The lack of access to a car was a discussed a few times in the focus groups.

*"A couple of times I have carpoled. And part of it is when somebody contacted me and they said they didn't have a car. I tried to Ride Share, you know. I wrote them. Nobody got back to me. I kept trying to contact them. And then they said yes, we will get back to you, but nobody got back to me so actually I ended up taking the person because they lived around my house..."*

**Attitudes:** Researchers have identified social and environmental attitudes as key factors in carpool formation.

For example, on the social side, this female participant said:

*"It's so much nicer that travel goes faster when there's another person to chat with. Especially with me, like since I'm traveling with friends, like it's me and a bunch of other 30-something females who I sugar with. You know, like we have a lot to talk about."*

Or added another carpooler:

*"So we do have a lot of conversations that are work related that really help us sort through some of the problems that we have within our own departments. So, that was the surprise to the carpooling for me... and I really miss their friendship and I miss their conversations when I'm on my own."*

Another added:

*"It's really nice to just catch up in the morning with people that you don't work all day with and it's really great when you carpool with different people because you get to see what they are up to, how their life is going and it's not always about work."*

It's not just social aspects it's a way to relax after a long day.

*"When I'm doing it, I'm doing it for pure sense of self. After I've put in a really long day at work and I've gotten up at five o'clock to get ready for work to meet the carpool by 20 after six to be here by 6:30 and I get after... I'm tired and day in and day out it just wears on me personally. So when I carpool the interaction with other people, the joking...we are like Las Vegas - what we say in the carpool stays in the carpool."*

**Environment:** Participants also added environmental reasons as a reason for carpool, but they were neither as prominent or as frequent.

As one participant said:

*"It's nice...you know I feel guilt driving this body and you know two and a half tons of steel and glass to work. The amount that's...and sitting a lot of it...just idling, which is zero miles per gallon in traffic. That just seems obscene to me. So maybe I'm a little...maybe I'm a little bit shamed into wanting to carpool, too. It just seems such an efficient way to do things."*

**Advocates for carpooling:** Participants in the study are clearly interested in and motivated to carpool. The organizational efforts that individuals go through to carpool on a regular basis are remarkable. At one end of the spectrum is a group of teachers who have been carpooling for 15 years to the school system in Washington County. Two drivers meet at the Richmond park and ride lot every day, following a detailed monthly schedule, where the other 7-8 individuals join them. Cars leave the workplace at two different times allowing early and late departures. Carpool rules dictate members are on time or are left behind. Part of the success of the carpool is the organizing skills of the leaders. However, this carpool also benefits from other options available through the workplace. For those who can't meet the carpool there are several options for rides back to the Richmond park and ride, either with the Link Express or with other staff in the school system. As one of the participants said:

*"We have our norms basically. The carpool leaves at seven o'clock whether you're there or not. If you need somebody to wait you'd better call them. Most people arrive at 6:50 – between 6:50 and 6:55. The first car that's full leaves. And you know you'd better be waiting if the carpool that you want to go in home in is leaving at 3:15 – you need to be there at 3:15. It has to be. There used to be...when there were fewer of us - when there were three or four or five of us - we could be much more flexible, but when we got beyond one car it just – you have to - it's the driver's rules as far as the driver says you're leaving – that's when you're leaving. If you can't leave at that time or if something comes out, there's the bus."*

Another thread running through these conversations was the effort that carpoolers go to find fellow carpoolers. For example, one participant said this is her response whenever she is introduced to a new employee at her workplace.

*"I wouldn't say you know, I'm like openly advocating for it, but if I hear someone who lives in Montpelier or Barre or Waterbury like my first question to them is to you want to carpool? Are you interested in carpooling? So when the opportunity presents itself, I definitely inquired to see if there is a way that they can join us."*

Said another:

*"The pool is just so shallow. I mean at one point I actually got a magnetic sign - a piece of magnetic material to put on the back of my truck and wrote on it that said, carpool every day, figuring when I'm driving down Route 12, everybody that's driving at the same time – are my - that's my market. You know, the people that I see both ways - so I had a sign that said looking to carpool and an e-mail address. I didn't get a single hit, but and then using the website, there's only one person and it's really not a good fit at all."*

One participant considered following someone home and asking them to carpool.

*"I've seen like the same vehicle going down the road and I'm sure you see it, too, on your commutes. And I've almost like thought about following them home. But I don't want to be arrested for being a stalker. It might be a little bit too much."*

### **3.4 Incentives to Increase Carpooling**

The impact of company incentives on individual carpooling behavior is unclear based on the survey and focus group conversations. Participants mentioned incentives generally as one factor but not the deciding factor in their decision to carpool. At the top of the list for factors that would increase carpooling is a sharp increase in fuel prices and more available carpool matches. Examining employer-based incentives, the emergency ride home program, a parking cash-out program and use of a company car during the day placed in the top tier of incentives. The reduced parking fees did not rank highly at 3.45, possibly because most businesses don't charge for parking. Recognition may in fact be a disincentive judging by the strong low response by all respondents.

**Table 12. Respondents' perception of the impact of incentives (1=lowest; 5=highest)**

<b>Gas Prices</b> - Gas prices increase to \$5.00 a gallon	4.95
<b>Gas Prices</b> - Gas prices increase to \$4.00 a gallon	4.5
<b>Carpool partners</b> - Individuals who live near you and work near or at your office	4.45
<b>Guaranteed Ride Home</b> - Employer or service provides a guaranteed ride home if needed during day or after work day or reimburses for taxi ride	4.35
<b>Carpool matching service</b> - service finds out who is going where and finds a suitable match for carpooling	4.3
<b>Parking Cash-Out</b> - Workplace provided cash to individuals who carpool a certain number of days a week	4.25
<b>Use of company vehicle during day</b> - Employees can use a vehicle that is owned by the company for errands during the day	4.25
<b>Flexible work hours</b> - Carpoolers are allowed flexible working hours if they carpool	4.15
<b>Voucher to retail outlet</b> - Carpoolers receive a voucher worth \$10 to retail outlets, local restaurants, every week	4.15
<b>Use of company vehicle for carpool</b> - Employees can use a vehicle that is owned by the company to carpool to work in	4.15
<b>Park and Ride Lots</b> - State funded lots to meet fellow carpoolers	4
<b>Gas Prices</b> - Gas prices increase to \$3.00 a gallon	3.95
<b>Carpool Coordinator</b> - This individual organizes logistics of carpool and riders within your office	3.95
<b>No Parking</b> - Unless you carpool, you are unable to park your car at work	3.85
<b>Prize Drawing</b> - People who carpool are entered in weekly drawing to receive prize	3.85
<b>Preferred Parking</b> - Carpoolers receive parking spots closer to work entrance	3.6
<b>Reduced Parking Fees</b> - Cars brought to work by carpoolers are charged less for parking	3.45
<b>Recognition</b> - People who carpool are recognized in company materials such as newsletters, etc.	2.6

**Vermont Employer-based incentives:** A number of Vermont employers offer incentives to their employees to carpool. We conducted an informal survey of carpool incentives at several of the employers where survey participants work. For example, while respondents repeatedly mentioned the difficulty of finding carpool partners several employers provide confidential carpool matching services through the workplace, e.g. UVM, Champlain College, Fletcher Allen Health Care and ARC. Other employers provide gift card incentives for "regular" carpoolers. Several employers offer guaranteed ride home programs and subsidized bus service, such as UVM and Champlain College. In a survey of

employees at UVM, 16.8 percent reported carpooling in 2008, although the survey is based on those choosing to respond.<sup>40</sup> National Life, which has a number of successful carpools, offers preferential parking and funds towards gasoline for those who carpool at least once a week. Notable also are policies offered by two Vermont companies, NRG Systems and Resource Systems Group (RSG) to encourage carpooling, walking/biking to work and the use of more efficient/high mileage vehicles.

**Parking:** Parking came up a number of times, and the research suggests substantially raising the price of parking or making it unavailable will increase carpooling and the use of other modes.

In one case the relationship between parking and carpooling was clear.

*“Before we built our new building we had only 53 parking spaces and we had 90 employees so there was no choice. If you didn't get there before eight o'clock in the morning, you didn't get a parking spot. And so that really... we did great on carpooling! Now we have enough parking spaces for every employee. We put in another building and the town requires that you add a certain amount of parking spaces. And now we have enough parking spaces and our participation is down.”*

The most frequent carpooler in the group, who carpools 5 days a week, even though she lives only three miles from town, cites the high cost of parking in downtown Burlington and the subsidized bus passes offered by her employer as the reason. She either rides the bus or her carpool goes to the interceptor lot on Pine Street and the employer pays for the trip to the work place on the CCTA shuttle every day.

*“I carpool five days a week. And even though I only live 3 miles from town, it's actually been good in a couple of ways. We do take the park shuttle, but there are four or sometimes five people in my neighborhood and we get together because we all have to come in town at the same time. And we park at the park shuttle lot and our company actually subsidizes it, so it's free for us to park.”*

Flexible schedule is an incentive that has been identified as important. Most of the respondents to this survey have a flexible schedule or could request one. Respondents said that work places are generally supportive of carpooling except in one case where the employer has stressed working extra hours to get the job done.

*“That attitude just changed everybody's focus and now it's like something you don't talk about your carpool. You know, much, it's an underground sort of thing.”*

**Park and Ride lots:** Park and ride lots are seen as highly convenient gathering places for carpools to meet because they provide centrally located meeting places, and transit and other pick-up and drop-off options. Concern about the capacity and safety of these places was raised repeatedly. Of concern to policy-makers should be several comments about commuters who stopped carpooling because of issues related to park and ride lots.

*“When they took that away (the Williston park and ride lot) – the Richmond park-and-ride became completely congested. It was a little triangle of mud under the bridge and it started off, you know, with maybe 10 of us and then 20 and then we were parking on the streets and then when they built the park-and-ride - still no Williston park-and-ride. Now people are parking anywhere they can possibly fit - on the grass in Richmond.”*

Added another participant:

*"I actually know a few people that stopped carpooling because of that exit because the park-and-ride is just - there is no where to park your car." Another respondent talked about the lack of safety at a park and ride in Franklin County. "The challenges were leaving my car at the park and ride where I live and one car got - the front side window got smashed and then another vehicle, somebody took out the front bumper... So that's part of why I don't like carpooling too much."*

Although "covert" lots and meeting places exist around the state, those also present users with their own challenges:

*"In the Burlington area - I couldn't tell you one park-and-ride up there. And so the Staples Plaza ends up being a park-and-ride. And the whole time, you know, I did that for a year and every morning I'd like creep out of my car and hope nobody notices."*

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## **4. CONCLUSION/FURTHER RESEARCH**

Strong obstacles exist to carpooling in the US and in Vermont, including rates of car ownership, household size, dispersed land-settlement patterns, changes in travel behavior and attitudinal variables. Despite this, carpooling remains the second most used mode for traveling to work after driving alone.

Carpooling relies on the existing vehicle fleet and the existing road system and infrastructure. Increasing vehicle occupancy rates through increasing carpooling on the journey to work could make a substantial contribution to reducing energy used in transportation and reduce costs to Vermonters.

This analysis of a subset of Vermonters carpooling, or who want to carpool drawn from the GoVermont database is exploratory and based on self-selected respondents. A logical next step would be to conduct a comprehensive evaluation of the GoVermont program, drawing a statistically representative sample to understand more fully the effectiveness of the program in promoting carpooling.

Similarly, many of the carpools in Vermont are not represented in the GoVermont database, as many are either family carpools or initiated at the work place. The joint purchase of an NHTS add-on by VTrans, CCMPO and the TRC represent an opportunity to conduct further analysis of carpool patterns in Vermont. Additional information about the spatial, demographic and attitudinal factors that contribute to carpooling in Vermont would provide essential information to policy-makers.

One obstacle to carpooling raised in this study is the capacity and amenities at several park and ride lots along the I-89 corridor.

The GoVermont program should focus promotional activities in Franklin, Chittenden, Lamoille and Washington counties. GoVermont registrants in those counties and along the I-89 commute shed may have the greatest opportunity to find carpool matches at origin and destination points.

Supporting and coordinating with employer-based carpool programs should be one strategy of the GoVermont program.

## REFERENCES

- <sup>1</sup> David Jones. 2008. Mass Motorization & Mass Transit. Indiana University Press.
- <sup>2</sup> IPCC report, VTrans Climate Change report.
- <sup>3</sup> Ewing, et al Moving Cooler.
- <sup>4</sup> Buliung, R. N., Soltys, K., Habel, C., Lanyon, R. (2008). The "Driving" Factors Behind Successful Carpool Formation and Use. Transportation Research Board Annual Meeting 2009. Washington, D.C.
- <sup>5</sup> David Jones. 2008. Mass Motorization & Mass Transit. Indiana University Press.
- <sup>6</sup> The terms ridesharing and carpooling are interchangeable but this report uses the term carpooling. The U.S. Environmental Protection Agency defines carpooling as two or more people driving or commuting together in a privately owned vehicle, typically to the same destination or locations in close proximity to each other (EPA 2005).
- <sup>7</sup> Ferguson, E. (1997). "The rise and fall of the American carpool: 1970-1990." *Transportation* 24: 349-376.
- <sup>8</sup> Davis, S.C., Diegel, S.W., Boundy, R.G. (2009). *Transportation Energy Data Book: Edition 28*. Center for Transportation Analysis, Engineering Science & Technology Division. Oak Ridge National Laboratory, 2009.
- <sup>9</sup> US Census, Davis, S.C., Diegel, S.W., Boundy, R.G. (2009). *Transportation Energy Data Book: Edition 28*. Center for Transportation Analysis, Engineering Science & Technology Division. Oak Ridge National Laboratory, 2009.
- <sup>10</sup> National Household Travel Survey, 2009. Analysis by Transportation Research Center at UVM.
- <sup>11</sup> American Automobile Association
- <sup>12</sup> Vermont Energy Report. Transportation Research Center. 2010.
- <sup>13</sup> Teal, R. F. (1987). "Carpooling: Who, How, and Why." *Transportation Research A* 21A(3): 203-214. Li, J., Embry, P., Mattingly, S.P., Sadabadi, K.F., Rasmidatta, I., Burris, M.W. (2007). "Who Chooses to Carpool and Why?: Examination of Texas Carpoolers." *Transportation Research Record: Journal of the Transportation Research Board*(2021): 110-117.
- <sup>14</sup> Ferguson 1997, op cit.
- <sup>15</sup> Teal 1987,op cit; E.P.A. (November 2005). *Carpool Incentive Programs: Implementing Commuter Benefits as One of the Nation's Best Workplaces for Commuters*. Washington, D.C.
- <sup>16</sup> TRC Report: *Transportation Efficiency in Vermont*. 2008.
- <sup>17</sup> Hwang, K., Giuliano, G. (1990). *The Determinants of Ridesharing: Literature Review*. Berkley, University of California Transportation Center
- <sup>18</sup> Teal 1987, op cit; Margolin, J. M., MR; Stahr, M (1978). "Incentives and Disincentives of Ride Sharing." *Transportation Research Record* (673): 7-15.
- <sup>19</sup> E.P.A. (March 1978). *An Overview of Ridesharing and Mass Transit Employer Incentives*. Denver, CO Region VIII; Teal 1987, op cit.
- <sup>20</sup> Teal 1987, op cit.
- <sup>21</sup> Margolin 1978.
- <sup>22</sup> Teal, 1987; Tsao & Lin, 1999.
- <sup>23</sup> E.P.A. (February 1994). *A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs*. California; E.P.A. (September 2001). *Carpool Incentive Programs: Implementing Commuter Benefits Under the Commuter Choice Leadership Initiative*. Washington, D.C.; EPA 2005, op cit; EPA 1978 op cit.
- <sup>24</sup> Herzog, E., Bricka, S., Audette, L., Rockwell, J. (2006). *Do Employee Commuter Benefits Reduce Vehicle Emissions and Fuel Consumption? Results of the Fall 2004 Best Workplaces for Commuters Survey*. Transportation Research Board Annual Meeting Washington, D.C.
- <sup>25</sup> Gilman, C. (2008). "U-PASS at the University of Washington." *TDM Review*(2); Department of Transportation, W. S. (December 2007). *HOV User Survey: Washington State Freeway System*.
- <sup>26</sup> EPA 1978, op cit.
- <sup>27</sup> Pickrell, D. H., Shoup, D.C. (1980). "Employer-Subsidized Parking and Work-Trip Mode Choice." *Transportation Research Record* (786 )



<sup>28</sup> Tsao, H. S. J., Lin, D. (1999). Spatial and Temporal Factors in Estimating the Potential of Ridesharing for Demand Reduction, CA Partners for Advanced Transit and Highways.

<sup>29</sup> EPA 1978 op cit; Herzog, 2006 op cit.

<sup>30</sup> Altshuler, A. (1981). "Keynote Address: The Rideshare Challenge." TRB Special Report (193).

<sup>31</sup> Anderson, K. (2006 ). "Rethinking Carpool Parking Discounts." TDM Review(1): 15-16.

<sup>32</sup> Hoyt-McBeth, S., Kulyk, C. Cohen, S. (2008 ). "Applying Individualized Marketing to the Workplace." TDM Review (4).

<sup>33</sup> Gov. Douglas State of the State, Jan 10 2008

<sup>34</sup> Personal communication, Ross McDonald, GoVermont program manager.

<sup>35</sup> Ditch the Ride and Catch a Ride, Tim Johnson. June 20, 2010. Burlington Free Press.

<sup>36</sup> Personal communication, Ross McDonald, GoVermont program manager.

<sup>37</sup> Personal communication, Ross McDonald, GoVermont program manager.

<sup>38</sup> Ibid, Spike memo

<sup>39</sup> Personal communication, Ross McDonald, GoVermont program manager. Spike memo.

<sup>40</sup> CATMA 2008 Fall Transportation Survey.