Economic Impact of Bicycling and Walking in Vermont

Draft Report

Prepared by:
Resource Systems Group, Inc.
Economic and Policy Resources, Inc, and
Local Motion

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DATA ■ ANALYSIS ■ SOLUTIONS

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EXECUTIVE SUMMARY

The *Vermont Pedestrian and Bicycle Policy Plan* identified the need for a research study to determine the overall economic and environmental benefits of bicycling and walking on the State's economy. The study is meant to be a one year "snapshot" of the total economic and environmental benefit - including direct, secondary and spin-off benefits – of bicycle and pedestrian facilities and activities, including tourism, environmental, improved air quality and reduced green house gas emissions, real estate values, health, reduction in demand on the transportation systems, and other economic benefits.

The core economic model was developed by Regional Economic Models, Inc. (REMI) and is widely used throughout Vermont State government. The model is maintained by the Vermont Economic Progress Council (VEPC) and the Legislative Joint Fiscal Office (JFO) for required analytic work and is also used by the VT Dept. of Public Service. The computation of any direct and indirect state revenues and costs was completed using the Vermont Employment Growth Incentive (VEGI) fiscal cost/ benefit model as maintained by the VEPC. This model has been utilized for 15 years, was approved by the JFO and has successfully been audited by both the State Auditor of Accounts and the JFO.

The Vermont Agency of Transportation hired the consultant team of Resource Systems Group, Inc., Economic and Policy Resources, Inc., and Local Motion. VTrans and the consultants have been working with an assembled Task Force, which includes:

Name	*Organization*
Jon Kaplan	VTrans Project Manager
Scott Bascom	VTrans
David Ellenbogen	Vermont Bicycle and Pedestrian Coalition
Greg Gerdel	VT Department of Commerce and Community Development
Bruce Hyde	VT Department of Commerce and Community Development
Suzanne Kelley	VT Department of Health
Susan Schreibman	Rutland Regional Planning Commission
Justine Sears	UVM Transportation Research Center
Jennifer Wallace-Brodeur	AARP
Sherry Winnie	VT Dept. of Forests, Parks & Recreation

In addition to VTrans data on bicycle and pedestrian facility construction spending data, the consultant team contacted 61 municipalities regarding their bicycle and pedestrian infrastructure and maintenance costs, almost 70 bicycle and pedestrian related businesses and organizations, and gathered data on approximately 18,500 home sales in VT. VTrans and the consultant team also reached out through a public meeting on the data collection and approach.

Study Findings

- Expenditures for bicycle and pedestrian related infrastructure and programs in 2009 amounted to $9.8 million. Building and maintaining bicycle and pedestrian facilities and providing related programs in Vermont generates a total statewide employment of 233 direct and indirect workers with a total payroll of $9.9 million.

- Visitor expenditures were obtained for over 40 major running and bicycling events taking place across Vermont in 2009. In the absence of reliable visitor estimates associated with bicycling and walking activities, this data set provides a condensed picture of bicycling and walking tourism in Vermont. In 2009, these 40 major events attracted over 16,000 participants. Combined with associated family and friends, these visitors spent over $6 million in the state. Such spending for lodging, food and meals, gas, and other shopping goods and recreational services in Vermont supports a total of 160 workers with $4.7 million in labor income (wages and salaries plus proprietor income). Further analysis of data is recommended to expand the economic picture of bicycling and walking related visitors to Vermont.
- Bicycle-pedestrian-oriented businesses in Vermont were surveyed with respect to their 2009 operations. These businesses include bicycle & parts and bicycle clothing manufacturers, bicycle wholesalers, sporting goods stores (e.g., bicycle shops, running/hiking shoe stores), bike rentals, bicycle and walking tour operators, mountain biking recreational centers, bicycle repair shops, and bicycle-pedestrian associations. Survey results include an estimated $30.7 million in revenues, with over two-fifths of sales to non-Vermonters; 561 employees with total payroll of $9.9 million.
- These findings from the business survey were then combined with published data/information to develop a more complete picture of the bicycle-pedestrian-oriented business sector. In 2009, these businesses generated $37.8 million in sales revenues and directly employed 820 workers with $18.0 million in labor income (wages and salaries plus proprietor income). These bicycle-pedestrian businesses further generate $18.5 million in sales revenues and support another 205 jobs with $8.3 million in payroll.
- Combining these totals from bicycle-pedestrian infrastructure and program expenditures, bicycle-pedestrian event tourism, and bicycle-pedestrian-oriented businesses results in a total 2009 economic contribution of $82.7 million in revenues, over 1,400 jobs with $40.9 million in labor income (wages and salaries plus proprietor income).
- In 2009, the gross domestic product for the State of Vermont was valued at $24.6 billion with total employment of 418,700 and labor earnings of $16.6 billion.
- Transportation system costs related to consumer costs and public costs are no doubt significant, but given the inherent complexity and challenges (including feedback and offsetting effects) it is not recommended to incorporate these transportation system costs into an input-output framework.
- The effect of walkability on the value of home sales was evaluated. Using a national walkability index that considers the proximity of a home to businesses, employment, schools and other destinations, the closing price and other statistics for 18,500 home sales in Vermont were evaluated. The conclusion is that there is an increase in home values statewide of approximately $350 million because those homes are in more walkable areas. This value was not processed through the economic impact model because it is unclear whether there is a demonstrated “wealth effect” that results from this increased value. The wealth effect results when an individual perceives that they have increased wealth and then spend more on goods and services, further stimulating the economy. However, there clearly

is an economic benefit realized by home owners in more walkable areas of the state when they sell their homes.

The table below summarizes the economic contribution of bicycle and pedestrian activities in Vermont.

Economic contribution of bicycle-pedestrian-oriented activities in Vermont, 2009

	Direct economic contribution			Indirect impact			Total economic contribution		
Bicycle-Ped segments	**Output ($MM)**	**Jobs**	**Earnings ($MM)**	**Output ($MM)**	**Jobs**	**Earnings ($MM)**	**Output ($MM)**	**Jobs**	**Earnings ($MM)**
Infrastructure									
Bicycle-ped infrastructure	$8.963	136	$5.760	$6.371	70	$2.809	$15.334	206	$8.569
Bicycle-ped program	$0.850	16	$0.719	$0.771	11	$0.616	$1.622	27	$1.336
Subtotal, infrastructure	$9.813	152	$6.479	$7.142	81	$3.425	$16.956	233	$9.904
Bicycle-ped events	$6.201	123	$3.272	$9.470	37	$4.731	$9.476	160	$4.734
Bicycle-ped businesses	$37.844	820	$18.001	$18.468	205	$8.280	$56.312	1,025	$26.281
Total	**$53.858**	**1,095**	**$27.751**	**$35.080**	**323**	**$16.436**	**$82.744**	**1,418**	**$40.919**

Note: $MM is millions of dollars
Source: Economic & Policy Resources, Inc.

1.0 INTRODUCTION

In the recently completed *Vermont Pedestrian and Bicycle Policy Plan*, one of the action strategies was to "conduct a research study to determine the overall economic and environmental benefits of bicycling and walking on the State's economy." [Such a] "study would be a one-time snapshot of the total economic and environmental benefit (direct, secondary, and spin-off benefits) of bicycle and pedestrian facilities and activities, including tourism, environmental, air quality, and green house gas emissions, real estate, health, reduction in demand on the transportation systems and other economic benefits."

As noted in the *Vermont Pedestrian and Bicycle Policy Plan* and elsewhere, cycling and walking provide significant environmental, transportation, health and economic benefits. Though such benefits are obviously enjoyed at an individual level, in aggregate, there are various benefit streams that flow to society from active forms of transportation including:

- reduced health costs (e.g., reduced risks of chronic diseases and ill-health);
- reduced costs related to air pollution and greenhouse gas emissions;
- reduced traffic congestion and increased vehicle operating costs savings;
- increased productivity and reduction of sick days in the workplace; and
- increased demand for recreational/leisure goods and services.

In addition, bicycling and walking are viewed as opportunities to grow the regional economy. As the number of active transportation participants and individual trips in the region increases, so does the impact of bicycling and walking on state and local economies. Investments in pedestrian and bicycling infrastructure generate economic returns in the form of increased visitation of travelers and tourism and related expenditures. And, there is evidence to suggest that property values increase along greenways and trails as well as pedestrian and cycling-friendly neighborhoods and communities.

An overall economic assessment of bicycling and walking activities also includes a group of industries and businesses comprised of manufacturers of bicycles and parts, running/cycling gear and apparel, wholesalers/distributors, tour operators, and retailers and repair services.

The purpose of this study is to estimate the total economic benefits of walking and biking in Vermont during a typical year. The results will be used to help educate decision makers, the business community, planners, advocates and other stakeholders; and may suggest policy changes and other actions that should be pursued to further the economic and other benefits of these two non-motorized modes of transportation. This report describes the study methodology (including a primer on economic impact analysis), model inputs and results, and conclusions.

The study is being conducted by a consultant team with expertise in economic impact analyses and transportation system planning and is guided by a Study Task Force with representatives from state government, regional planning, and bicycle and pedestrian stakeholders (Table 1).

Table 1: Study Task Force

Name	*Organization*
Jon Kaplan	VTrans Project Manager
Scott Bascom	VTrans
David Ellenbogen	Vermont Bicycle and Pedestrian Coalition
Greg Gerdel	VT Department of Commerce and Community Development
Bruce Hyde	VT Department of Commerce and Community Development
Suzanne Kelley	VT Department of Health
Susan Schreibman	Rutland Regional Planning Commission
Justine Sears	UVM Transportation Research Center
Jennifer Wallace-Brodeur	AARP
Sherry Winnie	VT Dept. of Forests, Parks & Recreation

2.0 STUDY APPROACH AND METHODOLOGY

The desired outcome of this study is an estimate of the revenue generated and number of jobs created during one typical year in Vermont due to the investment in and use of walking and biking facilities by residents and visitors. The resulting impact on revenues that support the state's general budget is another economic benefit that is also estimated. This section describes the study methodology for accomplishing these goals, beginning with a primer on economic impact analysis.

2.1 Economic Impact Analysis—Primer

Economic impact analysis is a technique for measuring the net effects of new spending and investment on a region's employment, wages, and business output (e.g., sales). This is accomplished by estimating the amount of net new spending as a direct result of the project (direct effects). For instance, in the case of a dedicated bicycle-pedestrian infrastructure project (i.e., path), the direct economic impacts come from two main sources, or phases: (a) additional spending in the region from the construction and on-going maintenance of the infrastructure; and (b) once in place, the increased usage of the newly constructed bike-pedestrian path will augment visitor spending at area retailers, restaurants, lodging establishments and other services.

Beyond this initial influx of new funds, the new direct spending is transmitted or "ripples" throughout the region with secondary or indirect economic effects. These indirect effects are generated from purchases of inputs and supplies by businesses and consumption purchases from their employees. For instance, a portion of the increased visitor spending on lodging in the area goes to the employees of the hotel and toward the purchase of products and services from local businesses. These local workers and businesses will, in turn, use a portion of their increased revenues to buy other goods and services from local vendors. (A portion of increased revenue used to purchase non-local goods and services are considered "leakage" and thus, do not generate additional economic activity within the region.)

This direct investment coupled with the subsequent spending by local vendors and workers make up the total economic impact. This process of spending and re-spending within the regional economy is sometimes referred to as the multiplier process.

The principal tool used in ascertaining economic impacts associated with bicycling and pedestrian activity is an input-output model. At its roots, an input-output model is an accounting method to describe a specific regional economy. One can actually think of an input-output model as a spreadsheet of the regional economy where the columns represent the buyers (demand) and the rows are the sellers (supply). Any particular cell where a column and row intersect is the dollar flow between the buyer and seller of a particular good or service. The sum of a particular row is the total supply (in dollar value of output or sales) of that particular industry and the sum of any particular column is the total demand of the industry. Given the laws of supply and demand within competitive markets, total demand must be equivalent to total supply.

The utility of the input-output approach lies not solely as an effective data accounting framework, but in its ability to trace small changes in one part of the economy throughout the entire regional economy. In the case of bicycle-pedestrian activity, the construction and subsequent operation of new bicycle-pedestrian infrastructure introduces new spending into the regional economy. This new injection of money into the economy causes a ripple (or "multiplier") effect throughout the rest of the economy. Through the use of an input-output model, we can track and measure this economic impact.

There are several measures used to gauge the economic effects, including industry output (sales), income, and employment. Because the input-output approach is based on dollar flows or sales, the impacts are generally displayed in total output or sales. In practice, most policy-makers and citizens have difficulty in understanding the nature of industry output and/or sales. Consequently, methods have been developed to convert industry output (sales) to income and employment.

An appreciation of these three economic metrics (sales or output, income, and employment) can be gained by referring back to our example of a new bicycle-pedestrian path/walkway. Suppose that during the construction phase, the new bike-ped path costs $1 million and takes three construction workers along with an owner/operator three months to build. Further, suppose that this owner/operator pays each of his workers annually $40,000 and pays himself $52,000. In this simple case, industry sales are $1 million, annualized employment is one, and income is $43,000.

To bring this discussion back to the beginning, the derived economic multipliers from the input-output analysis are composed of three segments. The first part is the direct effect that caused the initial change in the economy. In our example of building bicycle-pedestrian-related infrastructure, the construction company contributes directly to the economy by employing people and paying wages and salaries. Given the structure of the input-output model, we know that construction activity will have a rippling effect throughout the economy. This rippling effect is captured by the second component of the economic multiplier (indirect effect) and the third component, referred to as the induced effect.

In the framework of the input-output analysis, construction companies have two types of expenditures (costs) that are transmitted through the economy. The first represent business-to-business transactions such as the purchase of construction materials, the purchase of transport services for hauling of materials, the purchase of architectural and engineering services, and the purchase of other services such as insurance, accounting, and the like. Such business-to-business transactions are termed the indirect effects. The construction firm will use the proceeds from sales to make investments in the company, to purchase needed equipment, and to buy needed supplies. Suppose the construction firm uses part of the proceeds to purchase a new hauling truck from a local dealership. That purchase represents a sale to the dealership which in turn uses part of that sale to pay his/her bills. This is an example of the ripple process captured by the indirect component of a multiplier.

The second type of expenditure that construction firms introduce into the broader economy is wages and salaries paid to employees and the spending of their incomes in the regional economy is captured by what is referred to as the induced effect. Construction firm owners and their employees spend their income for consumption goods and services—in local grocery stores and other retail establishments, movie theatres, restaurants, as well as paying their mortgages or rent. The restaurant owner uses part of that money spent by construction workers to pay his/her employees and the spending and re-spending cycle continues.

There are a number of input-output modeling systems available for use in this study of the economic effects of bicycling and pedestrian activities in Vermont. In this study, the REDYN modeling system was initially utilized to ascertain the scope and scale of economic effects of bicycling and walking activities in Vermont. The core economic impact model was developed by Regional Economic Models, Inc. (REMI), and is widely used throughout Vermont State government. The model is maintained by the Vermont Economic Progress Council (VEPC) and the legislative Joint Fiscal Office (JFO) for analytic work associated with legislative economic and fiscal analyses. REMI is also used by the Vermont Department of Public Service.

The computation of all direct and indirect state revenues and costs associated with the State's bicycle and pedestrian facilities and activities is completed using the Vermont Employment Growth Incentive (VEGI) fiscal cost/benefit model as maintained by the VEPC. The VEGI fiscal cost/benefit model has had a long and proven record as the most valid state fiscal impact model available for use in Vermont State fiscal analysis. The VEGI model's cost-benefit structure has been successfully employed for the past fifteen years—with appropriate periodic modifications as specified by changes in the program and in cooperation with the goals and objectives for the program as articulated by the Vermont General Assembly. The model was approved by the Joint Fiscal Committee and also has undergone several audits by the State Auditor of Accounts and the Legislative Joint Fiscal Office. Minor modifications were made for this study, where appropriate, to adapt the model for assessing the fiscal impacts of the State's bicycle and pedestrian facilities and activities.

2.2 Methodology Overview

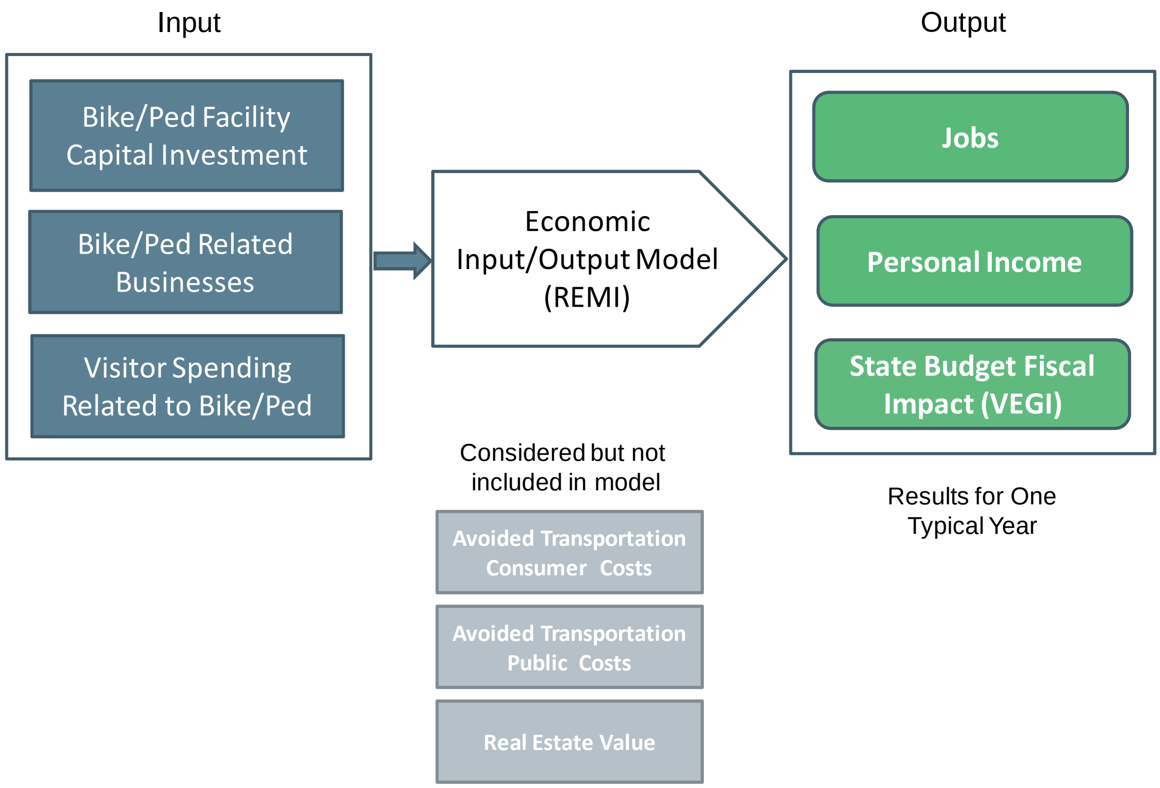
The methodology is based on the consultant team's review of numerous documents provided by VTrans, other research, and their experience with economic impact and transportation system analyses.[1] The economic assessment was originally based on:

1. The economic returns of capital investments in cycling and walking infrastructure;
2. Economic impacts associated with tourism and visitor spending;
3. Avoided transportation consumer costs realized by pedestrians and cyclists compared to travelling by automobile. Examples include vehicle ownership and operations, value of time lost in congestion and health benefits;
4. Avoided transportation public costs realized by society at large due to the shift of automobile travel to walking and biking. Examples include greenhouse gas and other emissions, traffic enforcement, noise impacts and safety;
5. The effect of walking and biking facilities on real estate values; and
6. Revenues and jobs created by walking and biking related businesses.

However, transportation costs (#3 and #4) and real estate values (#5) were ultimately not used because specific and reliable data are not available. It was therefore recommended that transportation system costs and real estate values not be incorporated into the input-output modeling framework. (See Figure 1.)

[1] A list of documents reviewed is provided in Attachment 1.

Figure 1: Overall Approach



2.3 Data Source Summary

The annual costs and benefits in dollars for all these components are estimated and used as inputs to the economic impact "input/output" model described above. Ideally, all of the costs would be used as inputs to the REMI economic impact model. However, the level of confidence associated with each of the economic impact categories described above in Figure 1 varies based on the quality of available data and whether or not the data needs to be processed further using other estimation techniques. (Appendix B lists the data sources consulted for this study.) An example of an economic impact category with a high level of confidence is the investment in walking and biking infrastructure which is based primarily on the actual costs of completed projects. An example of an economic impact category with less confidence is the public costs associated with greenhouse gas emissions which is based on (1) an estimate of vehicle miles travelled shifted to walking and biking in Vermont derived from a statewide household travel survey and (2) a general cost per vehicle miles travelled available from a third party source. Throughout the study, the consultant team with assistance from the Task Force determined which impact categories should be evaluated in the economic impact input/output model and which should be documented and discussed more qualitatively. The data sources were consequently organized into three categories:

- The first category involves identified costs and benefits for which the consultant team is able to identify or develop valid and defensible activity estimates. Data and activity estimates in this first category will have to meet a rigorous analytical standard that allows them to be included into the input/output model.

- The second category involve those sources where some informing data was available, but the available data--whether taken from secondary sources or developed during this study—is not up to a minimum analytical standard that would allowed it to be included into the economic impact input/output model.
- The third category of data and information involves those sources for which the investigators and the Task Force knew were of importance to bicycle and pedestrian facilities and activity estimates but for which there was little credible information available.

Table 2 presents the preliminary organization of the data described above into these three categories. As noted, the level of certainty for the Transportation System Costs and Real Estate Value was ultimately determined to not be robust enough for use in the model.

Table 2: Summary of Confidence Level for Potential Data Sources

Category	***High level of certainty – use in I/O Model***	***Medium level of certainty – may use in I/O model***	***Low level of certainty – Results presented for information only***
Bike/Ped Facility Capital Investment	• VTrans Capital Programs • Municipal Capital Budgets/Annual Reports		
Visitor Spending Related to Bike/Ped	• Tourism spending • Tour operators		
Transportation System Costs		• 2009 NHTS Data for VT • VMT Unit Costs from VTPI	
Real Estate Value			• Case Study Approach • Statistical Analysis Approach
Bike/Ped related Businesses			• Business survey

3.0 MODEL COMPONENTS AND RESULTS

As described above, there are three cost components that are evaluated in the economic input-output model to develop an estimate of the jobs and revenue that can be attributed to walking and biking in the state:

1. Bicycling and walking infrastructure/capital investment;
2. Revenues and jobs created by walking- and biking-related businesses; and
3. Visitor expenditures.

This section describes each of these inputs and the estimated revenue and jobs generated by them. Two other categories (real estate values and transportation system costs to the consumer and to the public) are also described below, although they were ultimately not included in the model.

3.1 Bicycle- and Pedestrian-Related Infrastructure

Obtaining specific cost information on bicycle and pedestrian-related infrastructure is fraught with difficulty. First, the nature of bicycle-pedestrian-related infrastructure; some of which is dedicated bicycle lanes on streets, others deemed walking and bicycle paths, with most in the form of sidewalks and roadway shoulders. Second, costs of most bicycle and pedestrian facilities—for instance, roadway shoulder widenings and sidewalks—are often incorporated with overall roadway projects and as such not specifically identified in the capital programs of Vermont Agency of Transportation and various local public works departments. Consequently, much of the data on bicycle-pedestrian infrastructure as found in Table 3 are estimated for 2009.

Table 3: Preliminary Estimates of Bicycle-Pedestrian Infrastructure Costs in Vermont, 2009

		Funding source ($ share)			
Description	**Total**	**Federal**	**State**	**Local**	**Private**
Vermont Agency of Transportation					
Bridge shoulder widening	$3,228,066	$2,582,453	$645,613	$0	$0
Bridge sidewalks	$3,306,806	$2,645,445	$661,361	$0	$0
Roadway shoulder widening	$283,264	$226,611	$42,490	$14,163	$0
Roadway related bicycle & pedestrian features	$192,161	$153,729	$28,824	$9,608	$0
Bike/ped safety projects	$161,841	$161,841	$0	$0	$0
Paved shoulders	$3,138,335	$2,510,668	$627,667	$0	$0
Bike/ped features in paving projects	$1,074,464	$859,571	$214,893	$0	$0
Enhancement program	$1,011,170	$808,936	$101,117	$101,117	$0
Bicycle/pedestrian program	$369,287	$295,430	$0	$73,857	$0
Subtotal, VTrans programs	$12,765,394	$10,244,683	$2,321,965	$198,746	$0
Recreational trails grant program					
Local community projects	$606,513	$178,197	$0	$428,316	$0
State projects	$305,998	$295,776	$10,222	$0	$0
Subtotal, Recreational trails	$912,511	$473,973	$10,222	$428,316	$0
Municipal sidewalk & bike projects	$1,300,000	$0	$0	$1,300,000	
Private sector sidewalks w/ housing	$820,000	$0	$0	$0	$820,000
Grand total	***$15,797,905***	***$10,718,656***	***$2,332,187***	***$1,927,062***	***$820,000***

Sources: Vermont Agency of Transportation; Various non-profit recreational trail groups; Department of Public Works various Vermont municipalities; and US Census Bureau.
Compiled and estimated by Resource Systems Group Inc. and Economic & Policy Resources Inc.

Table 3 shows that the costs of bicycle-pedestrian infrastructure projects and programs were estimated to total $15.8 million for 2009. Over two-thirds of the funds were sourced from the Federal government. About one-fourth of the total costs were funded by state and local governments, with the remainder coming from private sector contributions. The majority of the estimated bicycle-pedestrian infrastructure costs are for sidewalks and roadway shoulders.

Further adjustments were made for a number of Vermont Agency of Transportation infrastructure-related programs, specifically bridge shoulder widening, roadway shoulder widening, and paved shoulders. Utilizing a "shared-use" approach of bridge and roadway shoulders, it was determined that the bicycle-pedestrian combined share of these shoulders amounts to approximately 10 percent of the infrastructure costs. Consequently, the revised costs of bicycle-pedestrian infrastructure projects and programs were estimated to total $9.8 million (Table 4).

Table 4: Revised estimates of bicycle-pedestrian infrastructure/program costs in Vermont, 2009

Description	**Total**
Vermont Agency of Transportation	
Bridge Shoulder Widening	$322,807
Bridge Sidewalks	$3,306,806
Roadway Shoulder Widening	$28,326
Roadway related bicycle and pedestrian features	$192,161
Bike/pedestrian Safety projects	$161,841
Paved shoulders	$313,834
Bike/pedestrian features in paving projects	$1,074,464
Enhancement Program	$1,011,170
Bicycle/Pedestrian Program	$369,287
Subtotal, Vermont Agency of Transportation	*$6,780,696*
Recreational Trail Grant Program	
Local Community Projects	$606,513
State Projects	$305,998
Subtotal, Recreational Trails Grant Program	*$912,511*
Annual Municipal Sidewalk/Bicycle Projects & Maintenance	$1,300,000
Private Sector Sidewalks with Housing Projects	$820,000
Grand total	**$9,813,206**

Sources: Vermont Agency of Transportation; Various non-profit recreational trail groups; Department of Public Works, various Vermont municipalities; and US Census Bureau.
Compiled and estimated by Resource Systems Group, Inc. and Economic & Policy Resources, Inc.

These expenditure totals were further subdivided into two major categories—direct infrastructure costs and expenditures for program support of bicycling and pedestrian activities, including such programs as Safe Routes to Schools, Share the Road and bicycle commuter guides, pedestrian and bicycle facility plans, and recreational trail plans. The lion's share of these expenditures ($8.963 million) is directly for construction and maintenance of bicycle-pedestrian related infrastructure/facilities; the remainder ($0.85 million) is for bicycle-pedestrian program support.

Utilizing the REDYN input-output model, building and maintaining activities associated with bicycle-pedestrian infrastructure and bicycle-pedestrian program and planning activities in 2009 generated a total employment of 233 direct and indirect workers with average annual wages of $42,500 (Table 5). As expected, expenditures for bicycle-pedestrian-related infrastructure support scores of workers within the construction trades and professional/technical services (e.g., engineering and architecture firms). About 23 workers are supported by one million dollars of bicycle-pedestrian infrastructure spending. Bicycle-pedestrian program and planning activities support a number of workers in state and local governments as well as workers in non-profit organizations, such as trail associations and bicycle advocacy groups. Every one million dollars of bicycle-pedestrian program/planning support spending generates nearly 32 workers.

Table 5: Economic contribution of bicycle and pedestrian-related infrastructure &program spending in Vermont, 2009

	Direct economic contribution			Indirect economic impact			Total economic contribution		
Economic Contribution	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***
Infrastructure spending	$8.963	136	$5.760	$6.371	70	$2.809	$15.334	206	$8.569
Program expenditures	$0.850	16	$0.719	$0.771	11	$0.616	$1.622	27	$1.336
Totals	$9.813	152	$6.479	$7.142	81	$3.425	$16.956	233	$9.904

Source: Economic & Policy Resources, Inc.

3.2 Bicycle/Pedestrian Businesses

Information and data on consumer expenditures from bicycle and pedestrian-oriented businesses were obtained from a survey conducted during the summer/autumn of 2011 by Local Motion. The survey questionnaire (see Appendix D) was sent to 155 bicycle-pedestrian oriented businesses located throughout Vermont. The predominant activity is retail and service, though there is a cross-section of bicycling and pedestrian business activities, including:

- Manufacturing. Manufacturing of bicycles, parts and accessories is in decline in the United States and Vermont is the home of a couple of premier bicycle-related manufacturing concerns—Terry Bicycles (women's bicycle frames and clothing) in Burlington; and Louis Garneau (clothing) in Newport.
- Wholesalers/Distribution. Wholesale trade (distribution) in bicycles, parts and accessories and running/hiking shoes and gear is limited in Vermont; most wholesale/distribution of sporting goods (equipment, gear, and clothing) is within the non-bicycling and pedestrian arena—skiing and snowboarding, ice-skating and snowshoeing.
- Retail and service. Vermont is home to a number of independent bicycle and pedestrian-oriented retailers. In addition, there are several chain retail stores that sell bicycles and running shoes and related gear in Vermont.
- Other services. This category captures a significant number of businesses and organizations that do not easily fit in the other categories, such as:
    - Bicycle repair and maintenance shops
    - Mountain biking and hiking trail centers
    - Bicycle/walking touring companies
    - Non-profit bicycle promotion organizations
    - Bicycle couriers and bicycle display advertising

    These bicycle/walking services—particularly mountain biking and hiking trail centers and bicycle/walking touring companies—have a substantial tourism and traveler orientation. Mountain biking/hiking trail centers are increasingly viewed as "destination" places for the growing recreational traveler segment. Kingdom Trails and the Long Trail (Mount

Mansfield/Sunset Ridge) are top-ranked from mountain biking and hiking organizations respectively. Bicycle/walking tour companies have garnered a national (and international) clientele for guiding bicycle and walking tours in Vermont and beyond.

Survey returns were collected from 62 bicycle-pedestrian oriented businesses for a response rate of 40 percent. Results from the survey indicate a significant concentration of bicycle-pedestrian business activity in Vermont (Table 6). Collectively, surveyed businesses generated an estimated $39.2 million in total revenues for 2009; nearly two-thirds of which are bicycle-pedestrian related sales. Though the orientation of this activity is local-servicing, there is a substantial export-oriented component; nearly half of total sales of bicycles and pedestrian related goods and services are to non-Vermonters.

Table 6: Survey results of bike-pedestrian-oriented businesses in Vermont, 2009

Category	Amount	Share
Number of business responses	62	40%
Estimated total business revenues	$39,193,500	100.0%
Estimated share of revenues--bicycle & pedestrian	$25,124,960	64.1%
Estimated share of revenues--non-Vermont	$19,480,768	49.7%
Total employment	554	NA
Number of full-time workers	215	38.3%
Number of part-time workers	287	51.2%
Total estimated wages & salaries	$11,093,000	NA
Average wage & salary/worker	$20,023	NA

Sources: Local Motion and Economic & Policy Resources, Inc.

Further analytical work was conducted in this important aspect of bicycle-pedestrian-oriented businesses. With the exception of wholesale and distribution, there is a high degree of confidence of the number of businesses engaged in these various bicycle-pedestrian industry segments. Using data and information from other sources[1] combined with results from the business survey, a composite picture of the bicycle-pedestrian oriented business has been developed for 2009.

An estimated 180 bicycle-pedestrian oriented businesses were operating in Vermont during 2009; collectively these businesses employed 820 workers with total earnings of $18.0 million. Nearly three-quarters of the bicycle-pedestrian employment base were in retailing, including bicycle shops, running shoe stores, and outdoor recreation centers (Figure 2).[2] Bicycle-pedestrian manufacturers (bicycle frames, parts, and apparel) employ about 14 percent of the total bicycle-pedestrian business workforce. The remainder is further divided between bicycle-pedestrian tour operators, recreational sports centers, and bicycle/pedestrian associations (recreational trails associations, bicycle clubs and advocacy groups).

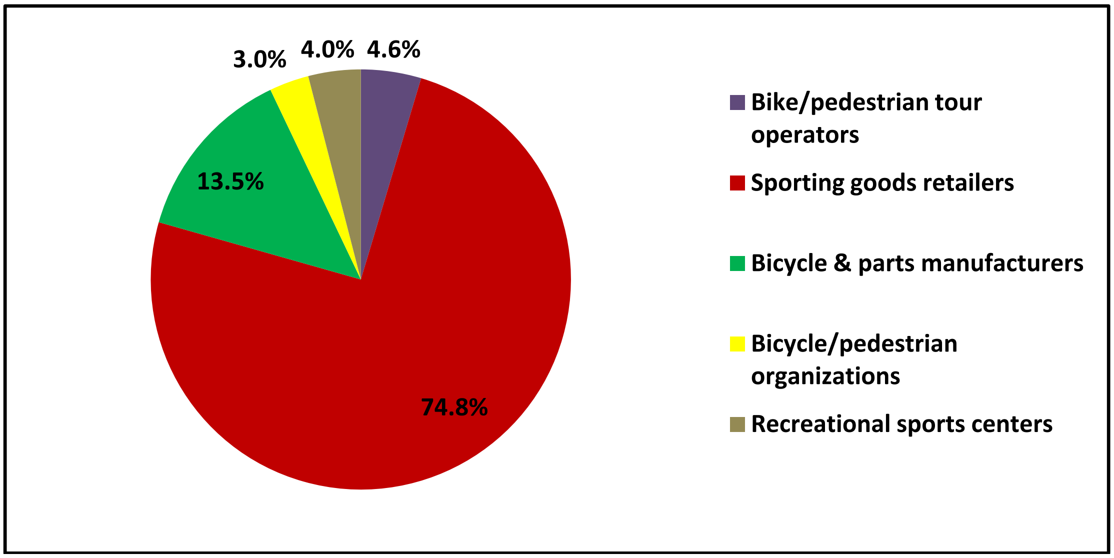
Average annual wages of $21,950 suggest a pronounced seasonality within the bicycle-pedestrian oriented industry. For instance, the Long Trail System in Vermont formally opens during Memorial Day weekend in late May and closes in late October each year. Mountain biking trail centers (some of

[1] Data sources include Quarterly Census of Employment and Wages from the U.S. Bureau of Labor Statistics and the Vermont Department of Labor; County Business Patterns and Economic Census from the U.S. Census Bureau; and Regional Economic Accounts from the U.S. Bureau of Economic Analysis.

[2] Bicycle-pedestrian oriented sales were estimated in these stores; only a portion of these center's employment was allocated to the bicycle-pedestrian segment.

which are cross-country ski and snowshoe trail centers during the winter) operate during the summer and early fall months; and bicycle-pedestrian tour operators conduct their bicycle/walking tours in Vermont between late spring and late fall. Retailers in bicycle-pedestrian oriented goods and services also exhibit seasonality in their sales.

Figure 2: Shares of employment in the Vermont bicycle-pedestrian oriented industry, 2009



Source: Economic & Policy Resources, Inc.

Utilizing the REDYN input-output model, bicycle-pedestrian oriented business activity further contributes to the state and regional economy in Vermont. In 2009, the bicycle-pedestrian oriented businesses generated total sales revenue of $56.3 million and supported 1,025 direct and indirect jobs with labor earnings of $26.3 million (Table 7).

Table 7: Economic contribution of bicycle-pedestrian oriented businesses in Vermont, 2009

	Direct economic contribution			**Indirect economic impact**			**Total economic contribution**		
Economic Contribution	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***
Bicycle-ped businesses	$37.844	820	$18.001	$18.468	205	$8.280	$56.312	1,025	$26.281

Sources: US Bureau of Economic Analysis; US Bureau of Labor Statistics; US Census Bureau
Compiled and estimated by Economic & Policy Resources, Inc.

3.3 Bicycle-Pedestrian-Related Visitor Expenditures

Tourism can be defined as the movement of people into an area for a brief period of time. Although visitor activity and expenditures within Vermont's hospitality and recreation sector is tracked on a regular basis, bicycle-pedestrian related tourism is difficult to estimate. As with bike-pedestrian oriented businesses, we simply do not have a reliable (annualized) number of visitors that come to Vermont for bicycling and walking/hiking activities. No one knows for instance, how many visitor days are associated with bicycle tourism,[1] nor the amount of related expenditures associated with either self-guided touring or guided tours. However, we do have one collected set of tourism-related bicycling and pedestrian-oriented activity that can be utilized, namely participation and expenditures related to major bicycling and running events in Vermont.[2] In 2009, there were over 40 major running and bicycling events that took place across Vermont, attracting over 16,000 participants (Table 8).

Table 8: Participants of major bicycling and running events in Vermont, 2009

	Event Participants	Associated Family and Friends	Total Persons Related to Events
Vermont Residents	7,886	15,772	23,658
Vermont Visitors	8,303	12,455	20,758
Totals	16,189	28,227	44,416

Sources: Event sponsors; Resource Systems Group, Inc.

As for any other type of tourism, the economic impact of bicycling and running event participation begins with some of every dollar visitors (participants and associated family/friends) spent on lodging, retail services, gas, food, entertainment, and other goods and services people buy. Total revenues generated from event tourism in Vermont were $6.2 million in 2009 (Table 9). Well over two-thirds of total revenues represent spending from out-of-state visitors.

Table 9: Estimated tourism expenditures related major bicycling and running events in Vermont, 2009

	Revenue Generated					
	Registration Fees	Lodging	Food/ Beverages	Gas/Fuel	Shopping/ Recreation	Totals
Vermont Residents	$434,720	$135,060	$398,428	$605,503	$461,312	$2,035,022
Vermont Visitors	$691,756	$902,398	$1,269,738	$726,953	$575,182	$4,166,027
Totals	$1,126,476	$1,037,438	$1,668,166	$1,332,455	$1,036,494	$6,201,050

Sources: Event sponsors; Resource Systems Group, Inc.

Event tourism can be modeled to assess the total impact on the Vermont economy. Utilizing the REDYN input-output model, tourism-related to major bicycling and running events support a total of 160 jobs (123 direct and 37 indirect jobs) within the Vermont economy (Table 10).

Table 10: Economic contribution of bicycle-pedestrian events in Vermont, 2009

Economic Contribution	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***	**Output *($millions)***	**Jobs**	**Earnings *($millions)***
Bicycle-ped events	$6.201	123	$3.272	$9.470	37	$4.731	$9.476	160	$4.734

Source: Economic & Policy Resources, Inc.

[1] For instance, in a recent report from the University of Vermont Transportation Research Center on estimating tourism related expenditures for the Burlington Waterfront Path and the Island Line Trail, the number of trail users are estimated for August 2008 based on the survey period. However, there is general reluctance to project trail usage over an entire year based on a sample amounting to two survey days during the late summer. See, *Estimating Tourism Expenditures for the Burlington Waterfront Path and the Island Line Trail* (Chen Zhang, Lance Jennings, and Lisa Aultman-Hall; UVM TRC Report #10-003, Transportation Research Center, February 2010).

[2] Results of event tourism are placed in the context of the biennial benchmark study—*The Travel and Tourism Industry of Vermont: A Benchmark Study of the Economic Impact of Visitor Spending on the Vermont Economy—2009* (Economic & Policy Resources, Inc. 2011).

In sum, bicycle rides/tours and running races are merely a proxy for bicycle-pedestrian oriented tourism which occurred throughout the state of Vermont between late spring and late fall of 2009. Given the overall importance of tourism to Vermont's economy, this event-oriented bicycle-pedestrian tourism (as exhibited in these 40 events) represents about 0.7 percent of total visitor expenditures of $1.424 billion in 2009. As noted earlier, bicycle-pedestrian tour operators provide a significant economic footprint for bicycle-pedestrian tourism within Vermont. However, difficulties with visitor counts and associated person trips and spending make overall estimation of bicycle-pedestrian tourism unreliable.

4.0 ADDITIONAL CONSIDERATIONS

4.1 Effect of Walkability on Real Estate Value

There is an expanding research area in assessing the effects of bicycling-pedestrian trails on property values. With the use of hedonic pricing techniques[1], study results indicate that proximity to bicycle-pedestrian trails adds value to residential properties.

Early results for this study (described in Appendix D) focused on the effect of walkability on real estate values for homes in Vermont. Using methodology described in *How Walkability Affects Home Values in U.S. Cities* (CEOs for Cities, August 2009), walkability scores were assigned to each residential property sold in Vermont between January 1, 2006 and December 31, 2009. Results suggest that the effect of walkability on Vermont real estate is a function of job density (number of jobs per square mile). Walkability has a significant positive effect on property values with job densities of greater than or equal to 110 jobs per square mile. As expected, using such a walkability measure is much more applicable to residential property values in the more urbanized portions of Vermont, such as Burlington metropolitan area, Montpelier-Barre, Rutland, St. Albans, and White River Junction. In a largely rural state, results from this walkability index do not apply to residential values in most areas of Vermont. In aggregate, the effect on residential real estate property values was estimated at $350 million statewide. This represents a significant wealth gain for residential property owners (largely urban-oriented) in Vermont. However, there are other attributes and trends affecting residential property values in the state.

Wealth effects associated with real (and personal) property holdings and their impact on household spending has been examined. In fact, recent research found that housing wealth has a significantly significant and large effect on household consumption.[2] Thus far, overall wealth effects have not been incorporated into an input-output framework. At this time, more work is needed on isolating (or attributing) walkability to household wealth effects. Consequently, it is not recommended to incorporate such wealth effects into an input-output modeling framework.

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[1] Economists have developed two broad approaches to estimate the dollar impacts of amenities and disamenities on property values. The less robust survey technique relies on surveys that ask people hypothetical questions concerning their willingness-to-pay for a certain amenity (or avoidance of a certain disamenity). The other approach—hedonic price technique, analyzes data coming from observed behaviors, including actual market transactions.

[2] Case, Karl E., John M. Quigley, and Robert J. Shiller. *Wealth Effects Revisited, 1978-2009*. Cowles Foundation for Research in Economics, Discussion Paper No. 1784, Yale University, February 2011.

4.2 Transportation System Costs of Bicycle-Pedestrian Activities

Transportation system costs are comprised of two major components—consumer costs that are borne by the individual traveler, and public costs that are borne by society at large. Consumer costs previously discussed include vehicle operating costs, long-term mileage based costs, and costs associated with the purchase a car, bicycle or other vehicle. Public costs discussed are those passed on by the individual to society overall, such as the impacts of emissions like greenhouse gases, crashes, congestion, and health. Appendix E describes the potential transportation system cost savings associated with avoided consumer and public costs of automobile travel as well as costs related to bicycling and walking activities. The analysis presented in Appendix E contains an array of transportation system cost components to evaluate. Total annual costs are compiled and compared for each transportation mode—automobile, walking, and bicycling with estimations provided for both Vermont urban and rural areas.

Meaningful economic analysis of these transportation system cost components is challenging. The principal problem is that there are too many variables with transportation system costs to be able to isolate particular changes in specific components. A transportation systems perspective with feedback and offsetting effects would lead to indeterminate results. A sophisticated economic tool such as an input-output model is able to forecast the cumulative impact of specific projects or policy changes on the economy. Critical to utilizing such a model is to be clear and certain in specifying the initial/direct effects.

Even in settling onto one aspect of transportation system costs, such as the health benefits (or health cost savings) associated with bicycling and walking activities, make for a daunting challenge. Health benefits as found in bicycling and walking could result in reductions in healthcare costs, improved worker productivity, increased life expectancy and improved quality of life. All of these benefits however lack specificity. Research on incidence rates (reductions in the risk of various diseases) for the “sufficiently active” individuals is still emerging; and monetary valuations in the form of healthcare costs savings is not sufficiently settled. Given all of the questions and uncertainties, it is recommended that transportation system costs not be incorporated into an input-output modeling framework.

5.0 CONCLUSIONS

The desired outcome of this economic impact study was an estimate of the number of jobs created and personal income generated during a typical year in Vermont due to the investment in and use of walking and biking facilities by residents and visitors. A summary picture of the economic impacts associated with bicycle-pedestrian oriented activities is depicted in Table 9[1]. Using such measures as output (total sales revenue), jobs (employment), and earnings (wages & salaries plus proprietor income), bicycle-pedestrian activities contribute $82.7 million in sales revenue, supports 1,418 jobs with earnings of $40.9 million to the Vermont economy in 2009. Each million dollars of bicycle-pedestrian related sales revenues generates about 26 direct and indirect jobs in the overall economy.

[1] Due to some level of “double-counting,” caution should be exercised in adding together these various segments of bicycle-pedestrian oriented activities.

Table 11: Economic contribution of bicycle-pedestrian-oriented activities in Vermont, 2009

Bicycle-Ped segments	Direct economic contribution Output ($MM)	Jobs	Earnings ($MM)	Indirect impact Output ($MM)	Jobs	Earnings ($MM)	Total economic contribution Output ($MM)	Jobs	Earnings ($MM)
Infrastructure									
Bicycle-ped infrastructure	$8.963	136	$5.760	$6.371	70	$2.809	$15.334	206	$8.569
Bicycle-ped program	$0.850	16	$0.719	$0.771	11	$0.616	$1.622	27	$1.336
Subtotal, infrastructure	$9.813	152	$6.479	$7.142	81	$3.425	$16.956	233	$9.904
Bicycle-ped events	$6.201	123	$3.272	$9.470	37	$4.731	$9.476	160	$4.734
Bicycle-ped businesses	$37.844	820	$18.001	$18.468	205	$8.280	$56.312	1,025	$26.281
Total	**$53.858**	**1,095**	**$27.751**	**$35.080**	**323**	**$16.436**	**$82.744**	**1,418**	**$40.919**

Note: $MM is millions of dollars
Source: Economic & Policy Resources, Inc.

In 2009, the gross domestic product for Vermont was valued at $24.6 billion; total employment (composed of wage & salaried workers and proprietors) was 418,673 with $16.6 billion of labor income. Using these metrics, bicycle-pedestrian oriented activities contribute less than one percent to the state's economy.

This study has found that:

- Bicycle-pedestrian-related infrastructure costs in 2009 amounted to $9.8 million. Building and maintaining bicycling-pedestrian facilities and bicycle-pedestrian program and planning activities in Vermont generate a total employment of 233 direct and indirect workers with total labor earnings of $9.9 million.
- Bicycle-pedestrian-oriented businesses in Vermont generated a total of $56.3 million in sales revenues and supported 1,025 direct and indirect jobs with $26.3 million in labor earnings (wages & salaries plus proprietor income).
- Bicycle-pedestrian-related visitor expenditures were obtained for over 40 major running and bicycling events taking place across Vermont in 2009. In the absence of reliable visitor estimates associated with bicycling and walking activities, this data set provides a condensed picture of bicycle-walking tourism in Vermont. In 2009, these 40 major events attracted over 16,000 participants. Combined with associated family and friends, these visitors spent over $6 million in the state. Further analysis indicates these events generate $9.5 million in total sales revenues and supports 160 direct and indirect jobs with $4.7 million in labor earnings.
- Combined, these bicycle-pedestrian oriented segments contribute $82.7 million of total sales and support 1,418 direct and indirect jobs with $40.9 million in labor earnings.
- Effects of bike-pedestrian trails on property values are associated with the increase of wealth. A walkability index developed for Vermont resulted in estimates of $350 million in residential real estate property valuation. Uncertainties include the total wealth effect associated with real property holdings and its significance with respect to increased household spending.
- Transportation system costs related to consumer costs and public costs are no doubt significant, but given the inherent complexity and challenges (including feedback and

offsetting effects) it is not recommended to incorporate these transportation system costs into an input-output framework.

Further refinement as to inclusion of cost and expenditure information on bicycling and walking activities in Vermont represents the next step. Particular focus is development of a more complete picture of costs associated with building and maintaining walking and biking infrastructure in the state as well as an expanded picture of visitor spending related to bicycling and walking activities in Vermont. Additional next steps are:

- Determining how to use these findings to encourage more walking and biking.
- Using the study findings to update or adjust the goals and objectives of the *Vermont Pedestrian and Bicycle Policy Plan.*
- Periodic updates to this economic impact analysis (such as every two years), including improving data collection to support the analysis.

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APPENDIX B: DATA SOURCES

This section provides an overview of potential data sources that will be used to estimate annual costs of the economic impact categories listed above and describes potential issues and gaps.

Bicycle and Pedestrian Facility Capital Investments

Data Sources:

- Annual VTrans capital programs for the last five fiscal years. The capital program identifies the amount of federal and state funds programmed for all phases of pedestrian and bicycle facilities (planning/design/permitting, right-of-way acquisition and construction). Project managers will be identified and contacted to verify project status and latest costs as available.
- Municipal budgets and capital programs. Municipalities also use local funds with no state or federal contribution to maintain existing sidewalks and bike paths and to construct new facilities. Municipal budgets and capital plans will be reviewed on-line when available. When these documents are not available, the consultant team will contact municipalities directly and ask for information. A preliminary list of municipalities to be contacted is identified in Attachment 1. The list generally includes all of the larger cities in the state and other towns that may have village centers or other activity areas that may have sidewalks and bicycle facilities (based on RSG's general knowledge of the state). Suggested additions from the Task Force are welcome.

Potential Issues:

- Bicycle and pedestrian facilities are often incorporated with roadway projects and may not be specifically identified as such in the VTrans capital program. RSG will work with VTrans to identify these types of multi-modal projects and will develop cost estimates for the pedestrian and bicycle components of the infrastructure using unit costs.

Visitor Spending/Tourism Related to Walking and Biking

Data Sources:

- Visitor activity and expenditures within Vermont's hospitality and recreation sector are estimated on an every other year basis through a benchmark analysis, with a tracking estimate completed in between benchmark study years. Both domestic and Canadian visitors to Vermont are estimated on a person-trip basis (day and overnight). Visitor expenditures are estimated within the following hospitality and recreation sectors of hotel and lodging, eating and drinking, recreation and entertainment, transportation, gasoline and oil, and retail trade.

Potential Issues:

- In the Vermont Travel and Tourism Industry benchmark studies, no distinction or special surveys have been made to estimate the number of bicycling tourists. Data on bicycle tourism in Vermont are dated—prior studies date back to 1995 and 1992.

- Bicycle tourism is essentially divided into two types—self-guided and guided tours. Bicycle tour companies in Vermont could be surveyed to obtain bicycle tourism counts (number and visitor days) and bicycle visitor-related expenditures in Vermont. Self-guided bicycle visitors and related expenditures will need to be estimated.

Transportation System Related Consumer and Pubic Costs

The transportation system related consumer and public costs resulting from walking and biking will be developed from the same data sets. The approach involves two steps: (1) estimating the amount of walking and biking that occurs annually in the state and (2) calculating the costs associated with avoided vehicle miles of travel and costs associated with miles walked and biked.

Data Sources:

- National Household Travel Survey (NHTS). To quantify the transportation related economic benefits of walking and biking, it will be necessary to develop a reasonable and defensible estimate of the annual number and distances of trips made on foot and on bikes in Vermont. The estimate will be based on data available in the 2009 NHTS. The 2009 NHTS includes data on daily trips collected over a 24-hour period for households and persons. VTrans, the Chittenden County Metropolitan Organization (CCMPO) and the UVM Transportation Research Center purchased an add-on option which includes survey responses from approximately 1,500 households in the state. RSG has the data from the add-on option in hand and has prepared a preliminary estimate of walking and biking trips which is summarized in Appendix E.
- Per Mile Costs for Automobile, Walking and Biking. Definitions for the transportation related costs are indicated in Table 21. The definitions and unit costs (Table 13) have been developed by the Victoria Transport Policy Institute (VTPI) and are published in the 2009 *Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications*. Values include the cost to the individual (consumer) and costs that are passed along to society at-large (public costs).

Table 12: Transportation System Cost Definitions

Transport Related Cost Category	Definition
Vehicle Ownership	Fixed costs of owning an automobile, bike and walking
Vehicle Operation	Variable vehicle costs, including fuel, oil, tires, tolls and short-term parking fees.
Operating Subsidy	Financial subsidies for public transit services.
Travel Time	The value of time used for travel.
Internal Crash	Crash costs borne directly by travelers.
External Crash	Crash costs a traveler imposes on others.
Internal Health Ben.	Health benefits of active transportation to travelers (a cost where foregone).
External Health Ben.	Health benefits of active transportation to society (a cost where foregone).
Internal Parking	Off-street residential parking and long-term leased parking paid by users.
External Parking	Off-street parking costs not borne directly by users.
Congestion	Congestion costs imposed on other road users.
Road Facilities	Roadway facility construction and operating expenses not paid by user fees.
Land Value	The value of land used in public road rights-of-way.
Traffic Services	Costs of providing traffic services such as traffic policing, and emergency services.
Transport Diversity	The value to society of a diverse transport system, particularly for non-drivers.
Air Pollution	Costs of vehicle air pollution emissions.
Green House Gas (GHG)	Lifecycle costs of greenhouse gases that contribute to climate change.
Noise	Costs of vehicle noise pollution emissions.
Resource Externalities	External costs of resource consumption, particularly petroleum.
Barrier Effect	Delays that roads and traffic cause to nonmotorized travel.
Land Use Impacts	Increased costs of sprawled, automobile-oriented land use.
Water Pollution	Water pollution and hydrologic impacts caused by transport facilities and vehicles.
Waste	External costs associated with disposal of vehicle wastes.

Source: "2009 Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications"; VTPI

Table 13: Transportation System Unit Costs

Cost Category	Auto		Bike		Walk	
	Consumer	Public	Consumer	Public	Consumer	Public
Vehicle Ownership	$0.27	$0.00	$0.07	$0.00	$0.00	$0.00
Vehicle Operation	$0.16	$0.00	$0.03	$0.00	$0.05	$0.00
Operating Subsidy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Travel Time	$0.13	$0.00	$0.38	$0.00	$1.25	$0.00
Internal Crash	$0.12	$0.00	$0.08	$0.00	$0.08	$0.00
External Crash	$0.00	$0.06	$0.00	$0.00	$0.00	$0.00
Internal Health Ben.	$0.00	$0.00	($0.10)	$0.00	($0.24)	$0.00
External Health Ben.	$0.00	$0.00	$0.00	($0.10)	$0.00	($0.24)
Internal Parking	$0.06	$0.00	$0.00	$0.00	$0.00	$0.00
External Parking	$0.00	$0.05	$0.00	$0.00	$0.00	$0.00
Congestion	$0.00	$0.02	$0.00	$0.00	$0.00	$0.00
Road Facilities	$0.00	$0.02	$0.00	$0.00	$0.00	$0.00
Land Value	$0.00	$0.03	$0.00	$0.00	$0.00	$0.00
Traffic Services	$0.00	$0.01	$0.00	$0.00	$0.00	$0.00
Transport Diversity	$0.00	$0.01	$0.00	$0.00	$0.00	$0.00
Air Pollution	$0.00	$0.03	$0.00	$0.00	$0.00	$0.00
GHG	$0.00	$0.02	$0.00	$0.00	$0.00	$0.00
Noise	$0.00	$0.01	$0.00	$0.00	$0.00	$0.00
Resource Externalities	$0.00	$0.04	$0.00	$0.00	$0.00	$0.00
Barrier Effect	$0.00	$0.01	$0.00	$0.00	$0.00	$0.00
Land Use Impacts	$0.00	$0.07	$0.00	$0.00	$0.00	$0.00
Water Pollution	$0.00	$0.01	$0.00	$0.00	$0.00	$0.00
Waste	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

1. Source: "2009 Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications"; VTPI

2. All costs are in 2007 U.S. Dollars

3. Auto costs assume 20% of travel occurs on urban highw ays during peak hours, 40% on urban highw ays during off-peak periods, and 20% on rural highw ays.

Potential Issues

- The unit costs provided by the VTPI are based on a comprehensive literature review of thirty-three reports and studies from multiple countries, different agencies, institutions and organizations with dates ranging from 1975 to 2009. About half of the studies were conducted in the United States. It provides a readily available and consolidated source of data. Some additional research will be undertaken to verify values and to determine if more applicable costs are available.
- The unit costs for automobile travel assume 20% of travel occurs on urban roadways during the peak hours, 40% occurs on urban roadways during the off-peak hours and 20% occurs on rural roadways. This distribution is a default assumption and will be refined to reflect the travel in Vermont. The distribution in Vermont will be based on traffic data readily available from VTrans.

Effect on Real Estate Value

As noted in the scope of work, there are numerous publications with study results that show the change in property value for homes located near bicycle facilities. Examples cited include:

- A report published by the Rails-to-Trail Conservancy in 2008, *Active Transportation for America* states that developers were able to charge $5,000 more for homes located near trails.
- A study published in the Fall 2004 issue of the *Journal of Park and Recreation Administration* suggests that a home located near trails had appraised values 11% greater than similar homes located further away.

Another study uncovered during research for this working paper is *How Walkability Affects Home Values in U.S. Cities* (CEOs for Cities, August 2009). It found that houses with above average levels of walkability command a premium of about $4,000 to $34,000 over houses with just average levels of walkability in the typical metropolitan areas included in the statistical analysis. The study evaluated over 90,000 house sales in metropolitan areas with populations that range between 670,000 to six million persons. It was based on actual sales and controlled for other key factors affecting price including size, number of bedrooms, number of bathrooms, age, neighborhood characteristics and location relative to employment centers. Walkability was quantified using "Walk Score" a free on-line tool. As described in the study, the "… Walk Score algorithm looks at destinations in 13 categories and awards points for each destination that is between one-quarter mile and one mile of the subject residential property". Examples of the destinations include grocery stores, restaurants, library, fitness center, bookstores, movie theatres, and schools. The Walk Score considers proximity, but does not account for the availability, connectivity or pedestrian environment between the homes and the destinations. It may be possible to apply the methodology in Vermont, but additional research is necessary to determine if the sales data are readily available for a reasonable sample size.

Another option is the case study approach described in the scope of work. The before and after appraised values of homes located near a multi-use path for three to five locations in Vermont would be documented depending on the availability of data. Assistance from the Task Force is requested help identify representative case study locations.

Data Sources:

- House sales and related attributes in Vermont from the National Association of Realtors (for the walkability statistical analysis approach). A request has been made to the National Association of Realtors for compiling sales price for specific houses, addresses and other characteristics necessary for the statistical analysis of the contribution of walkability to price.
- Municipal Grand Lists (for the case study approach). Grand lists are typically published every year and show the appraised value for each property in a municipality. Assuming the completion date of a nearby sidewalk or bicycle facility project is known, it will be possible to document the before and after appraised value of a house.

Potential Issues:

- The Walk Score that will be used to quantify walkability and its effect on sales price (if this approach is used) considers proximity, but does not account for the availability, connectivity or pedestrian environment between the homes and the destinations.
- While it will be possible to document the before and after appraised value of a house published in a grand list, correlating change in property value to a sidewalk or bicycle facility project may not be possible. The appraised value is determined by appraisers that work directly for or are contracted by a municipality. The goal is to determine the fair market value of a property which is then used to determine the amount of property taxes paid. There are many factors that affect the appraised value. Access to sidewalks and bicycle facilities is not considered explicitly, but may affect how some appraisers rate the overall quality of a neighborhood. Town-wide appraisals are completed every five years. Between those years, the appraised value of a house will not change unless physical alterations are made. This five year cycle, general inflation and changes in the overall housing market may create too much noise to confidently conclude whether or not a sidewalk or bicycle facility has resulted in a change in property value.

Bicycle and Pedestrian Related Businesses

Sales and jobs associated with walking and biking businesses will be based on a telephone survey of related businesses to be conducted by Local Motion.

Primary Data Sources:

- List of bicycle and pedestrian related businesses. A preliminary list is provided in Attachment 2.

Potential Issues:

- It is desirable to collect information on annual revenue, number of employees and the value of payroll. Many businesses may provide other unrelated products and services making it necessary to determine the proportion of revenue and jobs that are related to walking and biking. We anticipate developing some simple questions such as:
  - How many people do you employ?

- In a typical year, within what range does your revenue fall (example: less than $100,000; $100,000-$500,000, $500,000-$1 million, etc. Ranges will be determined)
- What proportion of your business/revenue is related to walking and biking?

This type of financial information is proprietary and many business owners are unlikely to provide detailed information. The information may also be speculative when a business owner is asked to estimate the proportion of sales related to walking and biking. As a result, the data will not have a high level of certainty, and may not be used as an input to the economic impact model. The information collected will still be valuable in providing a general description of this overall cost category.

Attachment 1: Municipalities Contacted regarding Bike/Ped Infrastructure and Maintenance costs

Barnet
Barre
Bellows Falls/Rockingham
Bennington
Bethel
Bradford
Brandon
Brattleboro
Bristol
Burlington
Castleton
Chester
Colchester
Danville
Derby
Enosburg Falls
Essex
Essex Junction
Fair Haven
Hardwick
Hartford
Hinesburg
Jericho
Ludlow
Lyndon
Manchester
Middlebury
Milton
Montpelier
Morrisville
Newfane

Newport
Newport
North Bennington
Northfield
Norwich
Pittsford
Poultney
Pownal
Putney
Randolph
Richmond
Rutland
Rutland Town
Saint Albans
Saint Johnsbury
Saxtons River
Shelburne
South Burlington
South Royalton
Stowe
Swanton
Townshend
Vergennes
Vernon
Wallingford
Waterbury
West Rutland
White River Junction
Wilmington
Windsor

FN1	LN1	FN2	LN2	Title	Company	City
John	Freidin				25 Bike Tours of Vermont	Charlotte
Willy and Jenny	Williams				Adventure Trek USA	Thetford
Ray & Pam	Allen				Allenholm Farm	South Hero
Scott	Rieley				Alpine Shop	South Burlington
Massimo	Prioreschi				Backroads	Berkeley
Larry	Niles				Bike Vermont	Woodstock
Brenda	Lewis				Bredeson Outdoor Adventures	Bridport
Steve	Fuchs				Burlington Boot Camp	Essex Junction
Abbie & Eric	Bowker				Catamount Family Center	Williston
Eric	Bowker	Lucy	McCollough		Catamount Outdoor Family Center	Williston
Barry	Bender				Clearwater Sports	Waitsfield
Bill	Supple	Gribbin	Loring		Climb High	Burlington
					Country Inns Along the Trail	Brandon
Carolyn	Walters Fox			Public Relations	Country Walkers	Waterbury
Pat & Mike	Weisel				Cowpatty Bikes	Underhill Center
					Craftsbury Outdoor Center	
John	Worth				East Burke Sports	East Burke
Hans	Jenny				Fellowship of the Wheel	
Ian	Buchanan	Sarah	Shorett		Fit Werx	Waitsfield
George	Wisell	Mandy	Wisell		Five Trees Bikes / Bike 29	Waterbury Center
Bill	Salmon				Grafton Pond Mtn Bike Center	Grafton
Doon	Hinderyckx				Green Mountain Bicycle Services	Rochester

FN1	LN1	FN2	LN2	Title	Company	City
Kevin	Bessette			President	Green Mountain Bike Club	
Gary	Kessler			Race Director	Green Mountain Stage Race	Waitsfield
					IdeRide	East Burke
Jeannie & Chris	Houghton				Just Sports	Colchester
Ken	Johnston				Ken's Island Peddler	Grand Isle
Lou	Bresee				Lake Champlain Bikeways	Burlington
Chapin	Spencer				Local Motion	Burlington
				Manager	Louis Garneau	Newport
Pierre	Couture				Millstone Trails Association	Websterville
					Mount Snow Resort	West Dover
Bruce	Bell				Mountain Sports & Bike Shop	Stowe
					Mountain Top Inn	Chittenden
Pat & Jay	Miller	JP	Cousino		North Star Sports	Burlington
Glenn	Eames				Old Spokes Home	Burlington
Jamie	Huntsman	Carrie	Baker-Stahler		Onion River Sports	Montpelier
Marc	Sherman	Mike	Donahue		Outdoor Gear Exchange	Burlington
Jim	Walsh				Paradise Sports	Windsor
Eric	Krivitsky				Penguin Cycles	Brownsville
					Peter Glenn Ski & Sports	Essex
Rich	First				POMG Bike Tours of VT	Richmond
Rob	Maynard				Power Play Sports	Morrisville
John	Van Hazinga				Riding High Pedicab	Burlington
Jason	Carpenter				Royal Cycles	Burlington
Anna	Boisvert				Skihaus	Middlebury
Zandy	Wheeler	Spike	Clayton		Skirack	Burlington
Eli	Enman	Kasie	Wallace		Sleepy Hollow Inn	Huntington
Susan	Rand			President	Sojourn Bicycle Tours	Charlotte
Larry	Cruz	Chris	Ouellette		Sport Shoe Center	
					Sugarbush	Warren
Richard	Shappy				Tailwind Bikes	New Haven

FN1	LN1	FN2	LN2	Title	Company	City
Liz	Robert				Terry Bicycles	Burlington
David	Tier	Justin	Crocker		The Bike Center	Middlebury
					Trapp Family Lodge	Stowe
Jack	Nuber	Fred	Sperber		True Wheels	Killington
Gregg	Marston				VBT Bicycling Vacations	Bristol
Maurice	Cadotte	Julie	Toupin		Velo Chambly	
Steve and Sherry	Lulek				Vermont Adventure Tours	Rutland
Nancy	Schulz				Vermont Bicycle & Pedestrian Coalition	Montpelier
Bill	Cross				Vermont Ground Charter	Burlington
Patrick	Kell				Vermont Mountain Bike Advocates	Waterbury
Gray	Stevens				Vermont Outdoor Guide Association	North Ferrisburg
Gene	Bell	Gail	Center		Village Bicycle Shop	Richmond
Jeff	Manning				Village Bike Shop	Derby
John	Hibshman				Village Sport Shop	Lyndonville
Marty	Banak				Wilderness Trails	Quechee
Dave	Porter				Winooski Bicycle Shop	Winooski
					Wonder Walks	Bristol
					Bike Hub	Norwich

APPENDIX C: VERMONT BICYCLE AND PEDESTRIAN BUSINESS SURVEY

Vermont Bike & Pedestrian Business Survey

For the State of Vermont's Economic Impact Study of Walking & Bicycling -- July 29, 2011.

About the Impact Study: This survey is a key component of the State of Vermont's economic impact study of walking and bicycling. The project is funded by VTrans and is being completed by a consultant team including Resource Systems Group, Economic & Policy Resources and Local Motion. For more info, contact VTrans Bike/Pedestrian Program Manager Jon Kaplan (802-828-0059) or click on www.localmotion.org/reports.

About this Business Survey: For the responses below, we are looking for data from 2009. All responses from bike/pedestrian businesses will be aggregated for the report. Specific responses from specific businesses will not be broken out. Thank you for your willingness to share your information so that we all may have a more accurate picture of the bike/pedestrian industry in Vermont. You will receive a call from Henry Webster-Mellon, Alyssa Bucci or Chapin Spencer in the coming weeks to ask you the following questions. You may also email your answers at any time to Henry (henrywm36@gmail.com).

1) What was your company's estimated annual revenue from bicycle-related business (equipment, parts, gear, repair, service, etc) and running/walking-related business (shoes, equipment, clothing, snowshoes, etc.) in 2009?

1. Under 10,000
2. 10,000 – 25,000
3. 25,000 – 50,000
4. 50,000 – 100,000
5. 100,000 – 250,000
6. 250,000 – 500,000
7. 500,000 – 750,000
8. 750,000 – 1,000,000
9. 1,000,000 – 2,000,000
10. 2,000,000—5,000,000
11. 5,000,000 – 7,500,000
12. 7,500,000 – 10,000,000
13. Over 10 million

2) What percentage did this comprise of your company's total revenue in 2009?
______

3) What percentage of this revenue do you estimate came from Vermont residents? ______

4) How many employees did your firm employ in 2009?

• Total number ___
  o Number of full-time employees ____
  o Number of part-time employees ____
  o Number of full-time equivalents (if known) ____

5) What would you estimate your firm's total wages and salaries were in 2009?

1. Under 10,000
6. 250,000 – 500,000

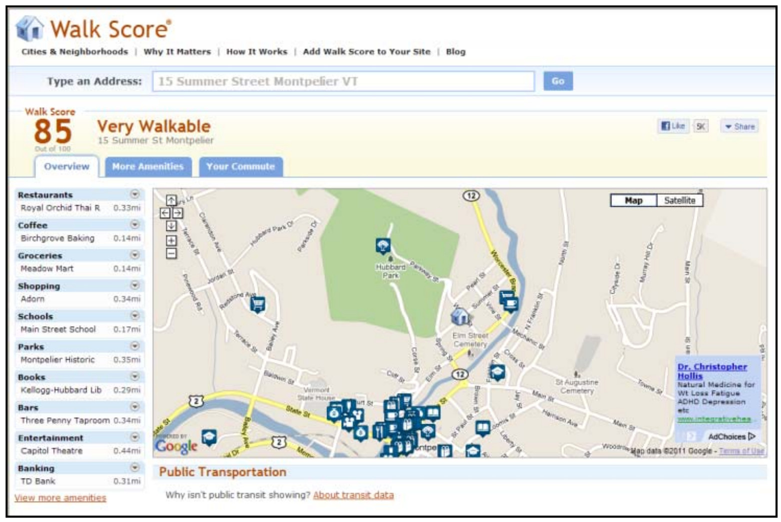
2. 10,000 – 25,000
3. 25,000 – 50,000
4. 50,000 – 100,000
5. 100,000 – 250,000
7. 500,000 – 750,000
8. 750,000 – 1,000,000
9. Over 1,000,000

APPENDIX D: EFFECT OF WALKABILITY ON REAL ESTATE VALUE

The effect of walkability on real estate values for houses in Vermont has been estimated using the statistical methodology described in *How Walkability Affects Home Values in U.S. Cities* (CEOs for Cities, August 2009). The CEOs for Cities study was designed with an orientation toward real estate properties in urban areas, however, the methodology was applied more broadly in this project to include real estate property throughout the urban and rural areas of Vermont. A statistical methodology was used to quantify how house size, number of bedrooms, number of bathrooms, age, type (single or multi-family), median household income, distance to the central business district, job density and walkability affect sales price; making it possible to isolate the contribution of walkability to residential real estate value.

Each property included in the analysis was assigned a walkability score using the methodology developed by WalkScore.com. A property's walkability score is based on the walking distance from the property to each of 9 different amenity categories, including shopping establishments, banks, schools, and entertainment (Figure 2).

Figure 3: Walk Score Calculation Example



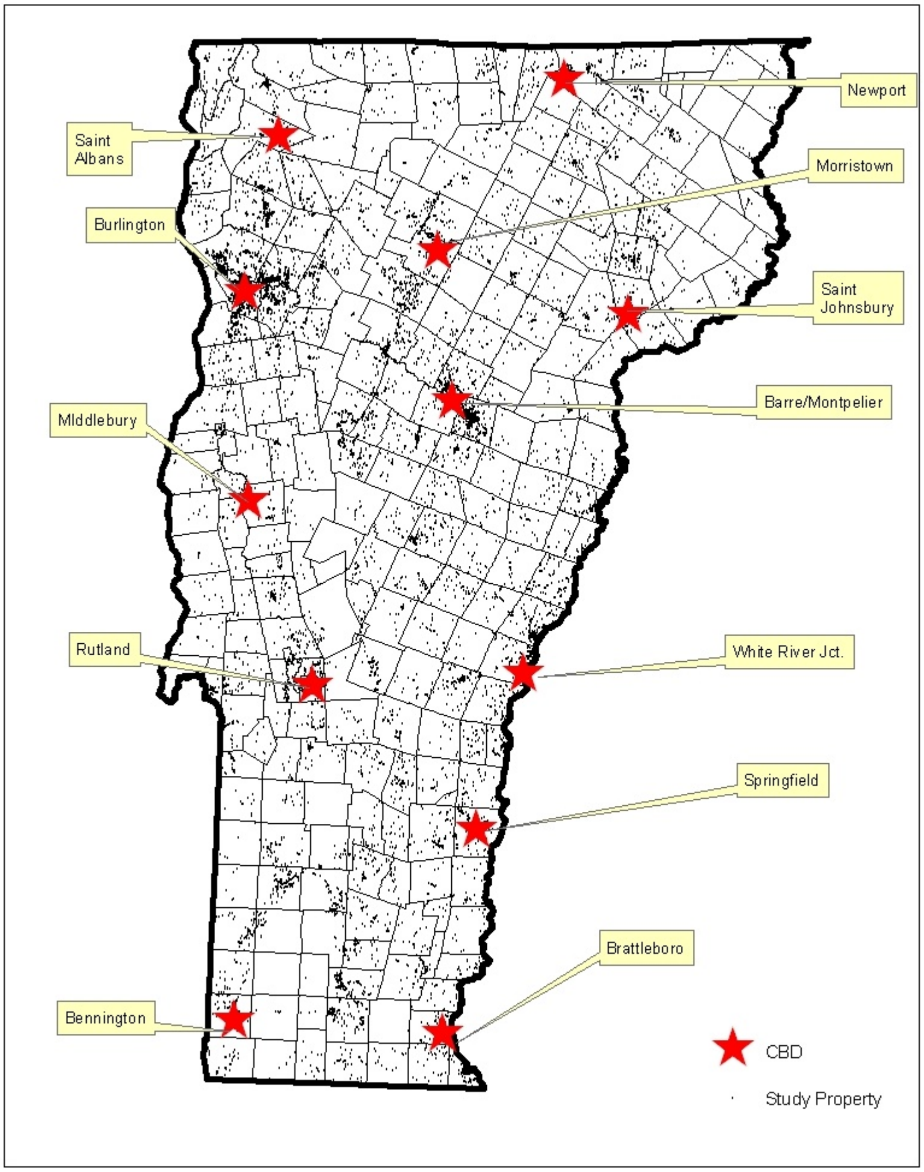
Thus, each Vermont property in this analysis was assigned a walkability score based on the Walk Score methodology, which ranges numerically in Walk Score values from 0 to 100, and qualitatively from "car-dependent" to a "walker's paradise" (Table 14).

Table 14: Walkability Score Descriptions

Walk Score	General Category	Description
90-100	Walker's Paradise	Daily errands do no require a car.
70-89	Very Walkable	Most errands can be accomplished on foot.
50-69	Somewhat Walkable	Some amenities within walking distance.
25-49	Car Dependent	A few amenities within walking distance.
0-24	Very Car Dependent	Almost all errands require a car.

RSG compiled the closing prices for all houses sold in Vermont from January 1, 2006 through December 31, 2009 (approximately 18,500 houses) from MLS (multiple listing service), an electronic database of real estate with information on home sales. Information was also collected from MLS on the address, number of bedrooms, number of bathrooms, year of construction, type, and square footage. WalkSore.com was used to assign a walkability score to each house using a custom-built program that accessed the website, entered the address for a specific house sale, and downloaded the resulting score[1]. Median household income, which is a proxy for neighborhood quality, was taken from the 2000 U.S. Census and the 2010 Census was used for job density. Figure 4 shows the distribution of house sales included in the analysis and the location of CBDs.

Figure 4: Location of Study Properties and Central Business Districts

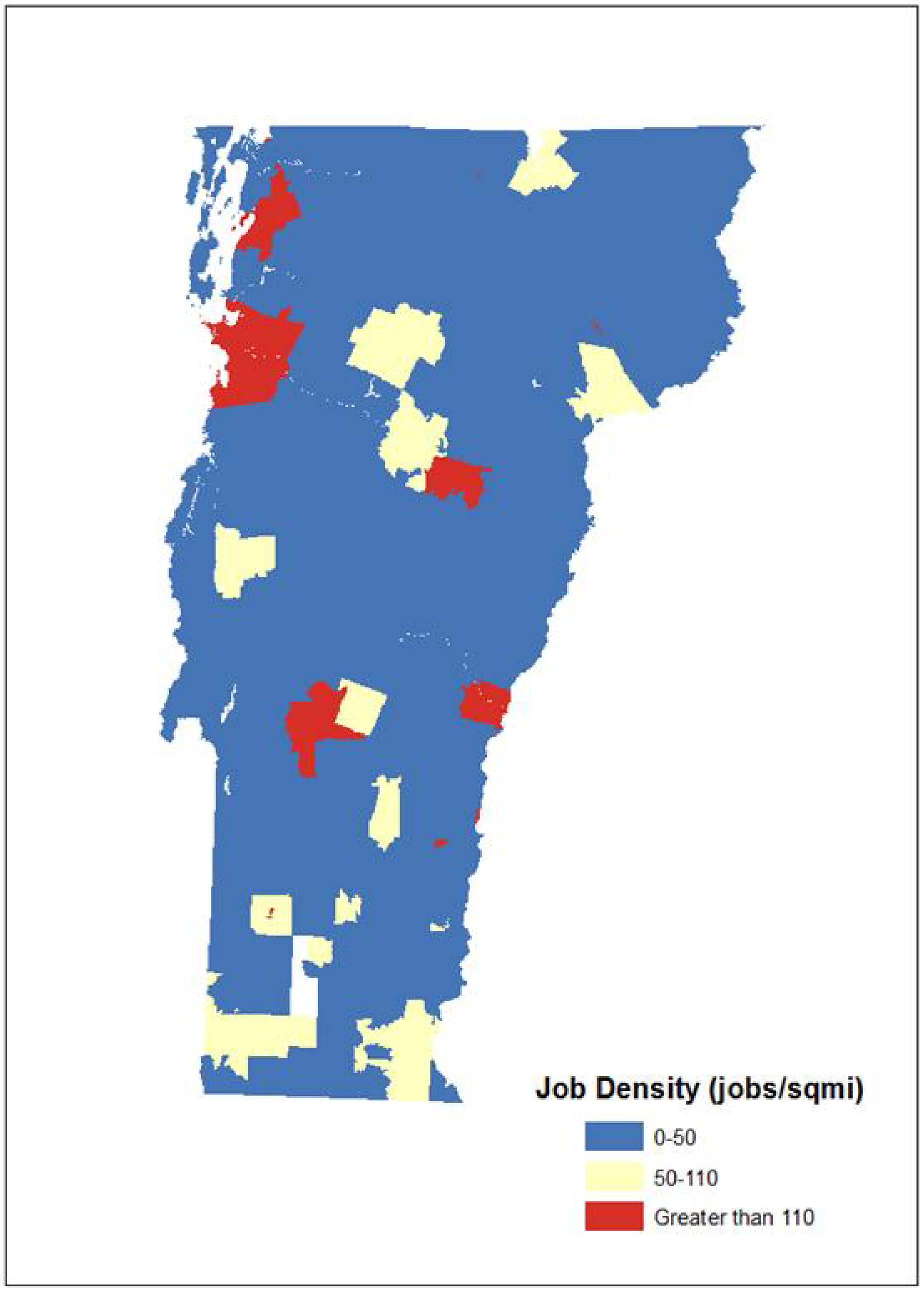


A statistical model of the effect of walkability on real estate value was estimated for the entire state, with property sale price as the dependent variable, and all other attributes of the property, including the walkability score, entered as independent variables. Results of the statistical model suggest that the effect of walkability on real estate value is a function of a job density (i.e., number of jobs per square mile, based on the 2010 US Census). Thus, the effect of walkability on real estate value was

[1] Walksore.com limits the amount of locations that can processed per day. The program was run over 4-6 weeks in order to process the walk score for all 18,500 locations.

estimated for three categories of properties, based on job density: 1) Greater than 110 jobs per square mile; 2) 50-110 jobs per square mile; and 3) 50 or fewer jobs per square mile (Figure 5).

Figure 5: Job Density



Results of the analyses suggest that walkability has a significant positive effect on property values in areas with job density greater than or equal to 110 jobs per square mile (generally the urban areas in Vermont). For example, an improvement in the walkability score of a property from the “Very Car Dependent” category to the “Somewhat Walkable” category is estimated to increase the value of the property by about $4,400 (Table 15).

Table 15: Estimated Effect of Walkability Score on Property Value – Job Density Greater than 110 Jobs per Square Mile

	Car-Dependent	Somewhat Walkable	Very Walkable	Walker's Paradise
Very Car-Dependent	$2292	$4378	$6252	$7668
Car-Dependent		$2086	$3960	$5376
Somewhat Walkable			$1873	$3290
Very Walkable				$1417

In contrast, in areas of Vermont with job densities between 50 and 110 jobs per square mile, the walkability score has no significant effect on property value. Further, in communities with 50 or fewer jobs per square mile, walkability is inversely related to property value (Table 16). For example, other things being equal, a change in walkability score from the "Car Dependent" category to the "Somewhat Walkable" category is estimated to decrease property value by about $6,700.

Table 16: Estimated Effect of Walkability Score on Property Value – Job Density Less than 50 Jobs per Square Mile

	Car-Dependent	Somewhat Walkable	Very Walkable	Walker's Paradise
Very Car-Dependent	-$7784	-$14492	-$20226	-$24391
Car-Dependent		-$6708	-$12442	-$16607
Somewhat Walkable			-$5735	-$9900
Very Walkable				-$4165

The results for areas with less than 50 employees per square mile (which as suggested in Figure 5 are the rural areas of the state) reflect the limitations of the methodology and do not constitute an accurate assessment of walkability's effect on sales price in lower density places:

- First, the CEOs for Cities study focused on larger metropolitan areas, and did not include any rural areas. It evaluated over 90,000 house sales in metropolitan areas throughout the United States with populations that range between 670,000 to six million persons. The study found that houses in these larger metropolitan areas with above average levels of walkability command a premium of about $4,000 to $34,000 over houses with just average levels of walkability in the typical metropolitan areas included in the statistical analysis. As indicated in Table 15, the walkability score also has a positive effect on property values within areas of Vermont with higher job densities, further suggesting that the methodology developed for the CEO's for Cities study is appropriate for urban areas.
- Second, the Walk Score methodology is based on proximity to multiple non-residential land uses. Arguably, persons that choose to live in rural areas value privacy, open space and other characteristics of country living and may perceive proximity to non-residential uses as a disamentity. Therefore, the negative effect of the Walk Score on sales price likely reflects these other factors, and not walkability in the true sense of the word.

Given that walkability has a positive effect on house values in areas with higher job densities, and assuming that walkability has a neutral affect in all other areas of the state, the aggregate effect on residential real estate property value is estimated at $350 million statewide. This estimate was derived by applying the average increase in the Walk Score of house sales in a zip code to the total number of housing units in the same zip code.

Wealth effects associated with real (and personal) property holdings and their impact on household spending has been examined. In fact, recent research found that housing wealth has a significantly significant and large effect on household consumption.[1] Thus far, overall wealth effects have not been incorporated into an input-output framework. At this time, more work is needed on isolating (or attributing) walkability to household wealth effects. Consequently, it is not recommended to incorporate such wealth effects into an input-output modeling framework.

[1] Case, Karl E., John M. Quigley, and Robert J. Shiller. *Wealth Effects Revisited, 1978-2009*. Cowles Foundation for Research in Economics, Discussion Paper No. 1784, Yale University, February 2011.

APPENDIX E: TRANSPORTATION SYSTEM COST ANALYSIS

Walking and Biking Trips in VT

The methodology for estimating the transportation system cost savings associated with walking and biking consists of (1) estimating the amount of walking and biking that occurs annually in the state and (2) calculating the cost savings due to avoided automobile miles of travel and the additional costs associated with miles walked and biked. This section of the memorandum addressed the first step and presents an estimate of the number of annual miles traveled in Vermont by foot and on bikes. The second step is addressed below in Section 3.0.

Based on the 2009 National Household Travel Survey (NHTS), Vermonters travelled approximately 69 million miles on foot and 28 million miles by bike during 2009. The NHTS utilized a telephone survey to document the trip making characteristics of survey participants in a 24 hour period. It documents:

- Purpose of the trip (work, shopping, etc.);
- Means of transportation used (car, bus, subway, walk, etc.);
- How long the trip took, i.e., travel time;
- Distance travelled;
- Time of day when the trip took place;
- Day of week when the trip took place; and
- If a private vehicle trip:
  - number of people in the vehicle , i.e., vehicle occupancy;
  - driver characteristics (age, sex, worker status, education level, etc.); and
  - vehicle attributes (make, model, model year, amount of miles driven in a year).

The survey's sample size is 1,690, from a total of 252,280, households in Vermont. The sample includes 13,119 person trips per day. Of these, 1,486 were walking trips and 146 were biking trips. The survey responses were weighted based on socioeconomic and demographic characteristics to estimate the total statewide values presented in Table 3.

Table 17: Final Estimate of Walking and Bike Trips in Vermont in 2009

Measure	All Trips	Walking	Biking
Number of Trips per Person/Day	3.70	0.42	0.04
Number of Trips per Household/Day	7.76	0.88	0.09
Annual Trips in Vermont	801,164,769	87,155,983	9,285,656
% of Total Trips	100%	10.9%	1.2%
Average Miles Travelled per Trip	7.92	0.83	2.53
Total Annual Miles Travelled	8,344,827,820	68,248,876	28,337,598
Percentage of Total Miles Travelled	100%	0.8%	0.3%

Transportation system costs are different in urban and rural areas due to different conditions such as congestion, parking, vehicle occupancy, and travel speeds. Therefore, the 2009 NHTS data have also been used to develop estimates of miles of travel for walking and biking within urban and rural areas (*Table 18*). The 2009 NHTS defines an urban area as having 1,000 or more persons per square mile.

Table 18: Final Estimate of Walking and Biking Miles for Rural and Urban Areas in Vermont in 2009

Mode	Urban	Rural	Total
Walk	27,099,269	41,149,606	68,248,876
Bike	9,409,342	18,928,256	28,337,598
Totals	36,508,611	60,077,862	96,586,473

These estimates have a margin of error of +/- 2.38% for the entire state, and +/- 4.17% and +/- 2.91% for urban and rural areas respectively (Table 19).

Table 19: Margin of Error for Survey Sample (95% Confidence)

Description	Vermont Urban	Vermont Rural	All Vermont
Number of Households in Sample (n)	553	1,137	1,690
Margin of error	4.17%	2.91%	2.38%

The margin of error (or sampling error) is based on the sample size according to the following equation (95% confidence level):

- Sampling Error = 1.96 X SQRT(.5*.5/n), where n is the sample size.

For the 2009 VT NHTS, the margin of error for the following key data elements is the same:

- number of trips per person day
- number of walking trips per person day
- number of biking trips per person day

95% confidence is selected as it is standard to describe the certainty of an estimate at this level. In narrative form 95% confidence means the following:

- When conducting the NHTS survey for Vermont with the sample size used, 95 times out of 100 a response will be obtained that are within 2.38% (+/-) of the derived estimate. In this case, the analysis indicates 68,248,876 annual walking miles in Vermont in 2009. We are 95% confident that the actual value is between 66,631,911 (2.4% lower than the estimate) or 69,875,841 (2.4% higher than the estimate). These data, along with the similar estimates for bicycling, are shown in Table 20.

Table 20: Range of Walking and Biking Miles in Vermont in 2009 (95% Confidence)

Description	Walking	Biking
Average	68,248,876	28,337,598
Low Estimate	66,621,911	27,662,066
High Estimate	69,875,841	29,013,129

For the purpose of this analysis, the average estimate of walking and biking trips will be utilized keeping in mind that they will affect transportation system cost estimates by +/- 2.4% statewide, +/- 4.2% in urban areas, and +/- 2.2% in rural areas.

Transportation System Costs

This section of the working paper applies transportation system unit costs to the miles travelled to calculate the net savings related to walking and biking trips in Vermont.

Transportation system costs include consumer and public cost components. Consumer costs are borne by the individual traveler such as vehicle operating costs (fuel, maintenance, insurance, etc), long-term mileage based cost (depreciation per mile, user costs from tickets and crashes, etc), and the cost to purchase and finance a car, bicycle or other vehicle. Public costs are passed on by the individual to society overall, such as impacts of tail pipe emissions including green house gases, crashes, parking, the value of time lost in congestion, and health. Additional detail on each of these components is provided below.

The potential transportation system cost savings are based on (1) the avoided consumer and public costs of automobile travel and (2) the added the consumer and public costs of walking and biking. The potential transportation system cost savings related to walking and biking presented below are based on the assumption that that all walking and biking trips replace automobile trips. This assumption has the following limitations:

1. If was not possible to walk or bike the trip may not be made (rather than shifting to travel by automobile). The result would be a reduction in trips if individuals do not have a car or the ability to drive; or if individuals choose not to travel for discretionary trips. If one assumes some trips are eliminated, the estimate of avoided costs presented below is high. However, there are other costs that cannot be explicitly accounted for due to reduced accessibility (if walking or biking were not possible) such as loss of independence, isolation, decreased access to jobs and services, and decreased economic activity. Thus, this limitation adds both upward and downward uncertainty into the analysis that from a total cost perspective minimizes its overall effect on the results.
2. The analysis of avoided costs assumes that an automobile trip would be the same distance as the walking or biking trip it replaces. However, travel time, rather than distance is often the determining factor when choosing a destination. For example, based on the 2009 NHTS data, the average distance for a trip made on foot in Vermont is 0.79 miles and takes approximately 16 minutes. During the same amount of time, an automobile traveling at an average speed of 30 miles per hour has a range of approximately 8 miles. If an individual has no choice but to drive, they may choose destinations further away, with less travel time. This limitation would result in underestimating the amount of avoided vehicle miles of travel replaced by walking and biking.

The first limitation is neutral while the second limitation results in a conservative (or low) estimate of avoided automobile costs.

Definitions for the transportation related costs are indicated in Table 21. The definitions and unit costs were developed by the Victoria Transport Policy Institute (VTPI) and are published in the 2009 *Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications*. RSG reviewed potential sources for unit costs from the Transportation Research Board (TRB), American Association of State Highway and Transportation Officials (AASHTO), Institute of Transportation Engineers (ITE), various bicycle and pedestrian organizations, and other sources. The unit costs presented by VTPI are recent and cover all modes of travel including automobiles, walking and biking. The methodologies for estimating costs are also consistent where appropriate across modes.

For example, the travel time unit costs for automobiles, walking and biking are based on the same median hourly wage rate.

Table 21: Transportation System Cost Definitions

Cost Category	Definition	Cost Allocation		Cost Type	
		Consumer	*Public*	*Fixed*	*Variable*
Vehicle Ownership	Fixed costs of owning an automobile or bike	X		X	
Vehicle Operation	Variable vehicle costs, including fuel, oil, tires, tolls and short-term parking fees.	X			X
Travel Time	The value of time used for travel.	X			X
Internal Crash	Crash costs borne directly by travelers.	X			X
External Crash	Crash costs a traveler imposes on others.		X		X
Internal Health Ben.	Health benefits of active transportation to travelers.	X			X
External Health Ben.	Health benefits of active transportation to society		X		X
Internal Parking	Off-street residential parking and long-term leased parking paid by users.	X		X	
External Parking	Off-street parking costs not borne directly paid by users.		X		X
Congestion	Congestion costs imposed on other road users.		X		X
Road Facilities	Roadway facility construction and operating expenses not paid by user fees.		X		X
Land Value	The value of land used in public road rights-of-way.		X		X
Traffic Services	Costs of providing traffic services such as traffic policing, and emergency services.		X		X
Transport Diversity	The value to society of a diverse transport system, particularly for non-drivers.		X		X
Air Pollution	Costs of vehicle air pollution emissions.		X		X
Green House Gas (GHG)	Lifecycle costs of greenhouse gases that contribute to climate change.		X		X
Noise	Costs of vehicle noise pollution emissions.		X		X
Resource Externalities	External costs of resource consumption, particularly petroleum.		X		X
Barrier Effect	Delays that roads and traffic cause to nonmotorized travel.		X		X
Land Use Impacts	Increased costs of sprawled, automobile-oriented land use.		X		X
Water Pollution	Water pollution and hydrologic impacts caused by transport facilities and vehicles.		X		X
Waste	External costs associated with disposal of vehicle wastes.		X		X

Source: "2009 Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications"; VTPI

Table 22 and Table 23 present the unit costs for urban and rural areas respectively. The VTPI developed unit costs in 2007 dollars for urban peak hour, urban off-peak and rural driving conditions. The 2007 dollars were adjusted by 1.03 to reflect 2009 dollars based on the Consumer Price Index[1]. The unit costs for automobile travel are based on an average automobile which is defined by VTPI as a medium sized car that averages 21 mpg overall (16 mpg city driving, 24 mph highway driving) and is driven 12,500 miles per year. Based on preliminary information provided by the UVM Transportation Center, the fuel efficiency of the Vermont fleet in 2010 was 22.9 miles per gallon[2], which is reasonably consistent with VTPI's assumption. VTPI's annual operating unit cost for automobiles is based on an American Automobile Association study that used an average price of gas of $2.30 per gallon[3]. This cost is consistent with gas prices in Vermont which averaged $2.32 per gallon in 2009[4]. Another key factor in the cost analysis is the value of travel time. The 2007 VTPI unit cost for travel time is based upon a median hourly rate of $15.00 per hour ($15.45 in 2009 dollars). The 2009 median hourly rate for all occupations in Vermont was $15.75[5], which is also reasonably consistent with the wage rate assumed by VTPI.

Because the NHTS data provide a reliable estimate of walking and biking travel for urban and rural areas in Vermont, the potential cost savings for each area has been estimated separately and then combined into a total for the state as follows:

- Table 22 (page 37) presents unit costs for average urban conditions in Vermont in 2009 dollars. Values for urban travel conditions in Vermont were created for each unit cost from a weighted average of the VTPI default values for urban peak and urban off-peak conditions based on 2009 data from VTrans continuous traffic count stations for urban highways throughout the state[6]. The VTrans data indicate that 10.7% of travel in Vermont urban areas occurs during the peak hour. Therefore, the VTPI urban peak unit costs were weighted by 10.7% and the urban off-peak by 89.3% to reflect average urban travel conditions in Vermont.
- Table 23 (page 38) presents the unit costs for rural travel. No additional modifications were made to the VTPI rural unit costs beyond the adjustment from 2007 to 2009 dollars.
- Table 24 and Table 25 (pages 39 and 40) present the total annual costs for each transportation system cost component for Vermont urban and rural areas respectively. With the exception of travel time (discussed below), the total for each cost component was calculated by multiplying its unit cost by miles traveled. The tables calculate the transportation system savings related to walking and biking by summing the avoided costs associated with automobile travel (presented as a negative number in the tables) and the added costs of walking and biking. Health benefits associated with walking and biking are presented as negative values because they create savings, while all other walking and biking unit costs are positive because they reflect expenses related to travel by foot and bike.
- The travel time estimate associated with automobile travel is the one cost component that has not been directly calculated by applying the unit costs to the miles of travel. As previously discussed, the analysis assumes that miles travelled by walking and biking

[1] http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/

[2] Sears, Justine and Karen Glitman, The Vermont Transportation Energy Report, University of Vermont Transportation Research Center, 2010 (this will be up on the web in September)

[3] American Automobile Association, "Your Cost of Driving, 2009 Edition", http://www.aaaexchange.com/Assets/Files/200948913570.DrivingCosts2009.pdf

[4] Based on monthly average gas prices compiled by VTrans http://www.aot.state.vt.us/conadmin/fuelpriceadju.htm

[5] May 2009, Occupational Employment Statistics (OES) survey. The survey is conducted twice a year measuring occupational employment and wage rates for wage and salary workers in nonfarm establishments in Vermont.

[6] "Continuous Traffic Counter and Grouping Study and Regression Analysis Based on 2009 Traffic Data", VTrans Traffic Research Unit

replace an equal number of automobile trips of the same distance and therefore result in avoided transportation system costs. However, travel time by car includes both on-road travel, and time for parking, walking to final destinations, and other inefficiencies (referred to as terminal time). Travel times for automobile trips have therefore been adjusted to include 10 and 5 minute terminal times for trips in urban and rural areas respectively.

Table 22: Transportation System Unit Costs for Urban Travel (2009 Dollars per Mile Traveled)

Cost Category	**Automobile**				**Bike**				**Walk**			
	Total	*Consumer Fixed*	*Consumer Variable*	*Public*	*Total*	*Consumer Fixed*	*Consumer Variable*	*Public*	*Total*	*Consumer Fixed*	*Consumer Variable*	*Public*
Vehicle Ownership	$0.28	$0.28	-	-	$0.07	$0.07		-	$0.00	$0.00		-
Vehicle Operation	$0.18	-	$0.18	-	$0.03	-	$0.03	-	$0.05	-	$0.05	-
Travel Time	$0.10	-	$0.10	-	$0.39	-	$0.39	-	$1.29	-	$1.29	-
Internal Crash	$0.09	-	$0.09	-	$0.09	-	$0.09	-	$0.09	-	$0.09	-
External Crash	$0.06	-	-	$0.06	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Internal Health Ben.	$0.00	-	-	$0.00	($0.10)	-	($0.10)	-	($0.25)	-	($0.25)	-
External Health Ben.	$0.00	-	-	$0.00	($0.10)	-	-	($0.10)	($0.25)	-	-	($0.25)
Internal Parking	$0.08	$0.08	-	-	$0.01	$0.01	-	-	$0.00	$0.00	-	-
External Parking	$0.06	-	-	$0.06	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Congestion	$0.03	-	-	$0.03	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Road Facilities	$0.03	-	-	$0.03	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Land Value	$0.04	-	-	$0.04	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Traffic Services	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Transport Diversity	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Air Pollution	$0.05	-	-	$0.05	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Green House Gas	$0.02	-	-	$0.02	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Noise	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Resource Externalities	$0.04	-	-	$0.04	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Barrier Effect	$0.02	-	-	$0.02	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Land Use Impacts	$0.09	-	-	$0.09	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Water Pollution	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Waste	$0.00	-	-	$0.00	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Totals (Dollars per mile)	*$1.21*	$0.36	$0.36	$0.48	*$0.40*	$0.07	$0.41	($0.08)	*$0.95*	$0.00	$1.19	($0.24)

Table 23: Transportation System Unit Costs for Rural Travel (2009 Dollars per Mile Traveled)

Cost Category	Automobile				Bike				Walk			
	Total	*Consumer Fixed*	*Consumer Variable*	*Public*	*Total*	*Consumer Fixed*	*Consumer Variable*	*Public*	*Total*	*Consumer Fixed*	*Consumer Variable*	*Public*
Vehicle Ownership	$0.28	$0.28	-	-	$0.07	$0.07	-	-	$0.00	$0.00	-	-
Vehicle Operation	$0.15	-	$0.15	-	$0.03	-	$0.03	-	$0.05	-	$0.05	-
Travel Time	$0.06	-	$0.06	-	$0.39	-	$0.39	-	$1.29	-	$1.29	-
Internal Crash	$0.09	-	$0.09	-	$0.09	-	$0.09	-	$0.09	-	$0.09	-
External Crash	$0.06	-	-	$0.06	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Internal Health Ben.	$0.00	-	-	$0.00	($0.10)	-	($0.10)	-	($0.25)	-	($0.25)	-
External Health Ben.	$0.00	-	-	$0.00	($0.10)	-	-	($0.10)	($0.25)	-	-	($0.25)
Internal Parking	$0.04	$0.04	-	-	$0.00	$0.00	-	-	$0.00	$0.00	-	-
External Parking	$0.03	-	-	$0.03	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Congestion	$0.00	-	-	$0.00	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Road Facilities	$0.02	-	-	$0.02	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Land Value	$0.04	-	-	$0.04	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Traffic Services	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Transport Diversity	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Air Pollution	$0.00	-	-	$0.00	$0.00	-	-	$0.00	$0.00	-	-	$0.00
GHG	$0.02	-	-	$0.02	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Noise	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Resource Externalities	$0.04	-	-	$0.04	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Barrier Effect	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Land Use Impacts	$0.04	-	-	$0.04	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Water Pollution	$0.01	-	-	$0.01	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Waste	$0.00	-	-	$0.00	$0.00	-	-	$0.00	$0.00	-	-	$0.00
Totals (Dollars per mile)	*$0.90*	$0.32	$0.30	$0.28	*$0.38*	$0.07	$0.40	($0.09)	*$0.95*	$0.00	$1.19	($0.24)

Table 24: Annual Transportation System Cost Savings due to Walking and Biking for Vermont Urban Areas (2009)

Annual Miles Traveled [(1)]**:**	25,053,947	9,409,342	27,099,269	
Cost Component	**Avoided Auto Travel Costs**	**Added Biking Associated Costs**	**Added Walking Associated Costs**	**Net Change**
Vehicle Ownership	$ (7,051,150)	$ 642,567	$ -	$ (6,408,584)
Vehicle Operation	$ (4,445,854)	$ 253,132	$ 1,486,101	$ (2,706,621)
Travel Time [(2)]	$ (25,834,381)	$ 4,252,156	$ 32,299,776	$ 10,717,551
Internal Crash	$ (2,151,638)	$ 808,076	$ 2,327,290	$ 983,729
External Crash	$ (1,425,784)	$ 29,208	$ 84,119	$ (1,312,458)
Internal Health Ben.	$ -	$ (924,906)	$ (6,729,515)	$ (7,654,421)
External Health Ben.	$ -	$ (924,906)	$ (6,729,515)	$ (7,654,421)
Internal Parking	$ (2,073,868)	$ 48,679	$ -	$ (2,025,188)
External Parking	$ (1,555,401)	$ 34,075	$ -	$ (1,521,325)
Congestion	$ (803,624)	$ 18,498	$ 33,648	$ (751,478)
Road Facilities	$ (674,007)	$ 19,472	$ 56,079	$ (598,456)
Land Value	$ (881,394)	$ 19,472	$ 56,079	$ (805,843)
Traffic Services	$ (355,150)	$ 10,709	$ 30,844	$ (313,597)
Transport Diversity	$ (181,463)	$ -	$ -	$ (181,463)
Air Pollution	$ (1,373,937)	$ -	$ -	$ (1,373,937)
Green House Gas (GHG)	$ (445,882)	$ -	$ -	$ (445,882)
Noise	$ (337,004)	$ -	$ -	$ (337,004)
Resource Externalities	$ (1,052,488)	$ -	$ -	$ (1,052,488)
Barrier Effect	$ (409,589)	$ 9,736	$ -	$ (399,853)
Land Use Impacts	$ (2,151,638)	$ -	$ -	$ (2,151,638)
Water Pollution	$ (362,927)	$ -	$ -	$ (362,927)
Waste	$ (10,369)	$ -	$ -	$ (10,369)
Totals	$ (53,577,546)	$ 4,295,967	$ 22,914,907	$ (26,366,672)

(1) Avoided Auto Miles = Walking and Biking Miles divided by 1.46 average persons per car for urban travel

(2) A separate calculation has been made for travel time that accounts for the time it takes to park and walk to final destinations (terminal time)

Table 25: Annual Transportation System Cost Savings due to Walking and Biking for Vermont Rural Areas (2009)

Annual Miles Traveled [1]:	40,051,908	18,928,256	41,149,606	
Cost Component	**Avoided Auto Travel Costs**	**Added Biking Associated Costs**	**Added Walking Associated Costs**	**Net Change**
Vehicle Ownership	$ (11,272,157)	$ 1,292,616	$ -	$ (9,979,541)
Vehicle Operation	$ (5,967,613)	$ 509,212	$ 2,256,610	$ (3,201,791)
Travel Time [2]	$ (19,216,008)	$ 7,398,520	$ 51,555,180	$ 39,737,692
Internal Crash	$ (3,439,666)	$ 1,625,562	$ 3,533,936	$ 1,719,833
External Crash	$ (2,279,296)	$ 58,755	$ 127,733	$ (2,092,809)
Internal Health Ben.	$ -	$ (1,860,583)	$ (10,218,611)	$ (12,079,194)
External Health Ben.	$ -	$ (1,860,583)	$ (10,218,611)	$ (12,079,194)
Internal Parking	$ (1,657,670)	$ 39,170	$ -	$ (1,618,500)
External Parking	$ (1,036,044)	$ 19,585	$ -	$ (1,016,459)
Congestion	$ -	$ -	$ 51,093	$ 51,093
Road Facilities	$ (663,068)	$ 19,585	$ 85,155	$ (558,328)
Land Value	$ (1,409,020)	$ 39,170	$ 85,155	$ (1,284,694)
Traffic Services	$ (290,092)	$ -	$ 46,835	$ (243,257)
Transport Diversity	$ (290,092)	$ -	$ -	$ (290,092)
Air Pollution	$ (165,767)	$ -	$ -	$ (165,767)
Green House Gas (GHG)	$ (621,626)	$ -	$ -	$ (621,626)
Noise	$ (290,092)	$ -	$ -	$ (290,092)
Resource Externalities	$ (1,409,020)	$ -	$ -	$ (1,409,020)
Barrier Effect	$ (331,534)	$ -	$ -	$ (331,534)
Land Use Impacts	$ (1,719,833)	$ -	$ -	$ (1,719,833)
Water Pollution	$ (580,185)	$ -	$ -	$ (580,185)
Waste	$ (16,577)	$ -	$ -	$ (16,577)
Totals	$ (52,655,360)	$ 7,281,010	$ 37,304,476	$ (8,069,874)

(1) Avoided Auto Miles = Walking and Biking Miles divided by 1.5 average persons per car for rural travel

(2) A separate calculation has been made for travel time that accounts for the time it takes to park and walk to final destinations (terminal time)

Table 26 combines the total costs for the urban and rural areas into a statewide number resulting in an estimated transportation system cost savings of approximately $34.5 million per year due to walking and biking.

Table 26: Summary of 2009 Annual Transportation System Cost Savings in Vermont due to Walking and Biking

Area	**Avoided Auto Travel Costs**	**Added Biking Associated Costs**	**Added Walking Associated Costs**	**Net Change**
Urban	$ (53,577,546)	$ 4,295,967	$ 22,914,907	$ (26,366,672)
Rural	$ (52,655,360)	$ 7,281,010	$ 37,304,476	$ (8,069,874)
Total	$ (106,232,906)	$ 11,576,977	$ 60,219,383	$ (34,436,546)

Travel time is the largest cost component of walking and biking and has a significant impact on the total estimated cost savings. Because the total cost of travel time is significantly greater for walking and biking (compared to auto travel for the same distances), the analysis creates the appearance that consumer, out-of-pocket costs are greater for trips made in Vermont on foot or bike by $7.5 million per year (Table 27). If the value of travel time is assumed to be neutral, the estimated consumer cost savings related to walking and biking would be $43.0 million per year and the total annual savings due to walking and biking would increase from $34.5 million to $84.9 million. The value of travel time is categorized as a consumer cost because it reflects the perceived value of time for individuals while travelling. Because perception does not equate to real out-of-pocket costs, assuming travel time is neutral is arguably a reasonable assumption and will be discussed further with the advisory committee.

Table 27: Effect of Travel Time Cost Component on Transportation System 2009 Annual Transportation System Cost Savings due to Walking and Biking

Travel Time Cost Factor Assumption	Total Savings	Consumer Related Savings	Public Related Savings
Included	$ (34,436,546)	$ 7,484,965	$ (41,921,511)
Neutral	$ (84,891,789)	$ (42,970,278)	$ (41,921,511)