Health Impact Assessment

State Employee Commuter Benefit Program

November 15, 2018

VERMONT
DEPARTMENT OF HEALTH
healthvermont.gov

Table of Contents

Cover photos courtesy of Go! Vermont and Vital Communities

Executive Summary

Following the success of the four-year pilot of the Capital Commuters Program, the Vermont Agency of Transportation (VTRANS) is seeking approval from Vermont's Agency of Administration to be able to offer an Employee Commuter Benefit Program to all State employees. The Vermont Department of Health and key stakeholders conducted a Health Impact Assessment (HIA) to assess the potential health impacts of the Commuter Benefit Program.

The goals of the HIA were to:

- Determine the potential health impacts of the State offering free or discounted Commuter Benefits for its employees,
- Recommend ways the proposed policy can support health and ways to best mitigate any potential adverse health impacts,
- Give State employees and transportation partners a voice in the process.

Key Findings

A proposed statewide Employee Commuter Benefit Program is expected to have 1,022 participants and cost $402,000 per year. For participants, it is expected that the number of commute trips by motor vehicle would decline by 29 percent, transit trips would increase by nearly 70 percent, and increases in walking, biking, car/vanpool, and teleworking would also be expected. In total, the annual health benefit for participating State employees is expected to be $245,000, related to reduced motor vehicle emissions, increased physical activity, and reduced risk of transportation-related injuries and fatalities. This estimate only reflects health-related benefits; benefits related to parking, operations, climate change, and other factors were not included. A summary of expected health impacts is summarized in Table 1 below.

Table 1. Summary of health impacts of a proposed Commuter Benefit Program

Health outcome	Predicted annual behavior change	Literature finding	Predicted annual health impact	Magnitude of health benefit
Respiratory	Reduced emissions from 921,460 fewer motor vehicle miles of travel per year	Reduced respiratory and cardiovascular impacts associated with reduced exposure to tailpipe emissions	Reduction of 0.001 deaths (economic value of $6,500-$14,800); reduced morbidity expected but not quantified	Small for program participants, though potentially much larger for community members
Chronic disease	Increase of 10.6 additional minutes of transportation-related physical activity per week	Reduced risk for mortality and morbidity related to cardiovascular disease, type 2 diabetes, breast and colon cancers, depression, dementia, osteoporosis, hypertension, and overweight/obesity	Reduction of 0.02 deaths (economic value of $167,500); reduced morbidity expected but not quantified	Large, especially for those not currently attaining recommended physical activity levels
Safety/ injury	Shift of drive alone trips to transit (35,161), walking (12,565), biking (6,577), and teleworking (9,551)	As compared to driving alone, reduced injuries and fatalities for transit users and teleworkers, but increased risks for pedestrians and cyclists	Reduction of 0.003 fatalities and 0.33 injuries per year (economic value of $66,500)	Moderate overall, though the injury/fatality risk for pedestrians and cyclists would increase compared to driving

Mental health/ stress	Decreased driving alone, increased carpool, vanpool, transit, walking, biking, and teleworking	Reduced stress, increased satisfaction, especially for pedestrians and cyclists	Did not quantify	Did not assess

Additionally, the Commuter Benefit Program is expected to provide non-health benefits including:

- reduced demand for parking
- increased access to potential job applicants
- improved employee satisfaction and productivity
- potential to catalyze improvements to transit service and walking/biking infrastructure that would benefit the larger community.

Reducing single occupant vehicle usage would also reduce greenhouse gas emissions, helping the State make progress towards achieving the goals of the Vermont Comprehensive Energy Plan.

Some populations - those with lower incomes, disability, or racial or ethnic minorities - are generally at higher risk for poor health outcomes. The literature indicates these populations tend to use transit more, so providing a Commuter Benefit Program could assist these populations to an even greater extent, especially those seeking new employment with the State. Impacts and benefits associated with these populations were described in the literature review but not quantified in the assessment. Some impacts such as reduced vehicle emissions or community safety improvements would also benefit non-employee populations that are disproportionately affected by the negative impacts of transportation systems.

Key Recommendations

Overall, this assessment suggests that providing a Commuter Benefit Program to State employees will have a positive impact on health outcomes for State employees, and both health and non-health benefits to the State as an employer, and indirectly to the Vermont community at large. The largest employee health benefits were associated with increased physical activity. Therefore, any strategies that can further encourage walking or biking as part of a transit or motor vehicle trip, or walking or biking alone, would further increase the expected benefits.

While overall findings were positive for all health outcomes, the assessment did identify an increased injury and fatality risk for pedestrians and cyclists, and that real and perceived risks can be a barrier to using these modes.

Based on these findings, we propose the following recommendations for consideration in developing a State Commuter Benefit Program:

- Fully subsidize employee Commuter Benefits
- Allow employees to flex schedules to accommodate transit times
- Provide incentives for walking and biking (prizes, discounts, raffles)

- Offer regular education and skills training opportunities regarding walk/bike safety
- Provide discounted or loaner safety equipment, including reflective clothing, lights, and helmets
- Recognize and celebrate employees who travel by means other than driving alone
- Work with local communities and transit providers to improve transit access and increase safe walking and biking options, particularly in high traffic areas

Acknowledgements

The Vermont Department of Health would like to recognize the contribution of the following partners without whom completion of this Assessment would have been exceedingly difficult. Participation in this process came in many forms, from active involvement in the scoping process and data collection to proof reading the final draft. Many thanks to Ross MacDonald from the Vermont Department of Transportation, Deb Sachs, GoVermont; Sandy Thibault, CATMA; Peter Keating and Bryan Davis Chittenden County Regional Planning Commission; Abby Bleything, University of Vermont Transportation Research Center; Nic Anderson, Champlain College Sustainable Transportation; Jennifer Wallace-Brodeur, Vermont Energy Investment Corporation; Deborah Lisi-Baker, UVM Center on Disability and Community Inclusion; Maura O'Brien, Vermont Department of Human Resources; and several Health Department staff for providing data, document review, and reports to consider.

Screening

What is being proposed?

In 2013, the Vermont Agency of Transportation (VTrans) began piloting a transportation demand management (TDM) program for State employees working in Montpelier, dubbed Capital Commuters. Following the success of the four-year pilot, VTrans is seeking to offer an Employee Commuter Benefit Program to all State employees for use on all Vermont transit services. Employees who want to participate will request a Commuter Benefit through the Chittenden Area Transportation Management Association (CATMA) website that can be immediately activated and used by swiping it upon getting on the bus. CATMA will invoice the State based on the number of trips taken. Participants will be eligible for carpool and vanpool services, a bike/walk rewards program, and other discounts and services. CATMA also provides a Guaranteed Ride Home program, which covers the costs of a taxi or similar service in the event of an emergency during a day when a commuter traveled to work without their car. The expansion of the Commuter Benefit Program to all State employees was recommended in the 2016 Vermont Comprehensive Energy Plan, as one way the State can lead by example to reduce greenhouse gas emissions.[1]

What is a Health Impact Assessment?

According to the Centers for Disease Control and Prevention (CDC) a Health Impact Assessment (HIA) is a "process that helps evaluate the potential health effects of a plan, project or policy before it is built or implemented."[2] HIA is an objective process composed of six main parts: screening, scoping, assessment, recommendations, reporting, and evaluation. HIA involves stakeholders from all sectors in order to assess the health consequences and recommend strategies that can be implemented to improve health

outcomes before a policy or plan is finalized. HIA is used in all sectors, from development projects to social policy.

HIA is also a useful tool to assess how a proposed decision will affect the health of a population and whether vulnerable populations are more likely to be impacted or whether the health impacts are distributed evenly within the population. The goal of HIA is to provide recommendations during the decision-making process that will protect health and reduce health inequities.

Why conduct an HIA on this proposal?

Incentivizing behavior change is an effective strategy to encourage individuals to try or adopt new healthier behaviors. However, implementing incentives and realizing the desired behavior change may have associated costs. The proposed policy to incentivize public transit use among State employees, while potentially effective in achieving positive changes such as reduced traffic, increased physical activity, and decreased household transportation costs, may have higher costs to the State and stress to employees. In addition, there is the question of whether the policy has equitable impacts for the State employee population.

This HIA involved gathering stakeholder input and examining research on these factors to make recommendations on promoting and supporting the potential health benefits of the proposed policy, while reducing or mitigating any negative outcomes or implications for vulnerable populations.

Operations staff at the Health Department began exploring how to promote employee use of alternative modes to single-occupancy vehicle use in the spring of 2017 due to substantial increases in State employee parking garage limitations. Concurrently, the Public Transit Coordinator and Go Vermont Program Manager at VTrans was preparing a proposal to expand the Capitol Commuters pilot project statewide. State employees working in the town of Montpelier received a 50 percent transit subsidy from the State as part of this pilot. Other benefits included guaranteed ride home, van and car pool benefits and other incentives to reduce single-occupancy vehicle use. This program had demonstrated successes in reducing single occupancy vehicle use; after three years of implementation, the program had 571 participants, an estimated reduction of 4.4 million miles of annual drive-alone travel, and a reduced parking demand of 201 spaces (which cost the State an estimated $500 annually per space).[3]

It is anticipated that expanding such a program statewide would further reduce motor vehicle travel and parking demand. It is also anticipated that the program will provide physical and mental health benefits to participants, and equity will be improved, because access to transit increases economic and social opportunities for people who are economically, physically or socially disadvantaged.[4]

Due to a tight timeline, it was decided to conduct a “Desktop HIA” on the policy proposal, meaning there was less stakeholder involvement than may have occurred had the team had more time and resources.

Scoping

While exploring the possibility of an HIA on the policy proposal, the Health Department team was continuing to promote the use of alternative transportation modes for its employees. This included hosting a Lunch & Learn in the summer of 2017 to educate employees on transit, walk/bike, and carpool/vanpool options available in Vermont.

During the summer of 2017, a team at the Health Department sought scoping input from several stakeholders to solicit input on the value and potential focus areas of an HIA on the proposed policy. A Stakeholders Meeting was held in the fall of 2017, including representation from the Health Department, VTrans, CATMA, Chittenden County Regional Planning Commission, the University of Vermont Transportation Research Center, Vermont Energy Investment Corporation, and the Vermont Clean Cities Coalition. The stakeholder group was engaged again later in the process to review the findings and suggest revisions or additional recommendations.

Based on input from the Stakeholders Meeting and additional conversations between the Health Department team and both internal and external partners, potential health impacts on employees that could occur as a result of the policy proposal were identified and summarized in the pathway diagram below.

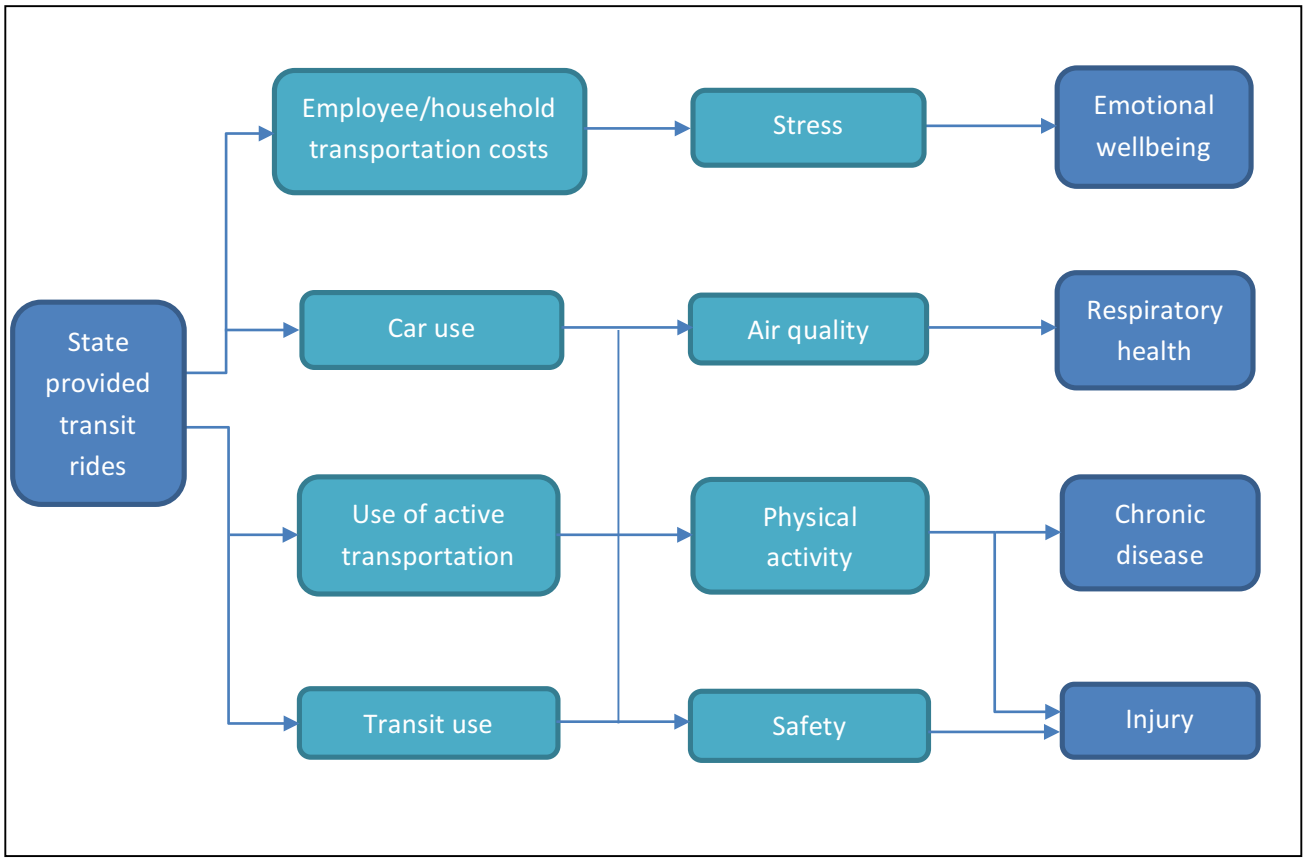
For the community at large, identified potential impacts included: a change in access to job opportunities for individuals who do not have consistent and reliable transportation, change in traffic congestion (especially at high traffic commuting times) and change in air quality with a possible reduction in car use.

For the State of Vermont, identified potential impacts included: change in absenteeism, parking lot and garage costs, healthcare costs (if the changes in travel mode impacts physical activity or accidents), and change in the applicant pool if more individuals have access to jobs. One specific example is the impact of transportation costs on the refugee and New American population who may need to rely more heavily on public transportation for various reasons (e.g. drivers licenses, and lack of credit history to secure auto loans). A report from the University of Vermont's Transportation Research Center (TRC) identified that access to transportation is a primary barrier for refugees and New Americans pursuing employment opportunities, with cost being a major contributing factor.[5]

For the purposes of this HIA, the team focused solely on health impacts for current employees. The primary potential impacts identified included: change in respiratory health (due to air quality impacts), chronic disease (due to change in physical activity levels), mental health (due to change in stress levels or change in physical activity), and injury (due to change in accident risk). The Health Department team reviewed the literature on the relationship between transit programs and each of these topics, and, where possible, quantified expected health impacts based on projections of travel behavior changes and published evidence of the health impacts of travel choices.

Pathway Diagram

Potential Impacts for Employees



Background and Context

Methodology

Health impacts of transportation behaviors were summarized by reviewing peer-reviewed scientific literature. Where possible, systematic reviews and meta-analyses were used as the key references for the literature review and as evidence for quantifying predicted impacts of the Employee Commuter Benefit Program. If there were no systematic reviews or meta-analyses available for a particular topic, a selection of individual, recent peer-review studies were used instead. Vermont data on current transportation and health characteristics were derived from most recent data available from the Vermont Department of Health, Vermont Agency of Transportation, or other state and national data sources, supplemented by findings from a survey of Vermont Department of Health staff. Data on the Capital Commuters Program and projected participation in a statewide Employee Commuter Benefit Program were derived from the Vermont Agency of Transportation and the Vermont Energy Investment Corporation.

State Employee Profile

According to the State of Vermont Workforce Report, Fiscal Year (FY) 2017, the State of Vermont employs 8,432 people; 7,792 are "classified employees", the rest are in executive branch.[6] At the end of FY17 the average age of Vermont State employees was 46, but the average age of classified employees has been gradually decreasing since FY13 with the percentage of Millennials (ages 25-34) nearly doubling from FY13 to FY17, from 12 percent to 24 percent.

For FY17, 7 percent of hires were ethnic minorities and 52 percent were females. While 57 percent of hires had a bachelor's degree or higher, 15 percent had "some college", and 18 percent had a high school diploma or less.

At the end of FY17 the average base rate salary for full time classified employees was $58,943, a 3.1 percent increase from FY16. The lowest average salaries were found at Buildings & General Services ($45,859) Vermont Veterans' Home ($48,731), Vermont Lottery Commission ($51,213), Libraries ($51,283), and Corrections ($51,554). Three hundred and thirty-one employees made under $35,000 per year and 1,338 made $35,000-45,000. American Automobile Association estimated that the average cost to own a vehicle in 2017 was about $8,500 per year.[7]

Vermont Department of Health Transportation Survey Summary

In the fall of 2017 the Health Department team conducted a survey of Health Department employees to gather information about current use of alternative modes and potential motivating factors to increase use of alternative modes (see Appendix 1). While the survey was a subset of the State employee population, the findings have implications for all State employees. The Health Department employs just over 500 out of the 8,432 total State employees.

There were 163 responses to the survey, 79 percent of which work at the Health Department's Burlington location. This location has the greatest concentration of buses and routes available in the state and would likely benefit the most from the proposed policy. Of the 163 responses, 39 percent live within 5 miles one way, from work and another 21 percent live within 10 miles. Table 2 summarizes current travel behaviors for survey participants, indicating that employees living within five miles of work were far more likely to use a mode other than driving at least one day a week, with walking and biking being the most likely alternatives. Carpooling use increased with increasing distance from work. Using the bus was most common for those living within 5 miles, though usage did not vary much by distance. Those living within 5-10 miles were the most likely to drive alone 4-5 days/week.

Table 2. Current travel mode to commute to work, by distance of home from work.

	Live within 5 miles	Live 5-10 miles away	Live > 10 miles away
Number of respondents	64	34	65
Drive alone 4-5 days/week	44%	82%	74%
Take the bus at least 1 day/week	20%	15%	17%
Bike at least 1 day/week	27%	15%	0%
Walk at least 1 day/week	42%	0%	0%
Carpool at least 1 day/week	8%	12%	15%

The primary barrier cited by 40 percent of respondents was the additional time it takes to travel by any other means than driving alone. About 30 percent indicated the need to pickup/drop off others or run errands on their way to or from work. About a quarter listed the weather as a barrier for much of the year. Twenty percent need their vehicle during the day for work purposes. About 10 percent were concerned about how to carry things to and from work using alternative transportation, or about arriving to work hot or sweaty. Obligations with children were mentioned frequently in the comments as a reason why it is difficult to use alternative transportation. Others mentioned the high importance of personal time, as well as concern about being able to work a full 8 hours without "counting" time spent on the bus. Some expressed concern about carpooling becoming an extension of the workday, with colleagues wanting to talk work on the way to and from their workstation.

The strongest motivations for considering options other than driving alone were increasing physical activity (34 percent), saving money (34 percent), reducing environmental impacts (33 percent), and saving time (22 percent). Thirty-five percent indicated that the bus would be their next most likely travel option, followed closely by car/vanpool (27 percent). Biking and walking were indicated by 12 percent each. Several commenters mentioned that because they live somewhere rural, there really aren't other viable options.

Incentives that might motivate people to try alternative modes included the guaranteed ride home, bus vouchers, reduced insurance premiums, accruing comp time for using alternative modes, and more flexibility permitted in schedules. Half of respondents (52 percent) stated that having the option to telework more than 1 day a week would reduce their likelihood to drive alone to work, 34 percent indicated that a guaranteed ride home would increase their likelihood to use alternative transportation. Twenty-eight percent said that an encouragement program or the ability to have an alternate work schedule would increase their likelihood to use alternative transportation. Sixty percent of respondents indicated that they would react positively to a financial incentive for walking, biking, using the bus, or car/vanpooling. Forty-five percent indicated that discounts for purchasing Commuter Benefits or for using a vanpool service would be a good strategy. Seventeen percent said they would be willing to give up their parking pass in exchange for a financial benefit.

More detailed survey findings are provided in Appendix 2.

Employee transportation benefits programs

A 2016 systematic review identified 12 randomized control trials or controlled longitudinal studies on workplace interventions to promote active travel.[8] Interventions were grouped into four categories – behavior change programs, workplace travel plans, financial incentives, and introduction of new transportation infrastructure. Overall, 10 out of the 12 studies resulted in either increased active travel and/or reduced driving to work. There was a median reduction of 11 percent in employees driving private vehicles to work across all review studies. Findings regarding change in active travel were very heterogeneous, ranging from no impact, to short-term increases that were not maintained over time, to significant increases in walking and biking. The authors concluded that while workplace interventions to increase active travel appear promising, the evidence is not very strong due to the small number of

controlled longitudinal studies, high risk of bias in the included studies, and disparate nature of the interventions and outcome measures.

Three of the 12 studies included health outcome measures. In one, an educational and motivational intervention of employees considering or infrequently walking or biking resulted in increased general health, mental health, and vitality (as measured by the 36-item Short Form Health Survey) as compared to controls.[9] In a second study, obese women that received education, guidance, and encouragement to increase active commuting achieved statistically significant reductions in body fat measurements at 6 and 18-month follow-up.[10] In the third, active commuters achieved a 5 percent increase in HDL cholesterol after a 10-week intervention as compared to controls.[11]

In a separate 2014 review that was not restricted to randomized control trials or controlled longitudinal studies, four additional workplace intervention evaluations were identified in the peer-reviewed literature.[12] All four studies found that increased walking/biking and decreased driving occurred as a result of each intervention. Interventions included two promotional campaigns (one with small financial incentives), a comprehensive travel management plan with financial incentives and disincentives, and a comprehensive bike promotional program.

In a second 2014 review, 13 articles were identified that evaluated workplace behavioral interventions using randomized control trials or controlled longitudinal studies.[13] Three of the reviewed studies were also included in the 2016 systematic review. The interventions were largely focused on enablement, education, and incentivization. The authors did not find consistent evidence that behavioral interventions reduced car use frequency, though the findings were highly heterogeneous and at high risk of bias.

Predicted Travel Behavior Changes

The Capital Commuters Program Evaluation estimated that 1,022 State employees would participate in a CATMA-administered universal Commuter Benefit program where the State covers 100 percent of the program costs.[14] The 2015 Capital Commuters Survey was used to estimate the expected change in travel behavior for transit benefit program participants, based on reported travel behavior changes made by Capital Commuters program participants.[15] Expected changes in average and total trips per week by mode, before and after signing up for the new Commuter Benefit program, were estimated in

Table 3 below.

Table 3. Expected travel behavior changes for the projected 1,022 transit benefit program participants.

	Before benefits program		After benefits program		Overall change in travel	
Travel mode	Travel days per person per weekday*	Aggregate travel days per weekday	Travel days per person per weekday *	Aggregate travel days per weekday	Change in aggregate travel days per week	Change in aggregate travel days per year**
Drive alone	3.19	3,265	2.27	2,316	-949	-43,647
Carpool	0.53	541	0.70	715	174	7,990
Vanpool	0.08	82	0.16	163	81	3,730
Transit	0.55	566	0.93	948	382	17,581
Walk	0.40	404	0.53	541	137	6,282
Bike	0.12	126	0.19	197	71	3,289
Telework	0.12	126	0.22	230	104	4,775

* Travel days per week were averaged across all survey respondents, assuming 0.5 days per week for the response "Less than one day per week," 2.5 days per week for the response "2-3 days per week," and 5 days per week for the response "5 or more days per week." Because the total days per week added up to more than 5, the average days per week was scaled down for all modes except for drive alone, which was assumed to be the most accurate.

** State employees were assumed to work 46 weeks per year on average after accounting for holidays, annual leave, sick leave, and personal leave.

Average commute time by mode was derived from American Community Survey data for Vermont (5-year estimates from 2012-2016). Average travel speed by mode was derived from the 2009 National Household Transportation Survey.[16] A travel speed of 7.5 miles per hour was assumed for cycling.[17] Average commute trip distance was calculated by multiplying the time by the speed for each mode.

Table 4. Travel time, speed, and distance assumptions for each travel mode.

Travel mode	Average commute time per trip (minutes)*	Average travel speed (miles per hour)**	Average commute distance per trip (miles)***
Drive alone	22.9	31.7	12.1
Carpool	26.5	31.7	14.0
Vanpool	26.5	31.7	14.0
Transit	33.8	11.5	6.5
Walk	10.6	3.6	0.6
Bike	23.4	7.5	2.9

* Carpool commute time was also used for vanpools.

** "Private vehicle" speeds were used for drive alone, carpool, and vanpool.

*** LINK transit trips are typically much greater than the average 6.5 commute distance for local transit trips

Health Impacts

Respiratory Health

Existing conditions

In 2016, 13 percent of adult Vermonters were diagnosed with lung disease, which includes asthma (10 percent) and chronic obstructive pulmonary disease (COPD, 6 percent).[18] The rate of asthma in Vermont has been higher than the nationwide average since 2007 and was the 5th highest in the U.S. in 2014.[19] Asthma-related emergency department (ED) visits and hospitalizations have been steadily increasing in recent years. In 2015, the rate of asthma hospitalizations was 75 per 10,000 Vermonters, while the rate of asthma ED visits was 184 per 10,000 Vermonters.[20] In 2016, among adult Vermonters, asthma prevalence was significantly higher for women, those with less education, and those with lower annual household income.[18] There were an estimated 224 premature deaths attributable to air pollution in Vermont in 2005, with ¼ of those deaths associated with air pollution from road transportation.[21]

Concentrations of most air pollutants monitored in Vermont have been decreasing since the early-to-mid 2000's and are all currently below annual average National Ambient Air Quality Standards (NAAQS). There are occasional days when shorter-term NAAQS are exceeded. Ozone is currently monitored at three sites. From 2011-2017, the ozone standard was exceeded in Bennington on average less than one day per year, while at Underhill, there hasn't been an ozone exceedance since 2010. Ozone monitoring in Rutland began in 2016 and there has yet to be an exceedance. Fine particulate matter (PM2.5) is currently monitored at four sites. While there weren't any daily PM2.5 exceedances over the last two years, there were four in Rutland in 2015, and the 10-year high was 11 in Rutland in 2011. Daily PM2.5 exceedances are less common at other monitoring sites in Vermont, last occurring in Burlington in 2013, Underhill in 2010, and Bennington in 2005.[22]

Motor vehicle pollution typically has the most impact on people in close proximity to vehicle traffic. In total, 2.7 percent of Vermonters, or nearly 17,000 individuals, live within 150 meters of a major highway. Additionally, 9.4 percent of public schools in Vermont, or 30 individual schools, are located within 150 meters of a major highway.[23]

Among the biggest motivators in considering options other than driving alone to work for Health Department employees who responded to Transportation Survey was to reduce environmental impacts (33 percent), which was just less than those motivated by physical activity and saving money (both 34 percent).

Literature review

Motor vehicle emissions are a major contributor to air pollution and it is well-established that these emissions have a detrimental impact on human health. Motor vehicle emissions include carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, particulate matter, and mobile-source air toxics. Motor vehicle emissions also contribute to the formation of ozone and aerosols. Motor vehicles also generate non-combustion particulate matter including resuspended road dust, tire wear, and brake wear. Exposure to traffic-related air pollution has been associated with a wide range of cardiovascular,

cerebrovascular, respiratory, and reproductive impacts. The highest direct exposure to traffic-related air pollution occurs within a few hundred meters of a roadway. Children, older adults, and individuals with pre-existing chronic diseases (particularly, respiratory and cardiovascular conditions and diabetes) tend to be at higher risk for health impacts from exposure to air pollution.[24,25,26] Recent studies have demonstrated that even at air pollutant concentrations below NAAQS, higher pollutant concentrations are associated with adverse health effects.[27,28]

A small number of intervention studies have demonstrated air quality and health improvements associated with traffic reductions, such as following implementation of a new congestion fee or while traffic was heavily restricted during a major event. Depending on the extent of the change and whether the traffic reduction was offset with a traffic increase elsewhere, interventions that reduce motor vehicle emissions can convey widespread benefits to a large population, and particularly to people most proximal to the affected roadways or districts. However, these population-level air quality benefits tend to be much smaller than the physical activity benefits for those shifting from motor vehicle travel to a more active mode of transportation.[29]

Road users tend to be exposed to the highest concentrations of traffic-related air pollution, which has created concerns about negative health impacts for those using active transportation modes.[29] A 2017 systematic review of 39 studies found that while car and bus commuters were exposed to more air pollution than pedestrians and cyclists, the larger inhalation rates and generally longer commuting times for active travelers resulted in a greater health impact for pedestrians and cyclists. However, they also found that the physical activity benefits provided by walking and biking far outweighed the negative impacts of air pollution. When travelling a 7km route twice every day, a 40-64 year-old cyclist would expect to gain 1.4 years of life expectancy as compared to a vehicle driver and 0.7 years as compared to a bus rider. When travelling a 3.5km route twice every day, a 40-64 year-old pedestrian would expect to gain 1.8 years of life expectancy as compared to a vehicle driver and 1.5 years as compared to a bus rider.[30]

Predictions

The change in vehicular emissions was based on the projected decrease in single occupant vehicle usage and increase in carpooling and vanpooling. Increased transit usage was not expected to affect emissions, as these trips will most likely occur on transit routes that were already in operation before the transit benefits program. The estimated change in vehicle miles per year was a reduction of 921,460 miles of travel.

Average emissions per mile and per trip end were provided by the California Air Resources Board (assuming an average vehicle age of 6-10 years) for $PM_{2.5}$, NO_x, and Reactive Organic Gas (ROG).[31] The estimated change in these three pollutants was calculated to be a reduction of 0.09 tons of $PM_{2.5}$, 0.19 tons of NO_x, and 0.20 tons of ROG.

Travel mode	Change in aggregate # of trips per year*	Change in aggregate vehicle miles of travel per year**	Tons $PM_{2.5}$ emissions per year***	Tons NO_x emissions per year***	Tons ROG emissions per year***
Drive alone	-87,294	-1,059,596	-0.102	-0.223	-0.238
Carpool	15,980	111,994	0.011	0.025	0.030
Vanpool	7,460	26,142	0.003	0.007	0.009
Transit	35,161	0	0	0	0
Total			-0.089	-0.191	-0.199

* A travel day was assumed to consist of two commute trips.

** We assumed an average of 2 employees per carpool and 4 employees per vanpool. Transit trips were assumed to use existing services, so no new transit miles or emissions were expected.

*** Emissions calculations were based on the following average rates: $PM_{2.5}$, 0.087 g/mi, 0.004 g/trip end; NO_x, 0.172 g/mi, 0.233 g/trip end; ROG, 0.153 g/mi, 0.614 g/trip end. Each trip was assumed to have two trip ends.

These reductions were input into the EPA Co-Benefits Risk Assessment (COBRA) model to calculate the expected health impacts.[32] Economic outputs from COBRA were multiplied by an inflation factor of 1.124 (Consumer Price Index, All Goods) to convert from 2010 US$ to 2017 US$.[33] The predicted health benefit due to reduced air pollution was negligible, with an estimated reduction in annual deaths between 0.0007 and 0.0015, and an estimated annual economic benefit between $6,500 and $14,800 due to all health-related impacts attributable to air pollution.

Discussion

The predicted health benefit for State employees due to reduced air pollution was negligible based on the relatively small number of expected participants. Although quantifying the impact was beyond the scope of this assessment, reduced vehicle emissions by State employees would also provide health benefits for the general public anywhere that vehicle travel is reduced, potentially multiplying the benefit by many times.

Additionally, employer programs that incentivize transit, car/vanpool, and non-motorized modes are one of several strategies needed to help meet the energy goals in Vermont's Comprehensive Energy Plan, as transportation is the largest contributor to greenhouse gas emissions in the state. More widespread adoption of transportation benefits program could provide much more significant benefits. For example, if 10,000 employees (with similar characteristics to Capital Commuters participants) joined similar employer travel programs, there would be a projected reduction of over 6.5 million vehicle miles of travel per year. Air quality benefits (such as reduced fine particulates from tailpipe emissions) alone do not provide a strong justification for an employer travel program but do provide a marginal benefit in addition to other benefits for health, reduced emissions of carbon dioxide and other greenhouse gases, and reduced demand for state-provided parking infrastructure.

Chronic Disease

Existing Conditions and State Employee Comments

Regular physical activity is associated with multiple health benefits including helping to manage weight and reduce risk of chronic conditions including heart disease, diabetes, arthritis and even some cancers.

In 2016 in Vermont:[18]

- Over $2 billion is spent each year to treat chronic diseases.
- Twenty-eight percent of adults are obese, and an additional 34 percent are overweight.
- Eight percent of adults have been diagnosed with some form of heart disease.
- Each year, approximately 3,600 Vermonters are diagnosed with some form of cancer, and 1,300 die from some form of cancer. Cancer is the leading cause of death for Vermonters.
- Diabetes affects more than 55,000 Vermonters. The prevalence of diabetes has been steady for the past several years.
- About three in 10 Vermonters have arthritis.

In addition, Vermont's most vulnerable populations – those who are older, of low socio-economic status (SES)- a measure of a person's social, economic, and work status - have physical or cognitive disabilities, or are ethnic or racial minorities tend to have higher rates of chronic disease and lower rates of meeting physical activity recommendations. For example, compared to Vermont adults of higher SES, those of low SES are twice as likely to have been diagnosed with lung disease, diabetes, and cardiovascular disease; are significantly more likely to have hypertension; and are more than twice as likely to not have any leisure time physical activity (32%).[34] No leisure time physical activity is measured by those who report that they did not participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise during the past month.

Vermonters with a disability have a higher rate of risk factors – particularly no leisure time physical activity, obesity and high cholesterol – and chronic disease: [35] In addition, among people with a disability:

- one in four has been diagnosed with lung disease (26%);
- one in five has been diagnosed with diabetes (18%) or cardiovascular disease (19%); and
- 15 percent have ever been diagnosed with cancer.

According to the Vermont State Employee Wellness Program, self-report data completed by 2,310 State employees in 2017 indicated that: 81.9 percent of employees did not get the recommended amount of physical activity; 32.7 percent had a body mass index, or BMI, (defined as weight in kilograms divided by the square of height in meters) in the obese range; and 33.4 percent had a BMI in the overweight range. Based on health insurance claims data, 5.8 percent of employees insured under the State of Vermont's insurance plan had a diabetes-related claim in 2017 and 5.2 percent had a hypertension-related claim.

Although physical activity can help with prevention or management of these conditions, most Americans do not get enough physical activity. In Vermont 77 percent of youth in grades 9-12 do not meet the recommended guidelines for 60 minutes of moderate intensity physical activity every day[36] and 41

percent of adults do not meet the recommendation of 150 minutes per week. Eighteen percent of Vermont adults reported no leisure time physical activity. Vulnerable populations have even higher percentages not meeting the recommended amounts of physical activity: 53 percent of low-income adults, 49 percent of people with depression, and 59 percent of people with a disability do not meet the recommended amounts of physical activity.[37]

Due to the rural nature of Vermont, lack of robust transit options, and the availability of free and adequate parking at all State agency building, most State employees drive to work alone. According to the Health Department Transportation Survey, which was largely focused on employees from the most urbanized part of the state with the greatest access to transit, most (71 percent) respondents drove alone to work 4-5 days per week. However, the biggest motivators for respondents in considering options other than driving alone to work were to increase their physical activity (34 percent) and save money (also 34 percent).

Literature Review

The use of public transit generally involves some walking to bus stops or train stations. A systematic review of 27 articles examined how much time is spent in physical activity among adults using public transportation and the potential effect on the population level of physical activity if inactive adults increased their walking through increased use of public transport.[38] Across all reviewed studies, public transit users engaged in 8–33 more minutes of walking per day as compared to non-transit users. The authors concluded that more minutes walked per day through greater uptake of public transport by inactive adults would likely lead to significantly greater increases in the adult population considered sufficiently active.

Another study assessed changes in transit-associated walking in the United States from 2001 to 2009 and documented the importance of "transit associated walking" to public health, by examining transit walk times using the National Household Travel Survey, a telephone survey administered by the U.S. Department of Transportation to examine travel behavior in the United States.[39] This paper found people are more likely to transit-walk if they are from lower income households, are non-white, and live in large urban areas with access to rail systems. These researchers concluded transit walking contributes to meeting physical activity recommendations. The authors also note research has found links between the use of public transit and physical activity, lower BMI, and travel safety.

A systematic review of longitudinal studies was used to estimate reduced mortality risk in response to walking and biking.[40] The authors found that achieving the weekly physical activity recommendation of 150 minutes of moderate-intensity physical activity by walking would reduce the risk of all-cause mortality by 11 percent, and by cycling would reduce the risk by 10 percent. The benefits for reduced all-cause mortality risk were greatest for those currently not meeting the physical activity recommendation, and generally decrease at physical activity levels greater than the recommendation. In addition to reduced mortality risk, other studies have found that walking and biking reduce the risk for a number of morbidities, including cardiovascular disease, type 2 diabetes, breast and colon cancers, depression, dementia, osteoporosis, hypertension, and overweight/obesity.[29]

Predictions

Based on the predicted changes in travel behavior above, we estimated that on average for the 1,022 expected participants in the transit benefit program, there would be an increase in walking to/from transit of 5.8 minutes per week, an increase in walking unassociated with transit of 2.2 minutes per week, and an increase in cycling of 2.6 minutes per week, or a total increase of 10.6 additional minutes of transportation-related physical activity per week.

To calculate the expected health impacts of these increased in transportation-related physical activity, it was first necessary to convert the estimate from minutes to metabolic equivalent hours (MET-hours), which are used to account for the differences in intensity and energy expenditure between different activities. As compared to an hour of sitting, which is equal to 1 MET-hour, we used assumptions from one of the reviewed studies that an hour of walking was equivalent to 4 MET-hours, and an hour of cycling was equivalent to 6.8 MET-hours. [40] After converting the physical activity estimate from minutes to hours, they were then multiplied by the activity-specific MET-hours to calculate a total predicted increase of 0.54 MET-hours of walking and 0.29 MET-hours of cycling per week.

Travel mode	Change in aggregate travel days per week	Change in aggregate physically active minutes of travel per week*, **	Change in physically active minutes of travel per person per week***	Metabolic equivalents for each activity	Change in MET-hours per person per week
Transit	382	6,762	5.8	4.0	0.39
Walk	137	2,563	2.2	4.0	0.15
Bike	71	2,966	2.6	6.8	0.29

* A travel day was assumed to consist of two commute trips.

** Each transit trip was assumed to be associated with 10 minutes of walking to travel from home to the bus pick-up and from the bus drop-off to the office (or reverse for the commute to home). Transit access mode and travel time were derived from 2009 National Highway Travel Survey data to estimate an average walking or biking travel time of 14.7 minutes per transit trip. This estimate was then rounded down by roughly 1/3rd to account for an assumed higher usage of park-and-ride or drop-off access to transit in Vermont, and the close proximity of transit stops to major State offices in Montpelier, Waterbury, and Burlington.

*** Per person per week averages were factored down by 46/52 based on the expectation that employees will only travel to work for a total of 46 weeks of the year.

In the systematic review described earlier, the authors estimated that 1 MET-hour of walking was associated with a 1.2 percent reduction in all-cause mortality risk for those not currently meeting weekly physical activity recommendations, and a 0.4 percent reduction in risk for those that are already meeting physical activity recommendations.[40] One MET-hour of cycling was associated with a 1.5 percent reduction in all-cause mortality risk for those not currently meeting weekly physical activity recommendations, and a 0.5 percent reduction in risk for those that are already meeting physical activity recommendations. Assuming that 41 percent of Vermont adults do not currently meet physical activity recommendations, on average, 1 MET-hour of walking would be associated with a 0.7 percent

reduction in all-cause mortality risk, and 1-MET-hour of biking would be associated with a 0.9 percent reduction in risk. The reduced risk for all-cause mortality for program participants was calculated separately for walking and cycling by multiplying the predicted additional MET-hours per week by mode by the risk reduction per hour, resulting in a 0.39 percent reduction in risk for walking and 0.26 percent for cycling, or a combined risk reduction of 0.65 percent.

The impact is a reduction in the all-cause mortality rate from 267.5 (the average from 2009-2015 for Vermonters 25-64 years old) to 265.8 deaths per 100,000 population, or a reduction of 1.7 deaths per 100,000 population per year.[41] For the 1,022 expected program participants, this results in a reduction in the number of annual deaths by 0.02 per year. Applying the same Value of a Statistical Life as was used in EPA's Co-Benefits Risk Assessment model, [32] increased physical activity due to the transit benefits program provides an estimated annual economic benefit of $167,500 due to reduced deaths attributable to physical inactivity.

It should be noted that reduced mortality is not the only expected outcome of increased physical activity but was the only outcome that was relatively easy to quantify for this assessment. As mentioned in the literature review, additional expected benefits include reduced disease and disability and improved mental well-being.

Discussion

The US Department of Health and Human Services recommends adults get 150 minutes of aerobic activity per week that can be achieved all at once, or through smaller bouts throughout the week. Using public transit or walking/biking to work allows people the ability to get small bouts of activity during their day, which contributes to their overall rates of physical activity. Physical activity also provides benefits for mental health, as discussed further below. Employee physical activity is already encouraged through the LiveWell Vermont State Employees Wellness Program. This program could potentially be used to specifically encourage physical activity through active transportation modes.

Safety/Injury

Existing Conditions and State Employee Comments

From 2009-2017, there were an average of 64 motor vehicle fatalities (including pedestrian and cyclist crashes with motor vehicles) per year in Vermont. [42] Fatalities per vehicle mile of travel were more common in rural areas than in urban areas. In 2016, the motor vehicle fatality rate was 9.9 per 100,000 population in Vermont, somewhat lower than the national average of 11.6 motor vehicle fatalities per 100,000 population.[43] From 2010-2014, motor vehicle crashes were the 2nd largest cause of unintentional injury deaths in Vermont, accounting for 20 percent of all unintentional injury deaths.[44] During that same time period, motor vehicle crashes accounted for seven percent of all unintentional injury hospitalizations or emergency department visits.[45] Males were more likely to die in a motor vehicle crash than females, but females were more likely to be hospitalized or visit the emergency department.[46] In either case, Vermonters between the ages of 15 and 24 were the most likely to be injured or killed in a motor vehicle crash.

From 2009-2017, there were an average of 5.6 pedestrian fatalities per year in Vermont.[42] From 2010-2014, there were an average of 193 pedestrians hospitalized or that visited the emergency department per year after being struck by a motor vehicle.[46] Pedestrians between the ages of 15 and 44 were the most likely to be hospitalized or sent to the emergency department after a crash with a motor vehicle.

From 2010-2017, there were a total of 6 on-road bicyclist fatalities in Vermont.[42] From 2010-2014, there were an average of 72 bicyclists hospitalized or that visited the emergency department per year after being struck by a motor vehicle.[46] Male bicyclists and bicyclists between the ages of 15 and 24 were the most likely to be hospitalized or sent to the emergency department after a crash with a motor vehicle.

Only seven percent of Health Department survey respondents cited safety as a barrier for walking or biking.

Literature Review

Although individual studies provide differing statistics on crash rates for transit modes, all agree that fatality rates per mile are far lower for transit than for personal automobiles.

> Public transportation is one of the safest ways to travel. It is ten times safer per mile than traveling by car because it has less than a tenth the per-mile traffic casualty (injury or death) rate as automobile travel. Public transit-oriented communities are five times safer because they have about a fifth the per capita traffic casualty rate as automobile-oriented communities. In addition, crash rates tend to decline as public transit travel increases in a community." American Public Health Transportation Association, 2016

A national study was conducted on crash rates by mode from 1999-2003 to calculate fatal and non-fatal injury rates per 100 million person-trips.[47] The overall fatality rate was 10.4 per 100 million person-trips, while the overall non-fatal injury rate was 754.6 per 100 million person-trips. As compared to passenger vehicles, the fatality rate was nearly 60 times higher for motorcyclists, more than twice as high for bicyclists, about 50 percent higher for pedestrians, and 96 percent lower for bus users. Fatality rates were higher for males, teens and young adults, and older adults. As compared to passenger vehicles, the non-fatal injury rate was about 13 times higher for motorcyclists, about 80 percent higher for bicyclists, about 75 percent lower for pedestrians, and 80 percent lower for bus users. Non-fatal injury rates were similar across genders but higher for teens and young adults.

Even considering external risk (risks to other road users), transit travel has less than half the total death rate as automobile travel. [48] Most transit trips include active transport (walking and/or cycling) links, and transit users tend to walk and bike more in total than motorists. Although per-mile fatality rates are

higher for walking and biking, at a population-wide level, the benefits far outweigh the risks through better health from physical activity and the low risk of causing injuries to other road users.

Similarly, as public transit travel increases in a community total (pedestrians, cyclists, motorists and passengers), per capita traffic casualty rates tend to decline. Various studies using different analysis methods indicate that relatively small transit ridership gains are associated with proportionately larger reductions in per capita crash rates. For example, one study analyzing 29 years of traffic data for 100 U.S. cities, found that a 10 percent increase in the portion of passenger-miles made by transit is associated with 1.5 percent reduction in total traffic deaths.[49]

Predictions

Annual average fatality and injury rates per person-trips, by mode, were derived from study of crash rates reviewed above.[47] The fatality and injury rates were applied to the predicted change in the number of trips for each travel mode as a result of participation in the transit benefits program.

The predicted change in fatalities for transit benefits program participants was a reduction in 0.003 fatalities and 0.33 injuries per year.

Travel mode	Change in # of trips per year	Fatality rate per 100M trips*	Injury rate per 100M trips*	Predicted fatalities per year	Predicted injuries per year
Drive alone	-87,294	9.2	803.0	-0.0080	-0.70
Carpool	15,980	9.2	803.0	0.0015	0.13
Vanpool	7,460	9.2	803.0	0.0007	0.06
Transit	35,161	0.4	160.8	0.0001	0.06
Walk	12,565	13.7	215.5	0.0017	0.03
Bike	6,577	21.0	1,461.2	0.0014	0.10
Telework	9,551	0	0	0	0
Total				-0.0026	-0.33

* "Passenger vehicle" rates were applied to drive alone, carpool, and vanpool modes

Using the same Value of a Statistical Life as used in the EPA COBRA model, [32] and a value of $124,670 per injury (based on published findings about injury costs, then multiplied by an inflation factor of 1.255 Consumer Price Index, All Goods to update from 2005 US$ to 2017 US$),[50,33] resulted in a reduction of $66,500 per year due to reduced traffic-related fatalities and injuries.

Discussion

It is predicted that shifting State employees' transportation mode to public transit will contribute to a positive impact on health outcomes by reducing traffic injuries and fatalities. Because transit trips also include walking or biking, there will be additional physical activity benefits as well. However, increased walking and biking, especially in high traffic areas, may lead to other injury risks that must be considered when transit use is promoted, particularly in transition areas where there will be increased congestion of cars, buses, walkers, bikers. These congested areas could be made safer through improved crossings, signage, adequate sidewalks and bike lanes, lighting, and keeping sidewalks and bike lanes clear of snow

and ice in winter. Making communities safer for walking and biking will not only provide benefits for State employees but also improve safety and health for all road users.

In addition, there is a perception that walking, and especially biking, is unsafe. Education and peer support could help increase safety and confidence and help to mitigate those fears. The State and CATMA could consider offering safety and skills workshops, or providing loaners or discounts on safety equipment, including reflective clothing, lights, and helmets.

Mental Health/Stress

Existing Conditions and State Employee Comments

Poor mental health is a significant concern for many Vermont adults. In 2016, 12 percent of Vermont adults reported poor mental health, defined as 14 or more poor mental health days in the past month. Twenty-two percent reported being diagnosed with a depressive disorder, significantly higher than 17 percent of U.S. adults overall. Adults reporting poor mental health were adversely affected in participating in daily activities such as work on average 4.9 days a month.[18]

Nine percent of Health Department employees who responded to the Transportation Survey indicated that reducing stress was a motivator when considering commuting options other than driving alone. Others reported stress-related motivators included saving money (34 percent), saving time (22 percent), reducing hassles with traffic (22 percent), and reducing hassles with parking (9 percent).

Literature Review

Experience with daily commutes can contribute to a person's stress and therefore, mental health status. Studies have shown that use of different transportation modes (car, transit, active) have different impact on stress levels. Commute-related stress is caused by an interaction between objective stressors, such as time, monetary costs, control, and comfort, and the subjective interpretation of those stressors.

Work-related commuting has been associated with stress and fatigue. Perceived stress while, or immediately after commuting, has been found to increase with duration, variability in commuting time, lack of predictability, lack of control, and crowding. In addition, commuting has been associated with negative health outcomes not directly related to the commuting situation itself. This may be related to having less time for health-promoting behavior such as physical activity, relaxation and social participation. Short sleeping time has been observed among commuters in the U.S. and Italy. In the U.S., commuting has been shown to be associated with lower social participation, which has in turn been associated with poor health outcomes. Commuting has been studied as one of the antecedents of work-family(/life)-conflict and is thereby related to lower general wellbeing and reduced physical and mental health[51].

In addition, costs associated with car ownership and maintenance can be stressful, especially for lower income individuals and families. While transit cost may be less than owning a car, it is still a daily expense that may be a barrier for someone seeking work at a place that requires daily commuting.

Studies have shown that driving results in the most commute-related stress because 1) significant extra time is needed for dealing with delays, and 2) drivers are more likely to experience stress if they are unsatisfied with their commutes.[52,53,54] Stress levels are typically higher for those with longer commutes and those encountering frequent traffic congestion. These same studies indicated that while transit stress is typically less, transit users also encounter stresses such as crowding, unexpected waiting, and needing to transfer between modes. Walking and cycling is typically associated with the least stress and

most satisfaction, largely due to having more personal control, being perceived as more interesting, and being perceived as providing value above and beyond simply reaching a destination.[55]

Switching from car use to public or active transportation can result in increased commute satisfaction. A 2014 longitudinal study found that switching from car travel to public transport or active commuting (walking and biking) was associated with improved psychological wellbeing measures. The feeling of being constantly under strain and difficulty concentrating were significantly (13 percent) higher among car travelers than active commuters. Negative associations were found between commute time with car travel and psychological wellbeing. Longer commutes were associated with worse wellbeing than shorter commutes. By contrast, longer commute times when walking were positively associated with psychological wellbeing; a 10 minute increase in walking time improved psychological wellbeing measures.[56]

An employee-based study at the Massachusetts Institute of Technology tested the hypothesis that incentives that motivate individuals that typically commute alone to use public transit will increase travel satisfaction.[57] A free one-month public Commuter Benefit was provided as an incentive to university employees with full-time parking passes. Employees that utilized the public Commuter Benefit at least two times per week were included in the analysis; a total of 67 employees met this criterion. Primary findings were 1) commute satisfaction of employees that switched to public transit at least two times a week increased significantly, and, 2) commute satisfaction, while decreasing in intensity, was maintained after six months of continued behavior change.

One study found that reducing commuting stress resulted in less job strain, especially for those with elevated sensitivity to commuting conditions.[58] Other studies have reported lower absenteeism for cyclists,[59] and better punctuality and workplace energy for cyclists and pedestrians,[60] some of which may be due to lower commuter stress for these modes.

Predictions

Mental health outcomes and measurements varied widely across the studies reviewed above, making it difficult to quantify predicted mental health impacts of an Employee Commuter Benefit Program. Based on findings in the literature, it is predicted that implementing an Employee Commuter Benefit Program would improve commuter satisfaction, reduce commuter stress, and improve psychological wellbeing for employees switching from car travel to public transport or active modes of transportation. It is also expected that decreased commute stress and improved psychological wellbeing could result in reduced absenteeism, increased punctuality, and increased productivity.

Discussion

The evidence suggests that stress can be reduced and satisfaction increased by switching from driving along to another travel mode, particularly when travel includes walking or bicycling, though nearly all travel modes generate stress in different ways. Finding ways to reduce commuter stress can be important for improving employee satisfaction, productivity, and retention, which provides benefits for the employer as well as the employee. In addition to providing incentives or other financial benefits to

encourage commuting by means other than driving alone, employers could also help reduce commuter stress through schedule flexibility and telework opportunities. A positive inducement could also be to find ways to recognize and celebrate those who have made transportation changes.

Summary of Findings

A proposed statewide Employee Commuter Benefit Program is expected to have 1,022 participants and cost $402,000 per year.[14] Based on reported travel changes from the Capital Commuters pilot, it is expected that the number of commute trips by single-occupant motor vehicle for the 1,022 participants would decline by 29 percent, transit trips would increase by nearly 70 percent, and increases in walking, biking, car/vanpool, and teleworking would also be expected. If there was no travel behavior change for the other 7,410 State employees, the overall reduction for all State employees would be a 4 percent reduction in single-occupant motor vehicle trips, which seems plausible and possibly conservative in comparison to the median reduction of 11 percent reported in a 2016 review of workplace travel programs.[8]

In aggregate, the annual health benefit for participating State employees only is expected to be $245,000, based on the health benefits associated with reduced motor vehicle emissions, increased physical activity, and reduced risk of transportation-related injuries and fatalities. Nearly 70 percent of the expected benefits were attributable to increased physical activity, 27 percent to reduced injuries and fatalities, and only 4 percent to improved air quality. Air quality benefits would also be provided to the general public as a result of reduced driving by State employees, though quantifying that impact was beyond the scope of this assessment. Mental health benefits were not quantified, but are expected to include reduced commuter stress, increased commuter satisfaction, and improved psychological well-being. The quantified benefit resulting from increased physical activity only accounted for reduced premature mortality, though additional benefits are expected from improved mental health and reduced chronic diseases related to physical activity. These findings are also consistent with the measured health impacts reported in a 2016 review of workplace travel programs, though the published evidence about the health impacts of employer travel programs is extremely limited.[8]

While all findings were positive for health outcomes, the potential for increased bicycle and pedestrian accidents and fatalities exist, both real and perceived, and should be addressed.

Non-health benefits were also identified, including reduced demand for parking, increased access to potential job applicants, improved employee satisfaction and productivity, and the potential to catalyze improvements to transit service and walking/biking infrastructure that would benefit the larger community. This program would contribute to other State initiatives such as the Vermont Department of Health's 3-4-50 initiative that signifies *3 behaviors – lack of physical activity, poor diet, and tobacco use – lead to 4 chronic diseases – cancer, heart disease and stroke, type 2 diabetes, and lung disease – that are the cause of more than 50 percent of all deaths in Vermont*. Through 3-4-50, VDH offers tools and tips to supports communities, worksites, and other sectors to increase opportunities for physical activity (healthy eating, and decreased tobacco use) to prevent chronic disease. In addition, reducing single occupant vehicle usage would reduce greenhouse gas emissions, helping the state make progress

towards achieving the stated goals of the Vermont Comprehensive Energy Plan. Since these were beyond the scope of this assessment, they were not quantified or monetized, but would be expected to add additional value.

Overall, this assessment suggests that providing a transit benefit program to State employees will have a positive impact on health outcomes, especially if it includes incentives and other types of support for State employees to walk or bike as part of their commute.

Recommendations

Overall, this assessment suggests that providing a Commuter Benefit Program to State employees will have a positive impact on health outcomes for State employees, and both health and non-health benefits to the State as an employer, and indirectly to the Vermont community at large. The largest employee health benefits were associated with increased physical activity. Therefore, any strategies that can further encourage walking or biking as part of a transit or motor vehicle trip, or walking or biking alone, would further increase the expected benefits.

Fully subsidizing employee commuter benefits will remove cost-related barriers for employees and encourage greater use of public transit. In addition, allowing employees to flex schedules to accommodate transit times will remove perceived and actual barriers related to transit delays or added commute time related to using public transit.

Incentives for walking and biking to work are recommended to encourage employees to actively commute. Incentives can be offered in the form of prizes, rewards points, raffles, or other methods. The CATMA Walk/Bike Rewards program is an example of an effective rewards program to encourage walking and biking to work. Alternatively, the State could develop its own rewards program or integrate incentives into the state employee wellness program (LiveWell Vermont). In addition to financial incentives, it is recommended that employees who travel by means other than single-occupancy vehicles are recognized and celebrated through either a formal or informal recognition program. Individual departments or divisions could take responsibility for recognizing employees in e-newsletters or other venues.

While overall findings of this HIA were positive for all health outcomes, the assessment did identify an increased injury and fatality risk for pedestrians and cyclists, and that real and perceived risks can be a barrier to using these modes. Offering regular education and skills training opportunities regarding walk/bike safety may help mitigate risk. The State could partner with local organizations to offer walk/bike safety workshops for employees. Two examples of organizations that currently offer walk/bike safety workshops include Vital Communities (Upper Valley region) and Local Motion (Chittenden County region). In addition, providing discounted or loaner safety equipment, including reflective clothing, lights, and helmets will reduce cost-related barriers to using safety equipment. Exploring partnerships with bike, sports, and outdoor equipment retailers may lead to discounts for state employees. In addition, the Vermont State Employees Association (VSEA) member advantage program offers discounts at various retailers for VSEA members and could potentially encourage more

bike, sports, and outdoor equipment retailers to join the program to offer discounts to state employees that are VSEA members.

It is also recommended that the State continue to partner with local communities and transit providers to improve access to transit (i.e. more routes, and safe access to transit stops) and increase safe walking and biking options (i.e. bike lanes, driver education on sharing the road, signs, safe speed limits in high traffic areas, etc.). These broader solutions not only encourage use of alternate modes of commuting but will also support overall increased physical activity for children, youth, and adults.

Plan for Reporting and Monitoring

If the policy is passed to extend the Capital Commuters Program to all state employees, staff from the Vermont Department of Transportation and Health will promote the program and it's benefits to all employees. Both will monitor staff uptake over time. The Vermont Department of Health will provide encouragement for staff to take advantage of the benefit and will survey staff every other year to understand and be able to address challenges or barriers for staff using the benefit. Statewide data on chronic disease, physical activity and bicycle and pedestrian injury rates will continue to be monitored.

APPENDIX 1
Vermont Department of Health Employee Transportation Survey

1. What is your primary worksite?

2. What town or city do you live in?

3. What is the one-way distance in miles from your home to your primary worksite? Please round the nearest whole number. Google Maps

4. How often do you use these different options to get to work, assuming good weather? (check all that apply)

	Never	1 day	2-3 days	4-5 days
Car/Vanpool				
Drive Alone				
Get Dropped Off				
Take the bus				
Bike				
Walk/Roll				

Other (please specify:

5. What does, or would most motivate you, to consider travel options other than driving alone to work? (choose no more than two)

- ☐ Save money
- ☐ Save time
- ☐ Reduce environmental impacts
- ☐ Reduce stress
- ☐ Increase my physical activity
- ☐ Reduce hassles with traffic and congestion
- ☐ Reduce hassles with parking where I work
- ☐ I would not consider other modes
- ☐ Other (please specify)

6. If you were unable to drive alone to work, what is the next most likely mode you would consider? (choose one)

- ☐ Bus
- ☐ Car/vanpool
- ☐ Bike
- ☐ Walk/Roll
- ☐ N/A - I never drive alone
- ☐ Other (please specify)

7. Would any of the following make it more likely for you to travel to work by means other than driving alone? (choose no more than three)

- ☐ Shifting your work schedule to different hours
- ☐ A guaranteed ride home program in case of an emergency,
- ☐ bad weather, etc.
- ☐ Encouragement programs that provide motivation, prizes, etc.
- ☐ Easier access to fleet vehicles for job-related purposes
- ☐ The option to telework more than one day per week
- ☐ Improved accessibility or disability related

- ☐ services/accommodations
- ☐ Buddy system – being able to bike, walk/roll, or bus to work with a colleague
- ☐ I would not travel to work by other means other than driving alone
- ☐ Other (please specify)

8. Would any of the following offered at your worksite make it more likely for you to walk, bike, or roll to work? (choose no more than three)

- ☐ Access to loaner bikes
- ☐ Expanded or improved bike parking facilities
- ☐ Bicycle maintenance services provided
- ☐ Training on bicycle skills, safety, rules of the road, maintenance, etc.
- ☐ The ability to park within five miles of your worksite & bike from there
- ☐ More bike lanes or off-street bike paths
- ☐ Safety or accessibility improvements to crosswalks and Intersections
- ☐ Buddy system – being able to bike or walk/roll to work with a colleague
- ☐ A program that provides motivation, activities/challenges, and celebration for walking/rolling or biking to work
- ☐ Other (please specify)

9. Would any of the following make it more likely for you to travel to work by public transit, carpool, or vanpool? (choose no more than three)

- ☐ Personal assistance with route planning or car/vanpool matching
- ☐ Having access to a park & ride lot between home and work
- ☐ Park & ride lots within 10 miles of my worksite
- ☐ Changes to your work schedule that better align with transit schedules
- ☐ More direct and efficient public transit options
- ☐ Changes to transit schedules that better align with your work schedule
- ☐ Dedicated parking spaces for car/vanpools
- ☐ Improved building or vehicle accessibility or other disability accommodations/services (Examples include: vehicles that are wheelchair accessible; a bus or shared transportation route that ends close to an accessible entrance; easily accessible information on transportation options and schedules.)
- ☐ Other (please specify)

10. Would any of the following financial incentives or disincentives make it more likely for you to travel to work by means other than driving alone? (choose no more than two)

- ☐ Giving up your parking pass in exchange for a financial benefit
- ☐ Financial incentives for walking, biking, using the bus, or car/vanpooling
- ☐ Discounts for purchasing Commuter Benefits or using a vanpool service
- ☐ A monthly fee to park at work
- ☐ Other (please specify)

11. What barriers make it difficult for you to travel to work by means other than driving alone? (choose no more than three)

- ☐ I live too far away to make other options work
- ☐ It takes too much time to travel by any other means
- ☐ I need my vehicle during the day for work purposes
- ☐ I need my vehicle during the day for personal errands
- ☐ I need to pick-up/drop-off others or run errands on my way to or from work
- ☐ I have a disability that prevents me from using other modes of travel
- ☐ I have too much stuff to carry to or from work
- ☐ The weather is a barrier for much of the year
- ☐ I don't want to arrive to work hot and sweaty!
- ☐ I don't feel safe walking or biking
- ☐ I don't want to carpool with other people
- ☐ My work schedule is too unpredictable
- ☐ N/A I never drive alone
- ☐ Other (please specify)

12. Do you have any other suggestions for encouraging employees to travel by options other than driving alone, additional constraints, or other comments about employee transportation options?

Appendix 2
Vermont Department of Health Employee Transportation Survey
Summary of Results

Introductory Information

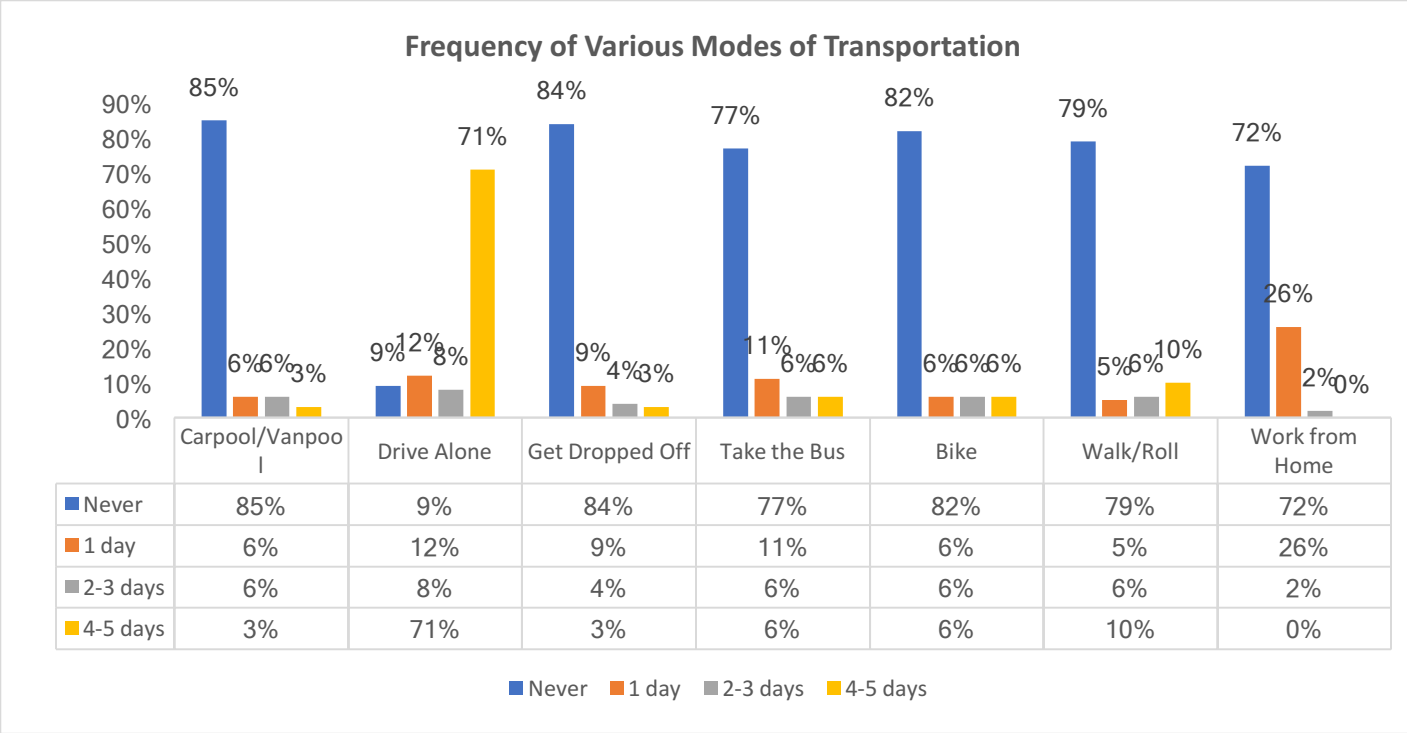
The Transportation Health Impact Assessment (HIA) survey was distributed to all Vermont Department of Health (Health Department) employees. There were 163 total respondents. As you read through this report, percentages of responses to a given question may not always equal 100%, as there was the ability to choose multiple responses for several questions.

The majority of respondents work at 108 Cherry Street, in either the Health Department's Central Office (65%) or the Burlington District Office (14%). There were respondents from all of the Health Department's twelve district offices except for one.

About one quarter (26%) of respondents live in Burlington, and about 10% live in Colchester or South Burlington. There were respondents from numerous other cities and towns as well. On average, respondents travel about 14 miles, one-way, from their home to their primary workstation. 60% of respondents reported living within 10 miles of work, while some live well over 50 miles from work.

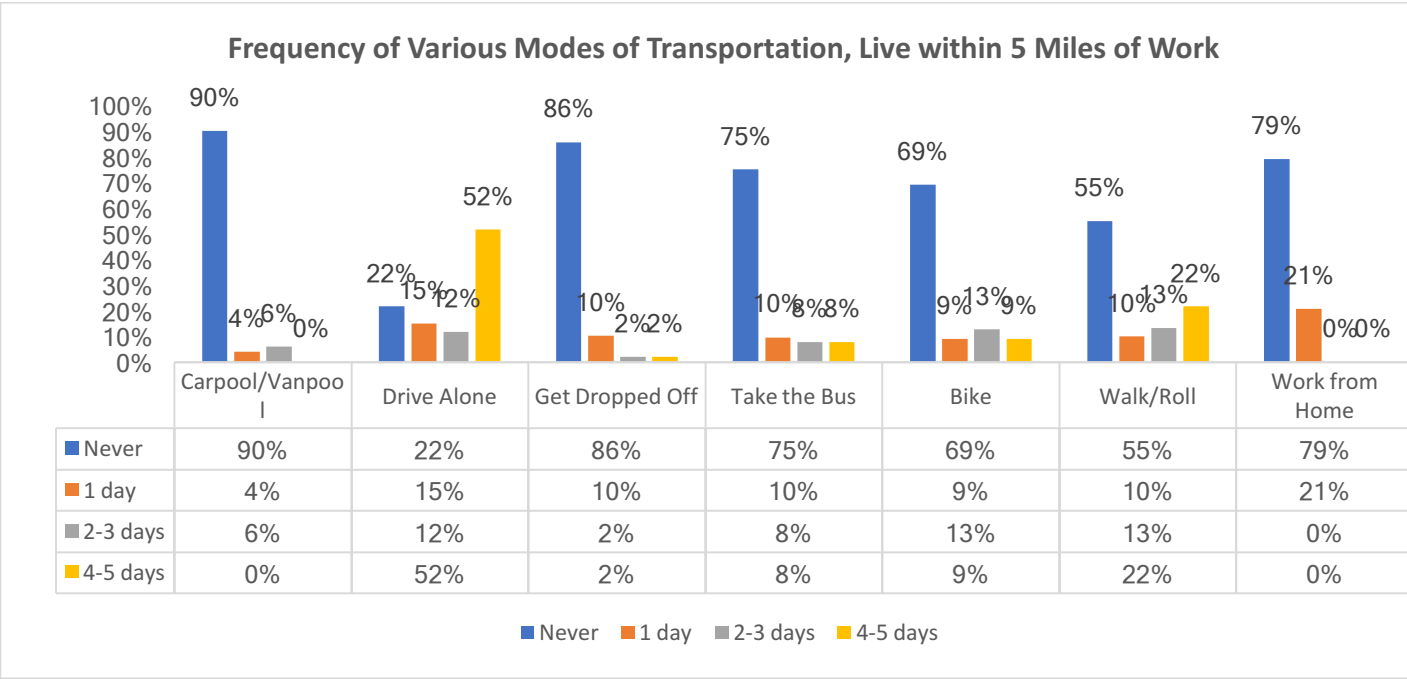
Modes of Transportation

Driving alone was the mode of transportation used by most respondents (71%) to get to work 4-5 days a week. About a quarter (26%) of respondents work from home one day a week. 23% take the bus at least one day a week, 22% walk/roll at least one day per week, while 18% indicated biking to work at least one day a week.



	Carpool/Vanpool	Drive Alone	Get Dropped Off	Take the Bus	Bike	Walk/Roll	Work from Home
Never	85%	9%	84%	77%	82%	79%	72%
1 day	6%	12%	9%	11%	6%	5%	26%
2-3 days	6%	8%	4%	6%	6%	6%	2%
4-5 days	3%	71%	3%	6%	6%	10%	0%

When looking at only those who live within five miles of work, only half (52%) of respondents drive alone to work 4-5 days per week. Percentages of those walking/rolling (45%) or biking (31%) to work were higher among this group.



	Carpool/Vanpool	Drive Alone	Get Dropped Off	Take the Bus	Bike	Walk/Roll	Work from Home
Never	90%	22%	86%	75%	69%	55%	79%
1 day	4%	15%	10%	10%	9%	10%	21%
2-3 days	6%	12%	2%	8%	13%	13%	0%
4-5 days	0%	52%	2%	8%	9%	22%	0%

Respondents were given the opportunity to write free text comments about their transportation decision making process. Many indicated that their reason for driving alone had to do with taking their children to daycare or school. Others mentioned the need to get to activities (either personal or work-related) directly before or after work. Some use active transportation (biking or walking/rolling) for part of the year, such as April through November, but choose to drive when it gets cold and dark out. Some take the bus or work from home only a few times a month. There were also some who expressed a desire to work from home one day a week, but it was not an option for them due to their management's policies.

Motivation to Consider Options Other than Driving Alone

The biggest motivators for respondents in considering options other than driving alone to work were to increase their physical activity (34%), save money (34%), reduce environmental impacts (33%) and time (20%). There were 11% of respondents who said that they would not consider other modes of transportation, regardless of various motivating factors.

Additional factors that were written in as comments included concern about picking children up during the day for appointments or in case of emergency, not wanting to wait for the bus or ride a bike in the cold, and the lack of full or partial subsidization of bus passes for Health Department employees.

Alternatives to Driving Alone

Respondents were asked what their next most likely mode of transportation would be if they were unable to drive alone to work. One third indicated that the bus would be their next most likely option, closely followed by 27% who would car or vanpool. About 12% indicated that they would either bike or walk/roll to work if unable to drive alone. Others mentioned working from home more frequently. Concerns were expressed about lack of options in rural areas, as well as the need to get to offsite meetings or appointments during the workday.

How to Reduce Barriers to Alternative Transportation

Half of respondents (52%) stated that having the option to telework more than 1 day a week would reduce their likelihood to drive alone to work. 34% indicated that a guaranteed ride home would increase their likelihood to use alternative transportation. 28% said that an encouragement program or the ability to have an alternate work schedule would increase their likelihood to use alternative transportation.

Additional comments included the desire for improved bike infrastructure and safer walking routes, as well as increased bike parking in the Cherry Street garage. Some respondents were interested in a bike share program, especially in the context of using a bike to get to offsite meetings during the work day. Others suggested allowing working while on route to "count" as part of the work day, or offering reduced insurance premiums for those who use active transportation to get to work. There were concerns expressed about lack of flexibility with alternative transportation options (children, appointments, after work commitments), as well as the lack of easy and safe alternatives in rural areas of the state.

Incentives for Active Transportation

About half of respondents indicated that more bike lanes, off-street bike paths, or improved crosswalks and intersections would make it more likely for them to use active transportation to get to work. Respondents expressed concerns about drivers not respecting or being aware of bikers and pedestrians.

About 20% of respondents indicated that a program to provide motivation, activities/challenges, and celebration of active transportation would incentivize them. Other ideas included increased presence of loaner bikes, provision of bike maintenance services at work, as well as assistance with purchasing a bike to use to get to and from work. Respondents stated that having guaranteed access to a fleet car for work trips during the day would make active transportation to and from work more feasible.

Incentives for Public Transit, Carpool, or Vanpool

About 40% of respondents indicated that more direct and efficient route options would make it more likely for them to utilize public transit to get to work. About 20% indicated that changes to either their work schedule or transit schedules to create better alignment between the two, would increase their likelihood of using public transit. Respondents expressed the need for a guaranteed ride home in case of an emergency. There was also concern about lack of public transportation or ridesharing options outside of Chittenden County.

Impact of Financial Incentives or Disincentives

Over half (60%) of respondents indicated that they would react positively to a financial incentive for walking, biking, using the bus, or car/vanpooling. 45% indicated that discounts for purchasing Commuter Benefits or for using a vanpool service would be a good strategy. 17% said they would be willing to give up their parking pass in exchange for a financial benefit.

Comments included the suggestion that compensatory time could be earned when using alternative transportation to get to work. There was concern around financial incentives not negatively impacting those who must drive alone to work for various reasons.

Barriers to Alternative Transportation

The major barrier for 40% of respondents was the additional time it takes to travel by any other means than driving alone. About 30% indicated the need to pickup/drop off others or run errands on their way to or from work. About a quarter listed the weather as a barrier for much of the year. 20% need their vehicle during the day for work purposes. About 10% were concerned about how to carry things to and from work using alternative transportation, or about arriving to work hot or sweaty.

Children again appeared frequently in the comments, as a reason why it is difficult to use alternative transportation. Others mentioned the high importance of personal time, as well as concern about being able to work a full 8 hours without "counting" time spent on the bus. Some expressed concern about carpooling becoming an extension of the workday, with colleagues wanting to talk work on the way to and from their workstation.

Additional Comments

Several respondents said that in order to initiate real change around alternative transportation, the cost benefit ratio needs to be shifted. Many individuals currently see alternative transportation as being less convenient and more time consuming than driving alone. Along these same lines, the State trip calculator often says that it is less expensive for personal vehicles to be used for short work-related trips during the work day. Ways to help shift this ratio may include charging for parking (which many were also very opposed to) or putting together data to quantify the climate and health impacts of various transportation modes for both commuting and traveling to work meetings during the day.

Respondents expressed a desire for flexibility when it comes to alternative transportation, stating that it is hard to commit to any option 100% of the time. Suggestions included the option to have a parking pass for 100 days out of the year or having the option to work from home in the morning if it's pouring out and then biking in later. Flexibility is especially important for single parents.

Comments around active transportation included offering a discount program to help purchase shoes, boots, or other gear to prepare for bad weather. Provision of bike lockers at park-and-bike lots, provision of towels for showers, and ensuring a safe place to park bikes when the Cherry Street garage is being worked on were also suggested. Having an event week like "Bike/Walk/Roll to Work Week" might be a good way to get more people to try one of these options and see that it is feasible.

Other ideas included implementing a van pool that would bring employees between district office locations, encouraging carpooling over public transportation for areas outside of Burlington, and offering resources for coordinating carpool groups. Others were interested in the use of State electric vehicle charging stations, as is the case in Montpelier.

References

[1] Vermont Department of Public Service, 2016 Vermont Comprehensive Energy Plan, http://publicservice.vermont.gov/publications-resources/publications/energy_plan/2015_plan

[2] Centers for Disease Control and Prevention. Health Impact Assessment http://www.cdc.gov/healthyplaces/hia.htm. Accessed January 16, 2015.

[3] Vital Communities. Capital Commuters Final Program Pilot Report. March 2016.

[4] Litman T. Evaluating Public Transit Benefits and Costs: Best Practices Guidebook. Victoria Transport Policy Institute. April 24, 2018.

[5] TRC Report #10-018, 2011 & Chittenden County Regional Planning Commission and Transportation Coaching Partners UVM Report, 2014

[6] Vermont Department of Human Resources, State of Vermont Workforce Report: Fiscal Year 2017, http://humanresources.vermont.gov/sites/humanresources/files/documents/DHR-Workforce_Report.pdf

[7] AAA. Your Driving Costs: How much are you really paying to drive? 2017 Edition. Accessed January 15, 2018.

[8] Petrunoff N, Rissel C, Wen LM. The effect of active travel interventions conducted in work settings on driving to work: A systematic review. Journal of Transport & Health. 2016: 3(1); p.61-76.

[9] Mutrie N, Carney C, Blamey A, et al. "Walk in to Work Out": a randomised controlled trial of a self help intervention to promote active commuting. Journal of Epi & Comm Health. 2002: 56(6); p.407-412.

[10] Hemmingsson E, Udden J, Neovius M, et al. Increased physical activity in abdominally obese women through support for changed commuting habits: a randomized clinical trial. Int J of Obesity. 2009: 33; p.645-652.

[11] Oja P, Vuori I, Paronen O. Daily walking and cycling to work: their utility as health-enhancing physical activity. Patient Education and Counseling. 2009: 33; S87-S94.

[12] Scheepers CD, Wendel-Vos GCW, den Broeder JM, et al. Shifting from car to active transport: A systematic review of the effectiveness of interventions. Transportation Research Part A: Policy and Practice. 2014: 70; p.264-280.

[13] Arnott B, Rehackova L, Errington L, et al. Efficacy of behavioural interventions for transport behaviour change: systematic review, meta-analysis and intervention coding. Int J of Behav Nut and Phys Act. 2014: 11(133).

[14] Vermont Energy Investment Corporation. Capital Commuters Program Evaluation. Prepared for Vermont Agency of Transportation, April 2017.

[15] Vermont Agency of Transportation. 2015 Capital Commuters Survey Report.

[16] U.S. Department of Transportation. Summary of Travel Trends: 2009 National Household Travel Survey. http://nhts.ornl.gov/2009/pub/stt.pdf.

[17] Fishman E, Washington S, Haworth N. Bike share's impact on car use: Evidence from the United States, Great Britain, and Australia. Transportation Research Part D: Transport and Environment. 2014: 31; p.13-20.

[18] Vermont Department of Health. Vermont Behavioral Risk Factor Surveillance System, 2016 Data Summary. www.healthvermont.gov/sites/default/files/documents/pdf/summary_brfss_2016.pdf.

[19] Vermont Department of Health. 3-4-50: Lung Disease in Vermont. http://www.healthvermont.gov/sites/default/files/documents/pdf/3-4-50_Asthma_%20Data%20Brief_FINALapproved_060117.pdf.

[20] Vermont Department of Health. Hospital Use for Asthma Among Vermonters. http://www.healthvermont.gov/sites/default/files/documents/pdf/hsvr_asthma_data_brief_hosp_ed_2017.pdf

[21] Caiazzo F, Ashok A, Waitz IA, et al. Air Pollution and Early Deaths in the United States: Part I: Quantifying the impact of major sectors in 2005. Atmospheric Environment. 2013: 79; p.198-208.

[22] U.S. Environmental Protection Agency. Air Data: Air Quality Data Collected at Outdoor Monitors Across the U.S. Accessed Jan 2018: https://www.epa.gov/outdoor-air-quality-data.

[23] U.S. Centers for Disease Control and Prevention. National Environmental Public Health Tracking Data Explorer. Accessed Jan 2018: https://ephtracking.cdc.gov/DataExplorer/#/.

[24] Health Effects Institute. Special Report 17: Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. January 2010.

[25] Anderson JO, Thundiyil JG, Stolbach A. Clearing the Air: A Review of the Effects of Particulate Matter Air Pollution on Human Health. Journal of Medical Toxicology. 2012: 8(2); p.166-175.
[26] Hoek G, Krishnan RM, Beelen R, Peters A, Ostro B, Brunekreef B, Kaufman JD. Long-term air pollution exposure and cardio- respiratory mortality: a review. Environmental Health. 2013: 12(43).
[27] Di Q, Wang Y, Zanobetti A, et al. Air Pollution and Mortality in the Medicare Population. N Engl J Med. 2017: 373(26); p.2513-22.
[28] Makar M, Antonelli J, Di Q, et al. Estimating the Causal Effect of Low Levels of Fine Particulate Matter on Hospitalization. Epidemiology. 2017: 28; p.627-34.
[29] de Nazelle A, Nieuwenhuijsen MJ, Antó JM, et al. Improving health through policies that promote active travel: a review of evidence to support integrated health impact assessment. Environment International. 2011: 37(4); 766-77.
[30] Cepeda M, Schoufour J, Freak-Poli R, et al. Levels of ambient air pollution according to mode of transport: a systematic review. The Lancet. 2017: 2(1); p.e23-e34.
[31] California Air Resources Board. Methods to Find the Cost-Effectiveness of Funding Air Quality Projects. Accessed January 2018: https://www.arb.ca.gov/planning/tsaq/eval/evaltables.pdf, p.7.
[32] U.S. Environmental Protection Agency. CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool. Accessed Mar 2018: https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool.
[33] U.S. Department of Labor, Bureau of Labor Statistics. Consumer Price Index. Accessed Jan 2018: https://www.bls.gov/cpi/.
[34] Vermont Department of Health. 3-4-50 Chronic Disease and Low Socio-Economic Status Data Brief. Vermont Behavioral Risk Factor Surveillance System: 2016.
[35] Vermont Department of Health. 3-4-50 Chronic Disease and Disabilities Data Brief. Vermont Behavioral Risk Factor Surveillance System: 2016.
[36] Vermont Department of Health. 2015 Vermont Youth Risk Behavior Survey.
[37] Vermont Department of Health. Vermont Behavioral Risk Factor Surveillance System: 2016 Data Summary.
[38] Rissel C, Curac N, Greenaway M, Bauman A. Physical Activity Associated with Public Transport Use—A Review and Modelling of Potential Benefits. Int J Environ Res Public Health. 2012: 9(7); p.2454-2478.
[39] Freeland AL, Banerjee SN, Dannenberg AL, Wendel AM. Walking Associated with Public Transit: Moving Toward Increased Physical Activity in the United States. Am J Public Health. 2013: 103(3); p.536-42.
[40] Kelly P, Kahlmeier S, Gotschi T, et al. Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship. Int J of Behav Nut and Phys Act. 2014: 11(132).
[41] Vermont Department of Health. 2015 Vital Statistics Annual Report. http://www.healthvermont.gov/health-statistics-vital-records/vital-records-population-data/vital-statistics-reports-and-maps.
[42] Vermont Agency of Transportation. Vermont Governor's Highway Safety Program: 2017 Annual Report. http://ghsp.vermont.gov/content/reports-and-data. Accessed June 5, 2018.
[43] Insurance Institute for Highway Safety. Fatality Facts: State by State. http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview. Accessed June 7, 2018.
[44] Vermont Department of Health. Leading Causes of Injury Mortality Among Vermont Residents. http://www.healthvermont.gov/sites/default/files/documents/2017/02/HSVR_Injury_Mortality.pdf. Accessed June 7, 2018
[45] Vermont Department of Health. Leading Causes of Injury Morbidity Among Vermont Residents at Vermont Hosptials. http://www.healthvermont.gov/sites/default/files/documents/pdf/HSVR_injury_morbidity.pdf. Accessed June 7, 2018
[46] Vermont Department of Health. Injury and Violence in Vermont. July 2018. http://www.healthvermont.gov/sites/default/files/documents/pdf/Injury_and_Violence_in_Vermont_07_31_2018.pdf. Accessed November 9, 2018.
[47] Beck LF, Dellinger AM, O'Neil ME. Motor Vehicle Crash Injury Rates by Mode of Travel, United States: Using Exposure-Based Methods to Quantify Differences. American Journal of Epidemiology. 2007: 166(2); p.212-218.
[48] Litman, Todd. Safer than You Think! Revising the Transit Safety Narrative. Victoria Transport Policy Institute. November, 2016.
[49] Litman, Todd. Safer than You Think! Revising the Transit Safety Narrative. Victoria Transport Policy Institute. November, 2016.

[50] Litman, Naumann RB, Dellinger AM, Zaloshnja et al. Incidence and total lifetime costs of motor vehicle-related fatal and non-fatal injury by road user type in the United States. Traffic Injury Prevention. 2010: 11(4): p.353-60.
[51] Hansson E, Mattisson K, Björk J, et al. Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden. BMC Public Health. 2011; 11:834.
[52] Haider M, Kerr K, Badami M. Does Commuting Cause Stress? The Public Health Implications of Traffic Congestion. SSRN. August 2013.
[53] Gatersleben B., Uzzell D. Affective Appraisals of the Daily Commute. Environment and Behavior. 2007: 39(3); p.416-431.
[54] Legrain A, Eluru N, El-Geneidy AM. Am stressed, must travel: The relationship between mode choice and commuting stress. Transportation Research Part F. 2015: 34; p.141-151.
[55] St-Louis E, Manaugh K, van Lierop D, El-Geneidy A. The happy commuter: A comparison of commuter satisfaction across modes. Transportation Research Part F. 2014: 26; p.160-170.
[56] Martin A, Goryakin Y, Suhrcke M. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. Preventive Medicine. 2014; 69; p.296-303.
[57] Abou-Zeid M, Fujii S. Travel satisfaction effects of changes in public transport usage. Transportation. 2016: 43(2)' p.301–314.
[58] Wener R, Evans G, Boately P. Commuting Stress: Psychophysiological Effects of a Trip and Spillover into the Workplace. Transportation Research Record. 2005: 1924, p.112-117.
[59] Mytton OT, Panter J, Ogilvie D. Longitudinal associations of active commuting with wellbeing and sickness absence. Preventive Medicine. 2016: 84; p.19-26.
[60] Loong C, van Lierop D, El-Geneidy A. On time and ready to go: An analysis of commuters' punctuality and energy levels at work or school. Transportation Research Part F. 2017: 45, p.1-13.