The Vermont Transportation Energy Profile

October 2015

VTrans Working to Get You There
Vermont Agency of Transportation

Acknowledgements

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Disclaimer

The Profile was developed and written as a collaborative project. The UVM Transportation Research Center is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the UVM Transportation Research Center or the Vermont Agency of Transportation. This Profile does not constitute a standard, specification, or regulation.

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Executive Summary

The transportation sector is responsible for 37% of the total energy consumed in Vermont (see Figure E-1), more than any other sector in the state. The energy used by the transportation sector is derived overwhelmingly from fossil fuels, with over 76% in the form of gasoline and nearly 20% in the form of diesel. Consequently, the 2011 Vermont Comprehensive Energy Plan (CEP) included four goals, with 12 measurable supporting objectives, related to reducing transportation sector petroleum and energy consumption (VDPS, 2011). The 2015 Vermont Transportation Energy Profile ("the Profile") is the second installment of a biannual reporting series that evaluates the state's progress toward achieving these transportation sector objectives.

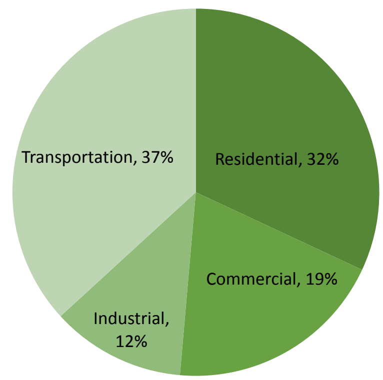

Figure E-1. Vermont Energy Consumption, 2013 (U.S. EIA, 2015)

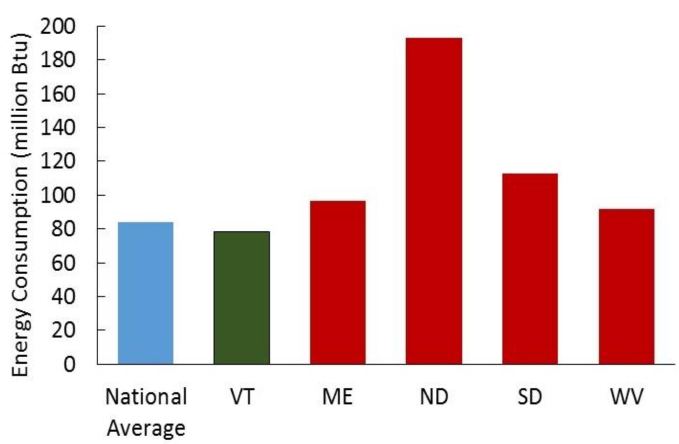

Figure E-2 Vermont per Capita Transportation Sector Energy Consumption, 2013 (U.S. EIA 2015)

Though the industrial sector is the largest consumer of energy nationally, this is not the case in Vermont. Vermont is one of 17 U.S. states that consumes more energy for transportation than for any other sector (U.S. EIA, 2015). Nonetheless, the state's per capita transportation sector energy use is below the national average, at 78.4 million Btu annually in 2013, and below levels seen in four rural comparisons states, as shown in Figure E-2.

The CEP set out 12 long-term transportation objectives, generally with 2030 target dates, to support transportation goals 1 and 2—reducing transportation-sector energy and petroleum use. These objectives are presented in Table E-1. In order to conduct this assessment, the change in each metric is compared to the average annual rate of change required to hit the CEP target. For example, the CEP calls for the state to add 2,284 park-and-ride parking spaces by 2030. In order to achieve this objective, the state must add an average of 120 spaces per year. When the average number of new parking spaces is at or above 120 spaces per year, the state is on pace to meet the CEP target. When the average number of new parking spaces falls below this rate, the state is lagging behind the CEP target.

For many of these metrics, progress toward achieving the CEP objective is likely to lag in the early years due to the necessity of upfront investments and the slow pace of behavior change. Progress may be particularly slow for metrics related to the vehicle fleet since cars and trucks typically have a long operating life. Thus cases where the state is currently lagging in achieving a particular objective should not be taken to mean that the objective cannot be achieved.

Table E-1 summarizes the state's progress toward achieving these 12 objectives. Most metrics are moving in the direction of the CEP objectives, but many are moving at a slower pace than is required to hit the CEP target. In addition, the updated data needed to evaluate progress toward some objectives are not available for the two-year time frame between the 2013 and 2015 Profiles.

Table E-1. Current Progress toward Achieving CEP Transportation Objectives

	Objective Targets[1]	Baseline Value[2]	Most Recent		Rate of Change[3]	
			Year	Value	Target	To Date
VMT Growth	1. Annual VMT growth ≤ 1.5%	7.141[4]	2013	7.116	≤ 1.5%	-0.18%
	2. Hold per capita VMT stable	11,402	2013	11,356	≤ 0%	-0.20%
Increase share of Low-Energy-Intensity Travel Modes	3. Reduce single-occupancy vehicle commute mode share by 20%	79.2%	2014	82.6%	-1.1%	1.13%
	4. Increase bicycle and pedestrian commute mode share to 15.6%	7.6%	2014	6.5%	0.4%	-0.34%
	5. Increase carpooling commute mode share to 21.4%	10.6%	2014	9.5%	0.6%	-0.38%
	6. Increase the number of state park-and-ride spaces to 3,426	1,142	2015	1,380	120.2	79.3
	7. Increase annual transit ridership to 8.7 million riders	4.58[5]	2014	4.84	0.22	0.09
	8. Increase annual passenger rail trips to 400,000 trips	91,942	2014	107,688	16,214	5,249
	9. Double rail freight tonnage	6.6[6]	2011	6.6	0.3	N/A
Fuel Efficiency/ Alternative Fuel Use	10. Increase the fleet-wide fuel economy to equal the 2025 CAFE standard (54.5 mpg)	20.3	2015	25.6	2.4	1.3
	11. 25% of registered vehicles powered by renewable sources	0.0%[7]	2015	0.2%	1.3%	0.05%
	12. Increase the number of medium- and heavy-duty vehicles powered by biodiesel or CNG by up to 10%	Since diesel vehicles can run on conventional diesel and biodiesel, this objective cannot be tracked without tracking biodiesel fuel sales.				

[1] Objective 10 has a 2025 target date; all other objectives have 2030 target dates.
[2] Baseline values for objective targets are from 2011.
[3] Rates of change are annual averages. Target rates indicate the average annual rate of change required to meet the CEP target. Rates of change for objectives 3–5 are measured as the change in percent of total commute trips. Objective 11 is measured as the change in the percent of the total vehicle fleet.
[4] Measured in billions of miles traveled.
[5] Measured in millions of riders.
[6] Measure in millions of tons.
[7] Measured as the percent of plug-in electric vehicles in the Vermont fleet.

If we are to achieve our goals, we must measure and evaluate our progress and adjust it on the basis of data, not just broad policy. Therefore, at least every five years, VTrans and other relevant state agencies as assigned by the Vermont Climate Cabinet in the implementation of the CEP will review data collected by the Agency and the U.S. Census Bureau to determine progress in meeting objectives. A summary report will be produced detailing progress levels in relation to targets and an explanation of whether the objectives are being met or not.

—Vermont Comprehensive Energy Plan, 2011

1 Introduction

The transportation sector is responsible for 37% of the total energy consumed in Vermont (U.S. EIA, 2015), more than any other sector in the state. Consequently, the 2011 Vermont Comprehensive Energy Plan (CEP) included four goals, with 12 measurable supporting objectives, related to reducing transportation-sector petroleum and energy consumption (VDPS, 2011). The 2015 Vermont Transportation Energy Profile ("the Profile") is the second installment of a biannual reporting series that evaluates the state's progress toward achieving these transportation-sector objectives. The Profile also provides baseline data to support future revisions of the CEP and to inform transportation policy-making more broadly.

The 2011 CEP was a multi-agency effort led by the Public Service Department that set an overarching goal of using renewable energy sources to meet 90% of the state's overall energy needs by 2050. To support this larger goal, the CEP outlined four specific goals for the transportation sector. These goals are to:

1. Reduce petroleum consumption in the state of Vermont through improved vehicle efficiency and increased use of alternative fuels;
2. Reduce overall energy use in the transportation sector through more efficient and less energy-intensive mobility options;
3. Address the effects of decreased petroleum consumption on transportation funding; and

2011 CEP STRATEGIES FOR TRANSPORTATION

Vehicles and Fuels

- Increase the fuel efficiency of vehicles registered in Vermont
- Increase registrations of electric vehicles in Vermont
- Support the deployment of a cleaner-burning and more energy-efficient truck fleet

Travel Modes

- Provide more efficient alternatives to single-occupancy vehicle trips
- Make transit options available for commuter trips in developed areas
- Encourage carpooling/car sharing
- Provide seamless connections between intercity rail, bus, and airport services
- Safely accommodate bicycles and pedestrians on all Vermont roadways

New Development

- Focus new development and jobs in "smart growth" locations, where land-use mix and density support shorter trips and transit, bicycle, and pedestrian modes.

4. Measure and evaluate progress toward meeting all goals on a regular basis.

The CEP also provided 12 measurable supporting objectives for goals 1 and 2. As shown in Table 1-1, these objectives relate to controlling the increase in vehicle miles traveled (VMT)—an estimate of the total on-road distance driven by all vehicles in Vermont, increasing the percent of trips taken using lower-energy-intensity travel modes such as walking and public transit, and increasing fuel efficiency and alternative fuel usage for vehicle trips.

Table 1-1. CEP Transportation Objectives for 2025 and 2030

Control Vehicle Miles Traveled:

1. Keep annual growth in vehicle miles traveled (VMT) to 1.5%.
2. Hold per capita VMT to 2011 levels.

Increase the Share of Travel Modes with Lower Energy Intensities:

3. Reduce the share of single-occupancy vehicle (SOV) commute trips by 20%.
4. Double the share of bicycle and pedestrian commute trips to 15.6%.
5. Double the share of carpooling commute trips to 21.4%.
6. Triple the number of state park-and-rides spaces to 3,426.
7. Increase public transit ridership by 110% to 8.7 million trips annually.
8. Quadruple Vermont-based passenger-rail trips to 400,000 trips annually.
9. Double the rail-freight tonnage in the state.

Increase Vehicle Fleet Fuel Efficiency and Alternative Fuel Usage:

10. Improve the combined average fuel economy (CAFE) of the Vermont vehicle fleet to meet 2025 federal CAFE standards by 2025.
11. Ensure that 25% of vehicles registered in VT are powered by renewable sources.
12. Increase the number of medium- and heavy-duty vehicles powered by biodiesel or CNG by up to 10%.

Note: All objectives are for 2030 and relative to a 2011 baseline except where noted otherwise.

Sections 2 through 5 of the Profile provide the data needed to evaluate the CEP transportation objectives in a broader transportation context. Progress toward achieving each of the 12 metrics is evaluated in Section 6. Final recommendations for CEP goal revisions and additional data collection needs are provided in Section 7.

1.1 Vermont in Context

In order to provide context for the data outlined in this Profile, national data are provided alongside Vermont data whenever possible. In addition, since transportation demand is closely tied to development patterns, Vermont data are juxtaposed with four comparison states: Maine, North Dakota, South Dakota, and West Virginia. These four states, shown in Figure 1-1, were selected based on similarities in terms of (1) the proportion of each state that is rural versus urban, (2) residential density distribution, (3) household size distribution, (4) the distribution of the number of workers in each household, and (5) overall population. In addition, potential comparison states were limited to states that experience significant winter weather and its associated impacts on travel.

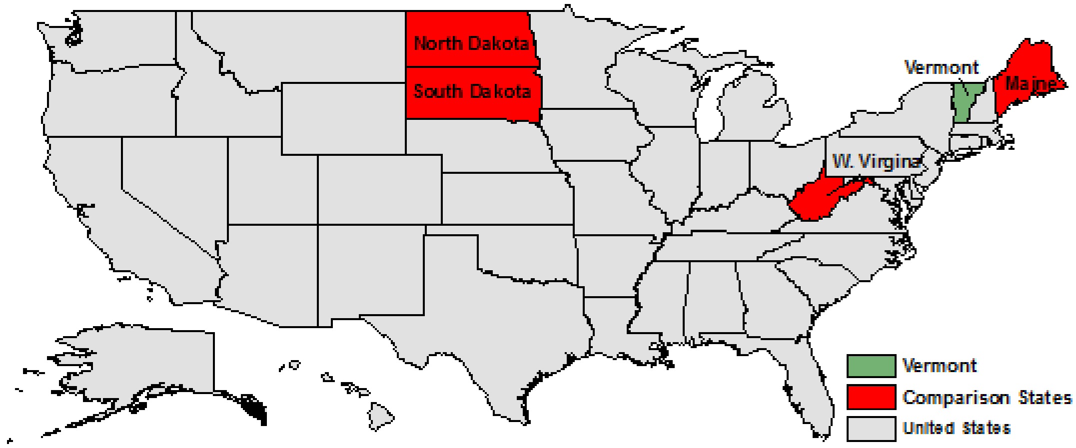

Figure 1-1. Vermont and Comparison States

1.2 Data Sets Used in the Energy Profile

This report draws on a variety of data sets to illustrate trends in Vermonters' travel behavior, vehicle fleet composition, and fuel sources that are relevant to CEP metrics and broader transportation policy-making initiatives. These data sources are expected to be available at regular intervals in the future. They include but are not limited to:

- The National Household Travel Survey (NHTS), six- to eight-year cycle
- The American Community Survey (ACS), annual cycle
- Vermont Department of Motor Vehicles (VDMV) licensing and vehicle registration data, annual cycle
- Federal Highway Administration summaries of roadway utilization from the Highway Performance Monitoring System, annual cycle
- Ridership reports from Vermont's 10 bus transit authorities, annual cycle
- Vermont Legislative Joint Fiscal Office (VLJFO) gasoline and diesel sales data, annual cycle

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2 Vermonters' Travel Behavior

This section provides data about travel behavior in Vermont. Individuals' travel behaviors (where, how, and how often they travel) are a key determinant of the total energy consumed within the transportation sector. Travel behavior in Vermont is heavily influenced by the state's rural and village-based land-use patterns. Per capita vehicle miles of travel (VMT) in Vermont has been falling but remains above the national average. Automobile usage is the dominant mode of travel, accounting for approximately 85% of all trips made in the state, but public transit and rail ridership have increased above the levels reported in the 2013 Profile.

2.1 Vehicle Miles of Travel

Total annual VMT is an estimate of the total mileage driven by all vehicles on a given road network. VMT is an important metric that is used in several capacities: in highway planning and management, to estimate fuel consumption and mobile-source emissions, to project potential gasoline tax revenues, and as a proxy for economic activity. Total VMT is influenced by how far people drive, how frequently they drive, and by vehicle occupancy rates.

After climbing steadily for several decades, VMT has declined in recent years at both the state and national level (see Table 2-1 and Figure 2-1). Recent declines in VMT likely reflect some combination of increasing petroleum prices, the economic downturn of 2008, demographic trends, and changing travel preferences, particularly among teens and young adults. Drivers age 65 and older, a growing proportion of the Vermont population, drive considerably less than drivers between the ages of 20 and 64 (FHWA 2015). In addition, teens and young adults are traveling less than their counterparts in previous generations did (Blumenberg et al., 2013). Rate of licensure, trip chaining, and the use of car sharing may also impact VMT and are discussed in Sections 2.1.1 through 2.1.3.

From 2007 to 2013, total and per capita VMT in Vermont fell by 7.5% and 8.4%, respectively. Over this same time period at the national level, total VMT fell by 1.4% and per capita VMT by 6%. In the four comparison states (ME, ND, SD, and WV), total VMT

VEHICLE MILES OF TRAVEL (VMT)

Definition: Annual VMT is an estimate of the total miles driven by all vehicles on a road network. VMT can provide insight into transportation energy use, emissions, and economic activity.

Trends: Since 2007, total and per capita VMT have fallen at both the state and national level. Vermont's per capita VMT remains higher than the national average as well as the average for the rural comparison states.

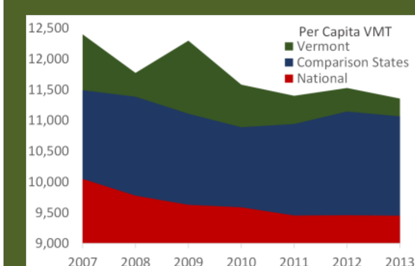

Figure 2-1. Trends in Per Capita VMT (FHWA, 2008–2014)

Driving Factors: The downward trend in VMT between 2007 and 2013 likely reflects a combination of factors, including changing demographics and the economic downturn of 2008. Vermont's higher-than-average per capita VMT is influenced by the state's rural character and significant travel by out-of-state drivers.

increased by 0.3%, driven largely by a significant increase in VMT in ND, while per capita VMT fell by 3.7%. While Vermont experienced the largest decline in per capita VMT over this time period, the state's 2013 per capita VMT was still higher than the national average and higher than the per capita VMT in three of the four rural comparison states, as shown in Figure 2-2. Overall, Vermont ranked 10th highest among all states in terms of per capita VMT in 2013, which is unchanged from 2011.

Vermont's comparatively high per capita VMT is influenced by the state's rural character. Sparse development patterns result in longer distances between residences, work, school, and shopping locations, requiring longer trips to meet residents' needs. Vermont also has a relatively high proportion of tourism and pass-through traffic originating out of state.

Table 2-1. Total and Per Capita VMT, 2007–2013

		2007	2008	2009	2010	2011	2012	2013
Total VMT (billions)	Vermont	7.694	7.312	7.646	7.248	7.141	7.216	7.116
	ME, ND, SD & WV	52.448	52.139	51.089	50.88	51.344	52.619	52.583
	U.S.	3,031	2,976	2,956	2,966	2,946	2,969	2,988
Per Capita VMT	Vermont	12,400	11,774	12,297	11,582	11,402	11,528	11,356
	ME, ND, SD & WV	11,492	11,386	11,109	10,890	10,942	11,145	11,066
	U.S.	10,050	9,777	9,628	9,589	9,455	9,459	9,452

Sources: FHWA, 2008–2014; USCB, 2009; USCB, 2014.

Vermont's predominantly rural land use is reflected in the proportion of it total roadway miles in rural, 89.8%, and urban, 10.2%, areas (see Table 2-2). VMT on urban roads accounts for over 26% of total VMT, more than 2.5 times the share of urban road miles.

Table 2-2. Vermont VMT by Road Class, 2013

Roadway Class	Urban/Rural	Total Roadway Miles	% of Total	VMT (millions)	% of Total
Interstate	Rural	280	2.0%	1,248	17.5%
	Urban	40	0.3%	387	5.3%
Arterial/ Major Collector	Rural	3,053	21.4%	2,839	42.5%
	Urban	493	3.5%	1,084	15.0%
Minor Collector/ Local	Rural	9,479	66.4%	1,171	13.9%
	Urban	921	6.5%	387	5.8%
Totals	**Rural**	12,812	89.8%	5,258	73.9%
	Urban	1,454	10.2%	1,858	26.1%

Source: FHWA, 2014.

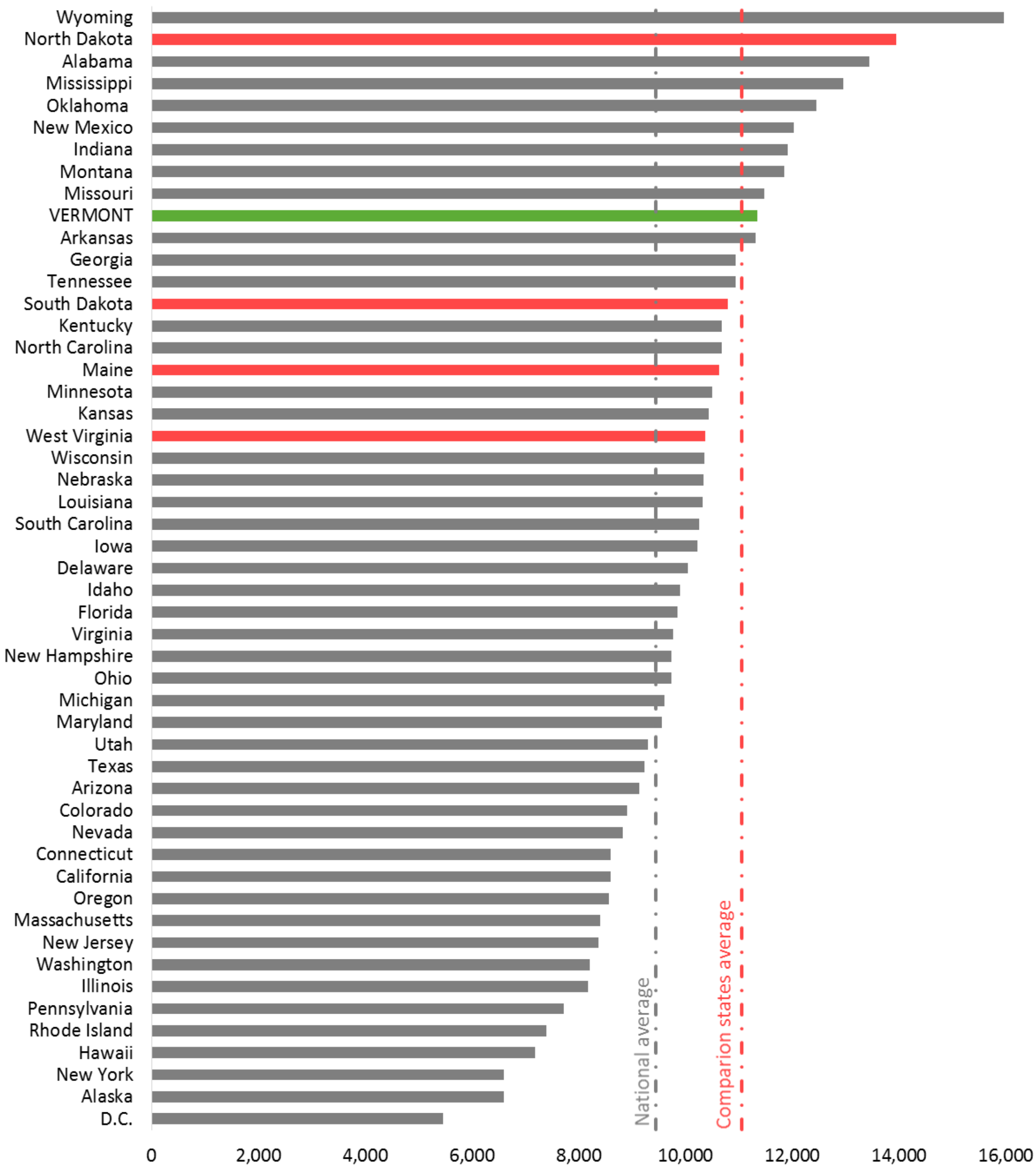

Figure 2-2. 2013 Per Capita VMT for U.S. States (FHWA, 2014; USCB, 2014)

2.1.1 Licensure

One factor that can influence VMT is the percentage of the population that is licensed to drive. The number of Vermonters with driver's licenses and learner's permits from 2007 through 2014 is shown in Table 2-3. The per capita licensure dropped between 2008 and 2010 but has rebounded to 2007 levels since 2012.

Table 2-3. Driver's Licenses and Permits in Vermont, 2007–2014

	2007	2008	2009	2010	2011	2012	2013	2014
Driver's Licenses	534,495	541,990	506,977	513,481	521,666	541,462	546,573	533,742
Learner's Permits	20,190	20,229	17,392	17,768	18,661	19,943	20,731	19,457
Licenses per Capita	0.86	0.87	0.82	0.82	0.83	0.87	0.87	0.85

Source: Fassett, 2015.

Vermont's rate of licensure per capita is higher than the national average and higher than licensure rates in any of the four rural comparison states. In part, this reflects the state's demographics, as the percentage of the population that is under 16 is lower in Vermont than in any of the comparison states.

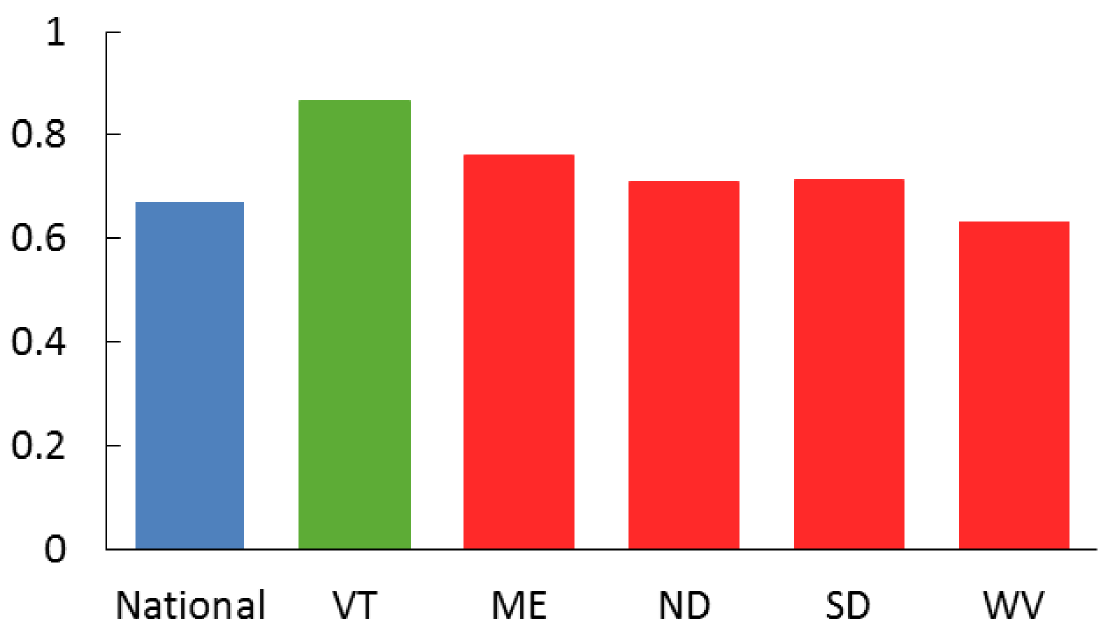

Figure 2-3. Per Capita Licensure, 2013 (FHWA, 2014; USCB, 2014)

2.1.2 Trip Chaining

Travelers' propensity for trip chaining is an additional determinant of VMT. Within the transportation field, a trip is defined as a single leg of a journey, with a discrete beginning and end. Traveling from home to work or from home to a store each constitutes a single trip. Trip chaining occurs when multiple trips are combined in a single journey. Traveling from work to the store to home is considered a single journey that chains together two trips. Trip chaining frequently results in fewer miles traveled than completing each trip independently. One method for tracking the frequency of trip chaining is to look at the percentage of trips that end at home. A reduction in the proportion of trips ending at home may indicate an increase in trip chaining. The distribution of trip destinations by Vermonters for all modes in 2009 is shown in Figure 2-4.

Figure 2-4. Distribution of Trip Purpose or Destination for Vermonters, 2009 (USDOT, 2010)

2.1.3 Car-Sharing Services

Vehicle-sharing organizations provide an alternative to personal vehicle ownership and are gaining popularity in Vermont. The net impact of car sharing on VMT is not yet known (Lovejoy et al., 2013). Researchers have alternatively suggested either that car sharing may increase VMT by giving non-car-owners access to a vehicle, or that it may decrease VMT by reducing overall car ownership rates.

Currently, measurements of the utilization of car-sharing vehicles is limited by the proprietary nature of each organization's data. CarShare Vermont currently has a total of 11 vehicles at locations in Burlington, Winooski, and Montpelier (CarShareVT.org). ZipCar, a national for-profit car-sharing outfit, has a total of five vehicles located in Middlebury, Poultney, and Royalton—Vermont towns with significant college populations (http://www.zipcar.com/cities). The creation of person-to-person (P2P) car-sharing service, such as RelayRides, provides a web-based option to search for privately owned vehicles available for hourly or daily rental.

2.2 Mode Share

VERMONT MODE SHARE

Definition: Mode share measures how people travel from location to location—that is, the proportion of trips that are made by private vehicle, public transit, active transport, or other means. Mode share is important for determining the overall energy efficiency of travel. Some modes, such as walking or taking a bus with higher ridership, are considerably more energy efficient than others, notably SOV trips.

Status: The overwhelming majority of trips in Vermont, nearly 85%, are taken in passenger vehicles. However, Vermont's SOV commute rate is below that of the comparison states, reflecting higher rates of biking and walking by Vermont commuters than by commuters in ME, ND, SD, and WV. Commute mode shares have been relatively stable from 2007 through 2013.

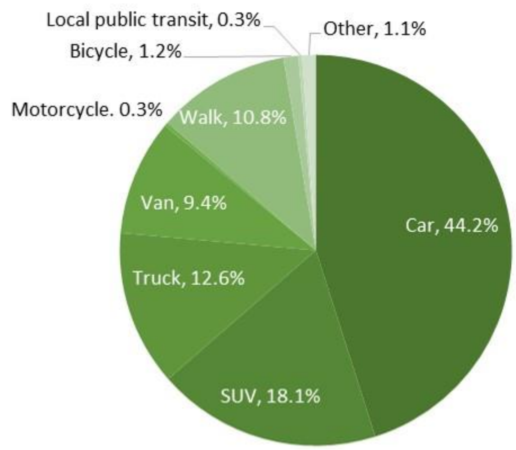

Figure 2-5. Vermonters' Mode Share, 2009 (USDOT, 2010)

Mode share refers to the proportion of all trips taken with a specific mode (e.g. private automobile, transit, or active transportation). It is commonly measured using travel surveys such as the NHTS, which was last completed in 2009. As shown in Figure 2-5, motorized modes, especially personal automobiles, were the dominant mode of travel reported by Vermonters in the 2009 NHTS. According to the 2009 NHTS, cars, SUVs, trucks, and vans accounted for nearly 85% of all Vermonters' trips. Notably, nearly half of these vehicle trips take place in larger, generally less energy-efficient vehicles—SUVs, light trucks, and vans. Further discussion of Vermont's privately owned vehicle fleet is provided in Section 3. An additional 1.3% of all trips are taken by transit.

Active transportation—walking and biking—accounted for 12% of all trips in the NHTS data set. Other, smaller survey data sets indicate a higher mode share for active transportation, as discussed in Section 2.4.

2.2.1 Mode Shares for Commuter Travel

The ACS collects reported mode data for commute trips on an annual basis. From 2011 through 2014, SOV commute mode share in Vermont increased from 79.2% to 82.6%. The mode shares for non-SOV commute modes for this same period of time all declined, as shown in Figure 2-6. Since single-year ACS estimates have a relatively small sample size, three-year estimates, which have a smaller margin of error, are used for comparing Vermonters' mode share with comparison state and national mode shares. Vermonters' commuting mode shares from the 2009 NHTS, 2007–2009 ACS, and 2011–2013 ACS, are shown in Table 2-4. Commute mode shares are largely unchanged over this time period. The proportion of Vermonters who commuted by SOV, 79.9%, is nearly identical to the national average, 79.8%, but lower than all four of the comparison states (ME, ND, SD, WV), which had SOV commute rates ranging from 82.1% to 84.3%.

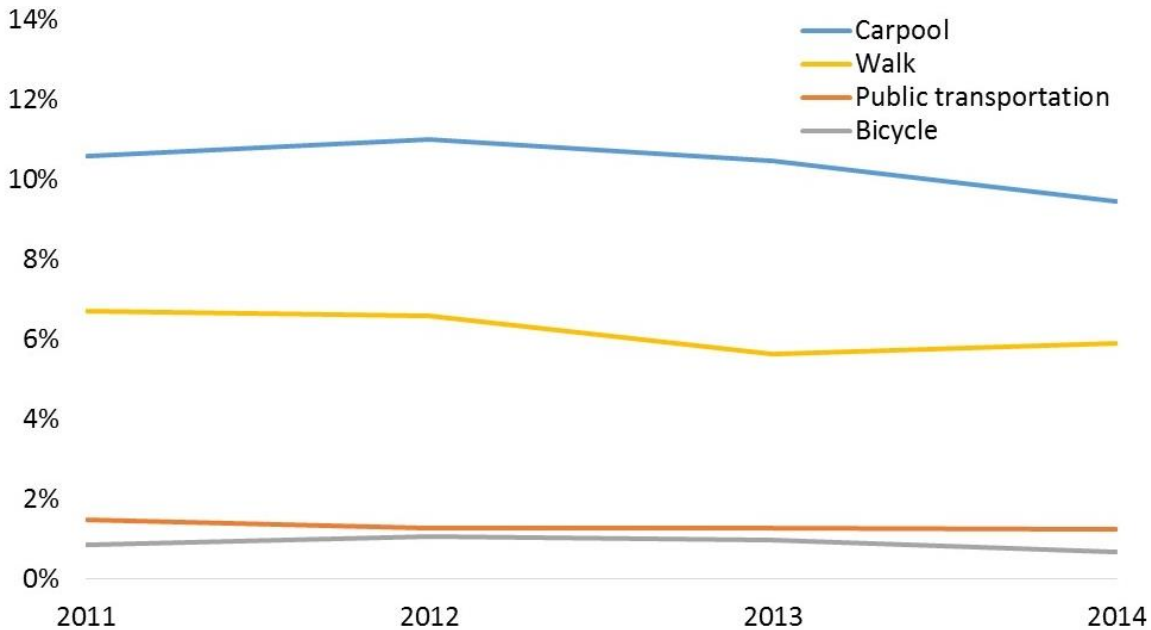

Figure 2-6. Mode Share for Non-SOV Commute Trips in Vermont, 2011–2014 (ACS, 2011–2014)

Table 2-4. Comparison of Commuter Mode Share and Occupancy for Vermonters, 2009

Mode	2009 NHTS[1]	2007–2009 ACS[2]	2011–2013 ACS[3]
Drove Alone by Car, Truck, or Van	82.7%	79.2%	79.9%
Carpooled by Car, Truck, or Van	11.7%	11.4%	10.7%
Used Public Transportation	0.6%	1.0%	1.3%
Walked	3.1%	6.7%	6.2%
Bicycle	0.9%	0.8%	1.0%
Used Taxicab, Motorcycle, or Other	1.0%	1.1%	1.0%

Sources: [1]USDOT, 2010; [2]ACS, 2010; [3]ACS, 2014.

Figure 2-7 shows the breakdown of commute trips that used a mode other than SOV for the U.S., Vermont, and the four comparison states. As would be expected given the state's rural nature, Vermonters use public transit less frequently than the national average. Vermonters carpooled at a similar rate to residents of the comparison states but commuted by walking or biking at a considerably higher rate, 7.2%, than the national average or than in any of the comparison states.

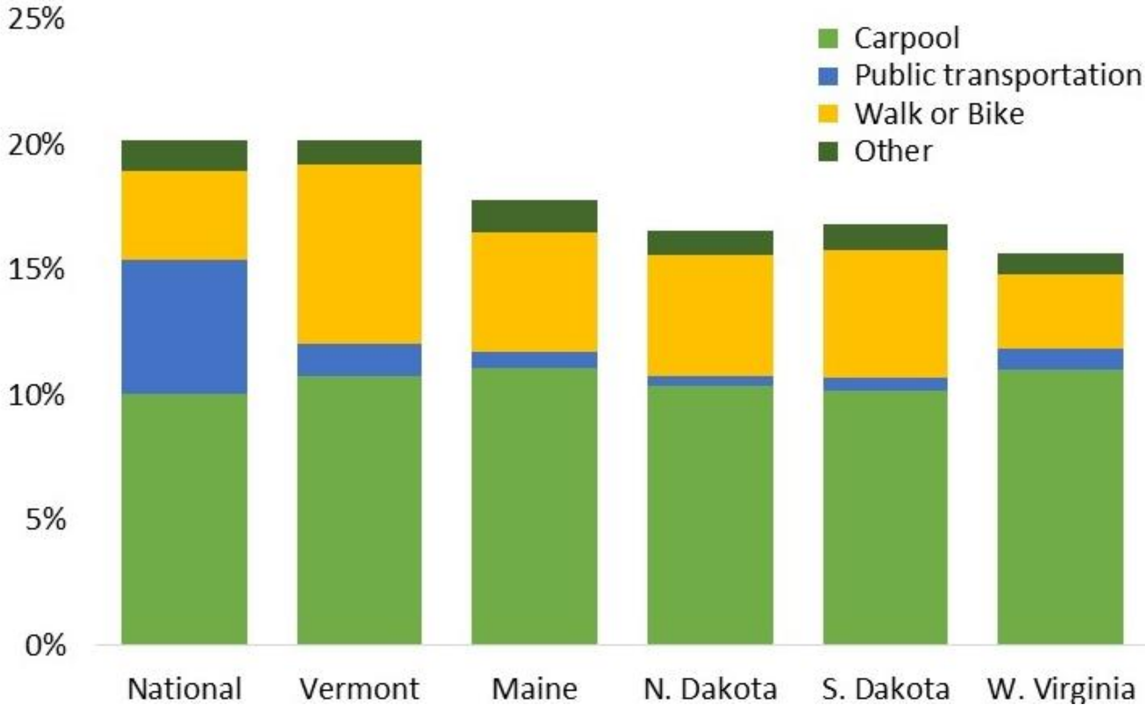

Figure 2-7. Commute Mode Share for Non-SOV Trips, 2011–2013 (ACS, 2014)

Table 2-4, Figure 2-6, and Figure 2-7 only include primary modes to work for commuters. Workers who worked from home are not included in these numbers. Vermonters worked from home at a higher rate (6.8%) than the national average (4.3%) or than in any of the comparison states (between 2.9% and 5.5%) (ACS, 2014).

2.2.2 Energy Intensity by Mode

Shifting travel to modes with lower energy intensities is one method for reducing energy use in transportation. Energy intensity can be considered at either the vehicle level or the passenger level. Vehicle energy intensity measures how many Btus are required to move a vehicle one mile without accounting for the number of passengers it carries. Passenger energy intensity measures the energy used to move each passenger one mile. An inverse relationship exists between occupancy and passenger energy intensity—the higher the occupancy, the lower the passenger energy intensity. In most cases, passenger energy intensity provides a more useful measure of energy efficiency than does vehicle efficiency.

Figure 2-8 shows U.S. DOE estimates of vehicle and passenger energy intensity for several commonly used motorized modes (Davis et al., 2014). In Figure 2-7, passenger energy intensity is calculated using national average occupancy rates for rail, air, transit buses, and demand-response transit. Passenger energy-intensities for cars and light-duty trucks are calculated with both one and two occupants to illustrate the impact of increased vehicle occupancy on passenger energy intensity. After demand-response transit, which frequently uses larger vehicles and has a low average occupancy rate, SOV trips in light-duty trucks and passenger cars have the highest energy intensity of the modes shown here. Policies aimed at reducing transportation energy use in Vermont may be able to achieve this objective by promoting mode shifting and by increases in average vehicle occupancy rates.

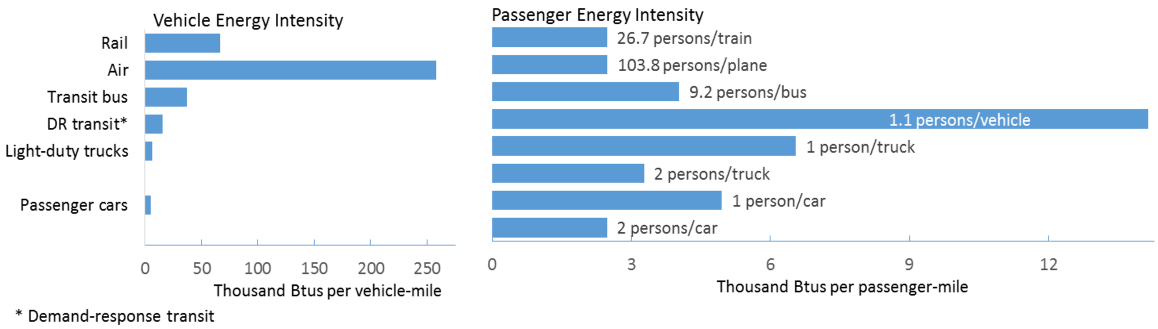

Figure 2-8. Energy Intensities of Common Transport Modes (Davis et al., 2014)

2.3 Vehicle Occupancy

VERMONT VEHICLE OCCUPANCY

Definition: Vehicle occupancy rates are a measure of the average number vehicle occupants per vehicle trip. Increasing vehicle occupancy can decrease VMT and the per passenger energy intensity of travel.

Status: Vehicle occupancy data are collected by travel surveys such as the NHTS. The most recent NHTS was completed in 2009. As of 2009, Vermonters' averaged a vehicle occupancy rate of 1.57 people per vehicle, below the national average of 1.67. Trends in vehicle occupancy will be reported in future Profiles as new survey data becomes available.

New Factors: The state has undertaken several initiatives to increase carpooling, and thus vehicle occupancy rates, since 2009, including expanding park-and-ride coverage and the Go! Vermont program. Since 2012, the number of parking spaces at state and municipal park-and-rides has increased by 40%, and the number of park-and-rides with transit connections has more than tripled. In the same time frame, Go! Vermont has registered 3,455 commuters for carpools and vanpools. The impact of these initiatives on vehicle occupancy rates is not yet known.

Vehicle occupancy rates measure the average number of vehicle occupants per vehicle trip. Vehicle occupancy is an important component of transportation energy intensity, as described previously. Increasing vehicle occupancy decreases the per passenger energy intensity per mile traveled. Generally, increasing vehicle occupancy also results in lower total VMT.

Occupancy data is generally collected via travel surveys. The most recent survey to collect vehicle occupancy data for Vermont was the 2009 NHTS. Vehicle occupancy rates from the NHTS are summarized for Vermont, the nation, and the four comparison states in Table 2-4. Vehicle occupancy is generally lower for trips that take place entirely in state than for trips that include travel in other states or Canada. Trips to work have the lowest occupancy rates of all trip types. Trips for meals and social or recreational purposes as well as trips to transport another individual, which by definition included multiple people per vehicle, have the highest vehicle occupancy rates (USDOT, 2010).

Table 2-5. Average Vehicle Occupancy, 2009

	Average Vehicle Occupancy
National	1.67
Vermont	1.57
Maine	1.54
North Dakota	1.70
South Dakota	1.73
West Virginia	1.41
Source: USDOT, 2010.	

2.3.1 Carpooling Incentives

According to NHTS records, carpooling rates in the U.S. have steadily declined from 20% in 1980 to its current estimated level of 12%. This 30-year decline may be attributed to a number of factors such as rising rates of vehicle ownership, declining household size, sustained low fuel prices, and an increase in suburban settlement patterns. In 2008, the state of Vermont established Go! Vermont, a carpooling initiative designed to reduce single-occupancy trips by encouraging higher rates of carpooling, transit use, biking, and walking. This initiative includes a website to link potential carpool participants and provide information for those seeking to share rides to work, meetings, and conferences. Go! Vermont has documented considerable success reaching potential carpoolers, as summarized in Table 2-6.

Table 2-6. Go! Vermont Program Benefits, SFY 2012–2015

Tracking Metric	Data
Registered Commuters	3,455
Rides Posted	4,224
Vanpools	19
Total Estimated Reduction of VMT	16,466,000
Total Estimated Savings in Commuting Costs	$9,276,000
Source: McDonald, 2015.	

2.3.2 Park-and-Ride Facilities

Park-and-ride facilities provide safe, no-cost parking spaces for those who carpool or ride the bus. Currently, the state operates 29 park-and-ride sites with approximately 1,380 total spaces (see Table 2-7); while individual municipalities maintain an additional 53 sites with a total of approximately 1,012 spaces (see Table 2-8). Overall, the number of park-and-ride parking spaces has increased by 40% since 2012. In addition, park-and-ride facilities at both the state and municipal levels are considerably more likely to function as multi-modal hubs by including connections to transit and bicycle parking.

Table 2-7. State Park-and-Ride Facilities in Vermont, 2012 and 2015

Number of State:	2012	2015	% Increase[1]
Park-and-Rides	25	29	16%
Parking Spaces (approximate)	1,140	1,380	21%
Facilities with Bike Racks	11	20	82%
Facilities with Transit Connection	3	19	533%
Facilities with Paved Surface	17	24	41%
Facilities Lighted	18	24	33%
Facilities with PEV Charging	0	1	-

Source: Davis, 2015.

Table 2-8. Municipal Park-and-Ride Facilities in Vermont, 2012 and 2015

Number of Municipal:	2012	2015	% Increase[1]
Park-and-Rides	26	53	104%
Parking Spaces (approximate)	550	1,012	84%
Facilities with Bike Racks	2	19	850%
Facilities with Transit Connection	9	20	122%
Facilities with Paved Surface	20	42	110%
Facilities Lighted	18	37	106%
Facilities with PEV Charging	0	0	0%

Source: Davis, 2015.

2.4 Active Transport

Increasing rates of active transport—walking and biking—is one means of reducing petroleum use through reducing the number of motorized trips. Because walking and biking count data is not as widely collected as vehicle count data, travel surveys remain the best source of biking and walking data.

Active transport tendencies of Vermonters, shown in Table 2-9, were taken from the 2009 NHTS data. Of the nearly 10,800 unique trips recorded in the 2009 Vermont NHTS data set, 39% are less than two miles and 28% are less than one mile. Roughly 87% of the trips shorter than two miles were made by motor vehicle, suggesting an opportunity for increasing active transportation trips. Many of these trips are for shopping, some of which may not be entirely compatible with non-motorized modes of travel. Other common trip purposes for these short trips include work and recreation, which may be more amenable to a shift in transport mode.

Table 2-9. Vermonters' and Nationwide Biking and Walking Tendencies, 2009

Number of Trips in the Past Week	Vermonters		Nationwide	
	Bike	Walk	Bike	Walk
0	85.4%	24.6%	87.2%	32.1%
1–2	6.9%	16.9%	8.2%	16.2%
3–5	4.2%	26.3%	4.4%	24.1%
5+	3.6%	31.6%	2.2%	26.6%
	100%	100%	100%	100%

Source: USDOT, 2010.

Active transport rates in Vermont are similar to those found nationally. Approximately 14% of Vermonters in the data set had taken at least one bike trip and 75% had taken at least one walking trip within the previous week. The NHTS data presented in Table 2-9 are self-reported tendencies as opposed to travel diary records. When self-reporting travel tendencies, respondents tend to overestimate rates of actual biking and walking, so we include this data independently. The data in Table 2-9 is intended to show Vermonters' intentions to bike and walk, an important trend to affect eventual shift in mode share towards active modes. However, given that this data is not derived from the actual travel diary section of the NHTS, it does not provide a reliable indication of mode share.

2.5 Bus and Rail Service

As shown in Figure 2-8, rail and bus service can each provide energy-efficient transportation options. At average occupancy rates, these modes are considerably more efficient than the state's most common commute mode, the SOV. The CEP includes goals to increase public transit and passenger rail ridership. This section describes current trends in passenger rail and transit ridership, and highlights the role of private interregional bus companies and multimodal hubs in facilitating increased bus and passenger rail utilization.

2.5.1 Public Transit Ridership

Public bus transit service in Vermont is operated by 10 regional service providers. The service areas for these providers are shown in Figure 2-9. Note that both the Green Mount Transit Agency (GMTA) and Rural Community Transportation, Inc. (RCTI) provide transit services in Lamoille County. In FY 2014, total public transit ridership was measured at 4.8 million passenger boardings, as shown in Table 2-10.

The majority of transit operations in Vermont along fixed routes can be characterized as smaller shuttle-bus services which seat approximately 20 people. The Chittenden County Transportation Authority (CCTA) is an exception, providing service with larger buses that seat approximately 40 people along the majority of its routes. Many of the transit providers in Vermont, as well as the Vermont Association for the Blind and Visually Impaired, also provide rides through demand-response, volunteer driver and elderly and disabled programs. These services accounted for approximately 430,000 of the total rides shown in Table 2-10.

Figure 2-10 shows the trend in transit ridership, across all trip types, from FY 2011 through FY 2014. Overall, transit ridership increased by 6% during this time period (VTrans, 2015a). The slight dip in transit ridership in 2014 may be attributable to the CCTA drivers' strike as transit use outside of Chittenden County continued its upward trend in 2014 (VTrans, 2015a).

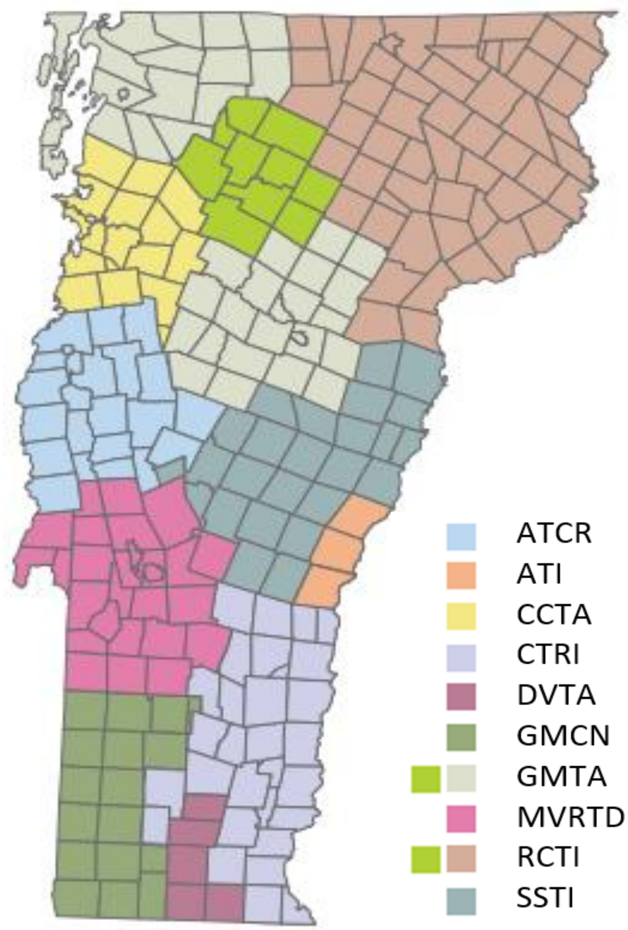

Figure 2-9. Transit Service Providers (VTrans, 2015a)

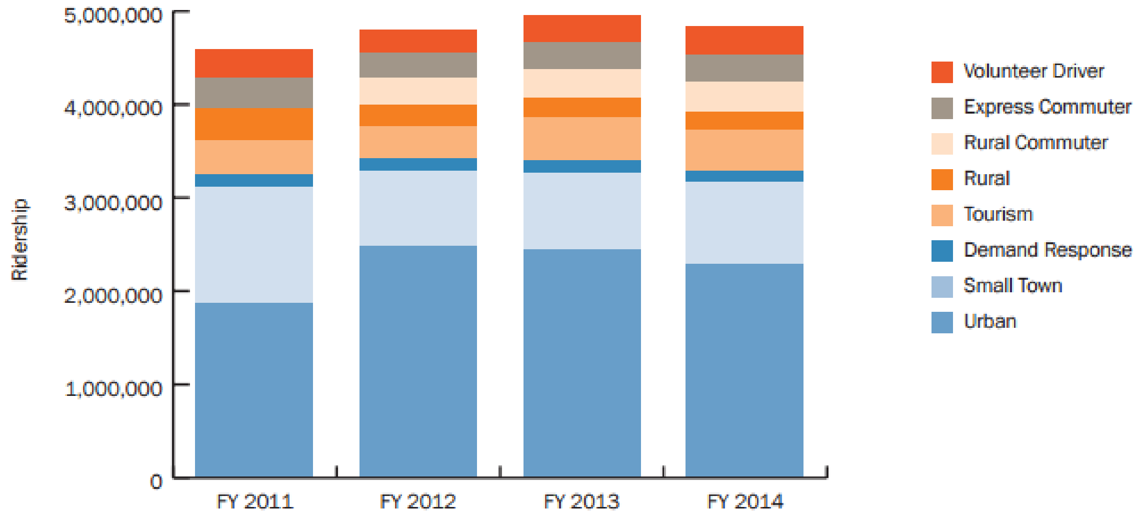

Figure 2-10. Transit Ridership FY 2011–2014 (VTrans, 2015a)

Table 2-10. Bus Ridership for Vermont Transit Authority Providers, FY 2011–144

Transit Provider	**Annual Ridership (thousands)**			
	FY 11	FY 12	FY 13	FY 14
Addison County Transit Resources (ACTR)	153.2	167.8	173.0	173.3
Advance Transit, Inc. (ATI)	169.8	171.8	180.6	172.6
Chittenden County Transportation Authority (CCTA)	2512.4	2703.2	2690.4	2545.4
Connecticut River Transit, Inc. (CRTI)	233.6	257.3	250.2	251.6
Deer Valley Transit Association (DVTA)	211.2	203.1	270.0	271.8
Green Mountain Community Network (GMCN)	75.4	96.5	109.9	117.1
Green Mountain Transit (GMTA)	419.0	424.2	427.0	418.4
Marble Valley Regional Transit (MVRTD)	557.8	545.0	585.8	633.4
Rural Community Transportation, Inc. (RCTI)	163.0	150.3	175.1	191.8
Stagecoach Transportation Services, Inc. (STSI)	77.8	83.4	75.2	60.8
Vermont Association for the Blind and Visually Impaired	5.2	5.3	5.2	4.3
Statewide Totals	**4,578.4**	**4,808.1**	**4,942.2**	**4,840.5**

Source: Pelletier, 2015.

2.5.2 Passenger Rail Ridership

Passenger rail service in Vermont is provided on two Amtrak lines: the Vermonter, running from St. Albans to its eventual terminus in Washington DC, and the Ethan Allen Express, running from Rutland to New York City via Albany. Passenger rail ridership is measured by tracking the number of passengers who board and disembark at rail stations in Vermont. Combined boardings and disembarkments (also called alightments) at Vermont rail stations from FY 2003 through FY 2014 are shown in Figure 2-11. Passenger rail ridership has increased steadily since FY 2004. Rail ridership has increased by over 10,000 boardings and disembarkments, or 11%, since FY 2012.

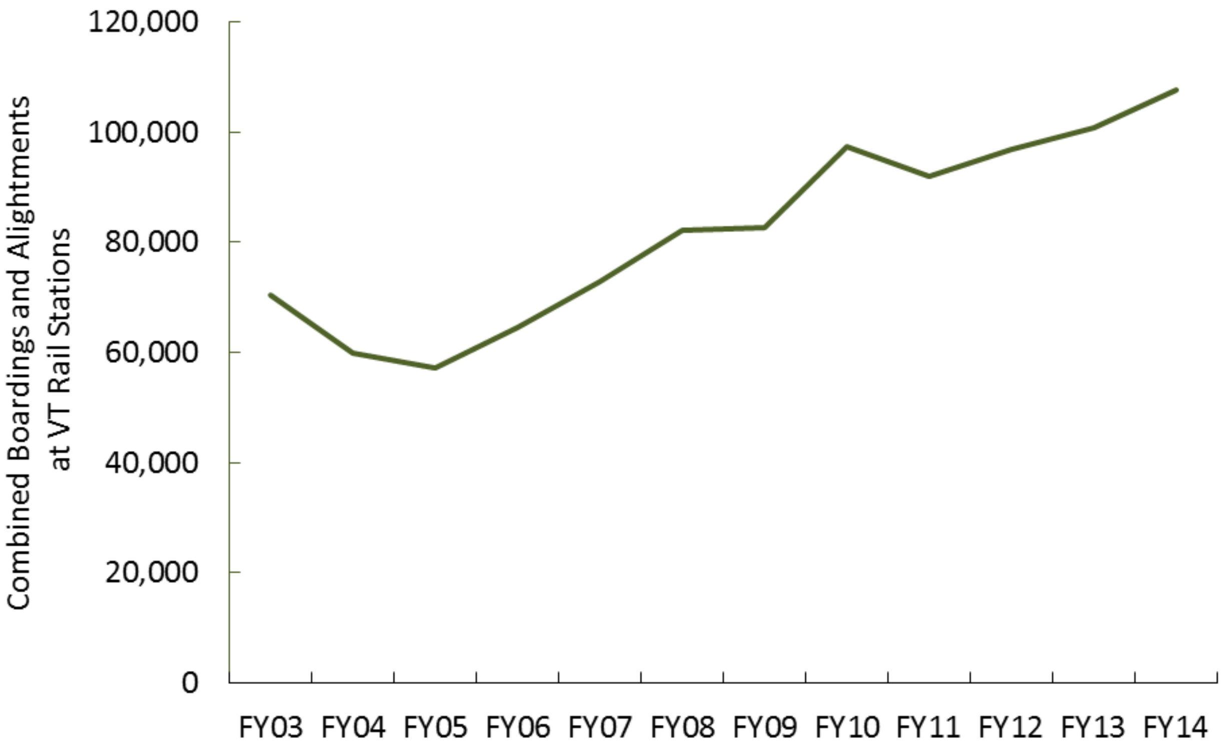

Figure 2-11. Amtrak Boardings and Alightments, FY 2003–2014 (Pappis, 2015)

2.5.3 Private Interregional Bus Service

In addition to public transit services described previously, three major intercity bus carriers currently service locations in Vermont. Megabus began its Vermont service in 2011 and currently operates daily service from Burlington to five destinations across the Northeast, without any passenger facilities. Greyhound also operates out of four locations in Vermont (Burlington, Brattleboro, Montpelier, and White River Junction) with service throughout the Northeast. Yankee Trails operates a route between Bennington, Vermont and Albany, New York. Ridership data for these companies is proprietary and not included in the CEP transit metrics.

2.5.4 Multimodal Connections

Though often overlooked and difficult to measure, an additional indicator of reduced reliance upon personal vehicles is the expansion of mobility options provided through multimodal hubs. Typically, multimodality refers to the use of more than one mode in travel along a journey. From an energy-use perspective, the ability to access multiple modes along a journey increases the potential for reducing the use of the highest energy intensity modes of travel by shifting part of the trip to a less energy-intensive mode. Multimodal facilitation is an evolving priority within Vermont's transportation infrastructure.

Park-and-ride facilities are, by nature, multimodal because they facilitate shifts from automobiles to transit buses or from an SOV to a multi-passenger vehicle. As discussed previously, an increasing number of park-and-rides offer transit connections and bicycle parking, increasing their value as multimodal hubs. Co-locating bus lines at rail stops and airports is another example of the creation of multimodal hubs, providing options for the first leg of a passenger rail or airplane trip. Many CCTA buses are equipped with bike racks for their riders, allowing for the combination of biking and bus transit on a trip. Bike boardings may be a trend that can be tracked statewide if other transit providers equip their buses with bike racks.

3 Privately Owned Vehicle Fleet

The energy and specific fuel consumed per vehicle-mile traveled is a function of the vehicle used to drive that mile. The Vermont fleet of privately owned vehicles encompasses a wide variety of vehicle types utilized for a wide range of travel purposes. Vehicle purchase decisions are influenced by a variety of factors, including household demographics, employment characteristics, regional geography, and perceptions about the local climate (Bhat et al. 2009; Busse et al., 2015). Local terrain may also influence the vehicle characteristics—such as clearance and four-wheel drive—that Vermonters look for in their vehicles. In this section, we track registrations of vehicle types to assess the overall efficiency of the vehicle fleet. Growth in sales of alternative fuel vehicles, such as electric vehicles, is highlighted.

Analysis in this section is limited to the fleet of privately owned automobiles and trucks registered in Vermont. Privately owned vehicles are defined as all vehicles with commercial or individual registrations. Publicly owned vehicles, as well as buses, motorcycles, and off-road vehicles, are also excluded from the analysis in this section. As of 2013, 7,833 publically owned vehicles, 1,271 privately owned buses and 28,777 privately owned motorcycles were registered in Vermont. These vehicles accounted for 6% of 2013 registrations.

3.1 Vehicle Registrations

Vehicle ownership is a strong predictor of vehicle use. Table 3-1 provides a summary of trends in driver licensing and vehicle registration at the state and national level from 2007 through 2013, the most recent year for which national data is available. At the national level, per capita vehicle ownership and vehicle ownership per licensed driver fell slightly between 2007 and 2010—likely influenced by the economic downturn in 2008, but have remained relatively stable since that time. Vermont did not experience a comparable dip in this number, perhaps because it is more difficult to go without a vehicle in a rural state.

VT PRIVATELY OWNED VEHICLE FLEET

Overview: The vehicles that Vermonters drive determines the efficiency of vehicle travel in the state as well as the fuels that are used for transportation. The Vermont vehicle fleet is composed almost entirely of gasoline- and diesel-fueled vehicles (94% and 5%, respectively), as shown in Figure 3-1. Less than 1% of all vehicles use other fuel types.

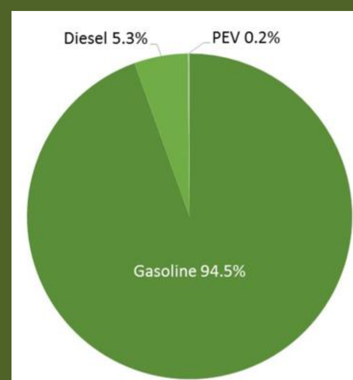

Figure 3-1. Vermont Vehicle Registrations by Fuel Type, 2015 (VDMV, 2015)

Trends in PEV Sales: Plug-in electric vehicles (PEVs), such as the Chevy Volt and Nissan Leaf, constitute a small but growing proportion of the Vermont vehicle fleet. Since 2012, registration of these vehicles has increased five-fold. As of July 2015, there are nearly 1,000 PEVs registered in Vermont.

Table 3-1. Vehicle Registrations and Driver's Licenses in Vermont and the U.S., 2007–2013

		2007	2008	2009	2010	2011	2012	2013
Vermont	Registered Vehicle (thousands)	555	571	546	554	564	568	574
	Vehicles per Licensed Driver	1.04	1.05	1.08	1.08	1.08	1.07	1.06
	Vehicles per Capita	0.89	0.92	0.88	0.89	0.90	0.91	0.92
Nation	Registered Vehicles (millions)	243.1	244.0	242.1	237.4	240.8	241.2	243.1
	Vehicles per Licensed Driver	1.18	1.17	1.16	1.13	1.14	1.14	1.15
	Vehicles per Capita	0.81	0.80	0.79	0.77	0.77	0.77	0.77

Source: FHWA, 2008–2014.

Vehicles per licensed driver and vehicles per capita in 2013 for Vermont and the four comparison states are shown in Figure 3-2. Vermont's numbers mirror those seen in Maine.

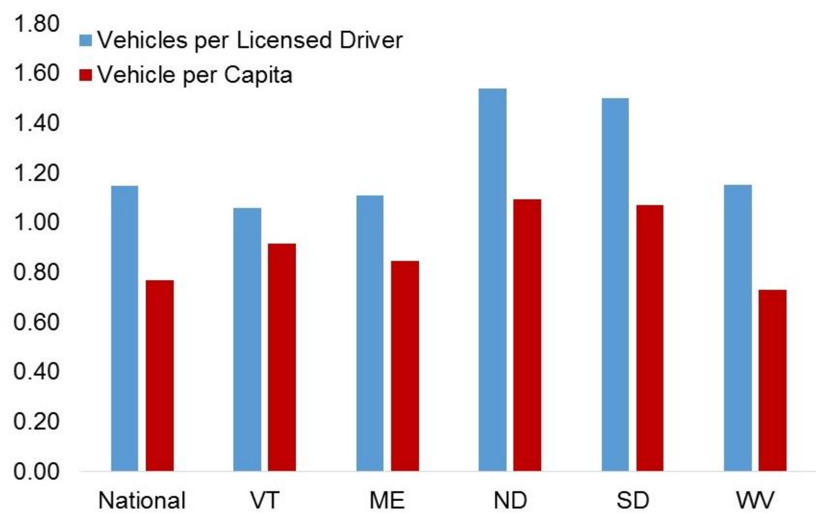

Figure 3-2. Vehicles per Capita and per Licensed Driver, 2013 (FHWA, 2014)

Note that for consistency of comparison between Vermont, national and rural comparison state figures for all vehicle data here are taken from the FHWA's Highway Statistics, 2013 (FHWA, 2014). The Vermont vehicle numbers in Section 3.2 and 3.3 are directly from the Vermont DMV data and vary with respect to the FHWA data by an average of 2.4% per year.

3.2 Vehicle Type

The vehicle fleet can be characterized by the type of fuel or propulsion system that powers it as well as by vehicle body type. As shown in Table 3-2, the fleet is dominated by conventionally powered vehicles, running on either gasoline or diesel. While internal combustion engine (ICE) gasoline vehicles are by far the most common vehicles registered in Vermont, gasoline-powered hybrid electric vehicles (HEVs) such as the Toyota Prius, plug-in hybrid electric vehicles (PHEVs) such as the Chevy Volt, and all-electric vehicles (AEVs) such as the Nissan Leaf have all grown in popularity. PHEVs and AEVs, collectively known as plug-in electric vehicles (PEVs), derive some or all of their energy from electricity, helping to reduce the amount of petroleum-based fuels used for transportation. HEVs are powered entirely by gasoline but tend to have significantly better fuel efficiency than comparable ICEs and thus also help reduce transportation energy use.

Table 3-2. Vehicles Registered in Vermont by Fuel Type, 2008–2015

Fuel Type		2008	2009	2010	2011	2012	2013	2014	2015
PEV	AEV	NA	NA	NA	NA	48	130	197	216
	PHEV	NA	NA	NA	NA	140	466	670	727
Propane /CNG		75	69	59	51	48	43	43	43
Diesel		32,140	30,724	25,932	28,513	38,684	28,209	29,879	31,155
Gasoline	ICE	578,881	528,930	524,810	550,711	541,872	516,339	525,199	542,028
	HEV	4,656	5,473	5,877	7,056	7,693	7,945	9,242	10,235

Sources: VDMV, 2015; Drive Electric Vermont, 2015.

The specific PEV models registered in Vermont as of July of 2015 are shown in Table 3-3. The Toyota Prius plug-in is the most popular PHEV in the state, while the Nissan Leaf is the most popular AEV model.

Table 3-3. Vermont PEV Registration by Vehicle Model as of July 2015

Make and Model	Number Registered in VT
Chevrolet Volt (PHEV)	138
Toyota Prius Plug-In (PHEV)	264
Tesla Roadster and Model S (PHEV)	38
Nissan Leaf (AEV)	118
Mitsubishi iMiEV (AEV)	28
Ford C-MAX Energi (PHEV)	204
Ford Fusion Energi (PHEV)	115
Ford Focus Electric (AEV)	11
Smart Electric Drive (AEV)	10
Other (including market conversions)	17
Total	943

Source: Drive Electric Vermont, 2015.

Vehicle size and body type are also important determinants of fuel efficiency. Figure 3-3 shows the 20 most common vehicle makes and models registered in Vermont. Several truck makes are among the most popular vehicles.

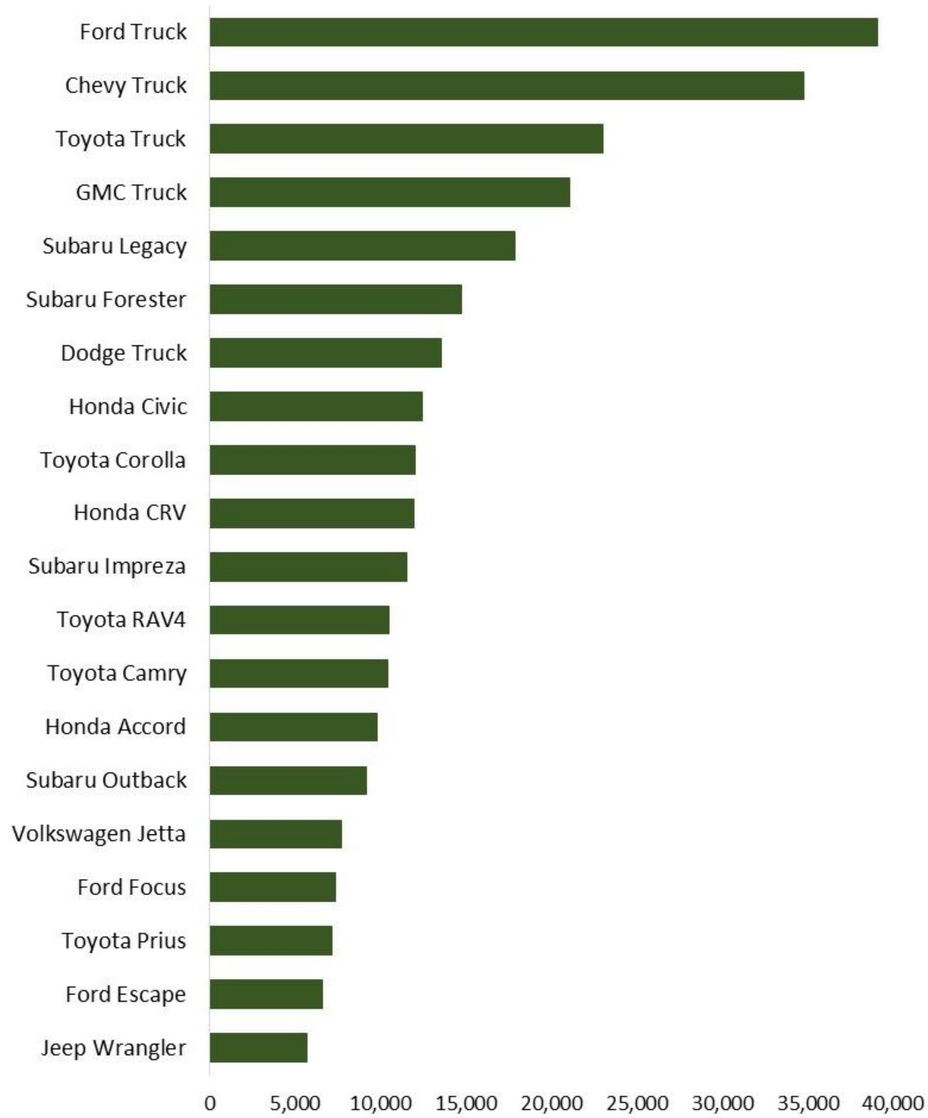

Figure 3-3. Top 20 Vehicle Models Registered in Vermont, 2015 (VDMV, 2015)

3.3 Fleet Age

Though new vehicles with increased fuel efficiency are being introduced rapidly into the American market, the fuel-saving effect of these models is highly dependent upon the turnover rate of vehicles in the current fleet. Figure 3-4 shows the distribution of automobile and truck model years for the vehicles registered in Vermont as of June 2015. Approximately 86% of Vermont's registered vehicles were manufactured after 2000. An improvement in the fuel economy of Vermont's privately owned vehicle fleet is likely to result from a decrease in the average age of the fleet.

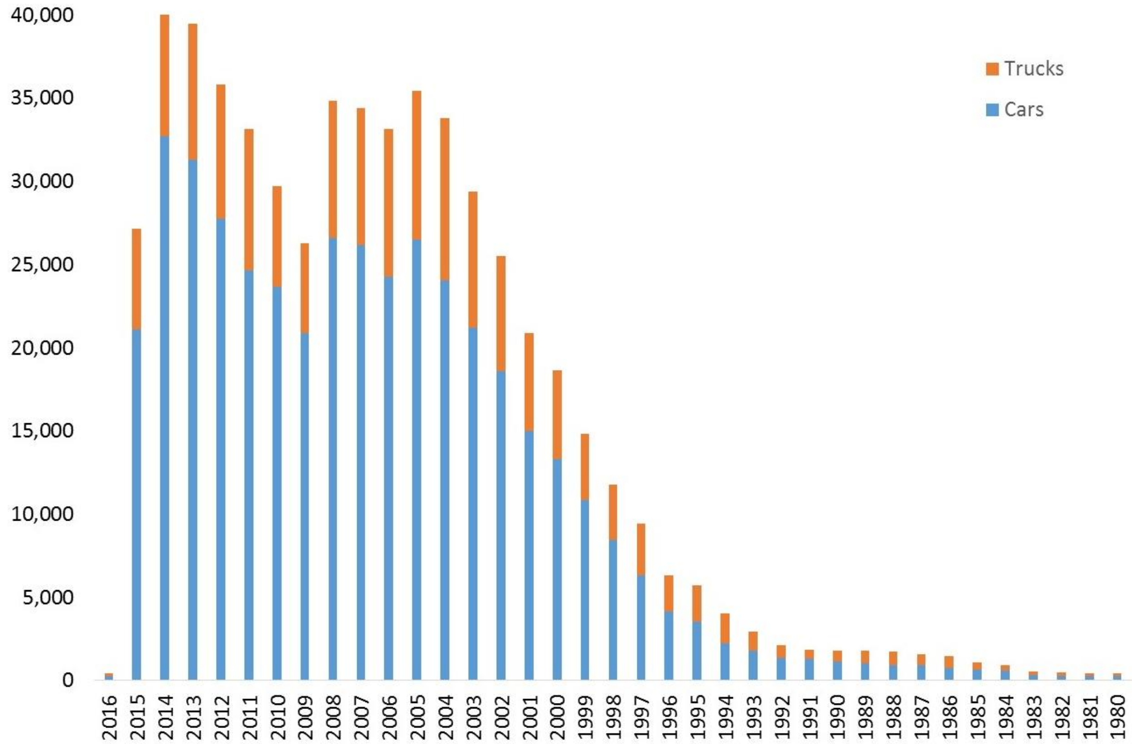

Figure 3-4. Distribution of Model Years for Vehicles in Vermont, 2015 (VDMV, 2015)

3.4 Fleet-Wide Fuel Economy

Vehicle fuel efficiency is a critical determinant of transportation energy use. Higher fuel economy vehicles can provide comparable mobility benefits with lower energy consumption than equivalent vehicles with lower fuel economy. The combined MPG of vehicles registered in Vermont has increased by an average 0.35 combined MPG per year from 2011 through the middle of 2015, as shown in Table 3-4.

The values in Table 3-4 were calculated by matching DMV vehicle registration data to EPA fuel economy data available from FuelEconomy.gov. Because the DMV vehicle-make-and-model data are manually recorded in abbreviated form, matching these records to the EPA MPG data required identifying irregularities in the abbreviations used and translating these abbreviations into the complete make-and-model names in the FuelEconomy.gov data set. For instance, the Nissan Versa could be entered into the DMV database with make defined as NISS, and model defined as VSA or VRS. Overall, 626 make-and-model abbreviations were matched to FuelEconomy.gov make-and-model names.

Approximately 85% of the registered vehicles in this time period could be matched to MPG data. The remaining 15% of the vehicle fleet could not be matched either because the vehicles were not in the FuelEconomy.gov data set, which is only available for vehicle model years after 1984 and does not include medium- and heavy-duty trucks, or because of anomalous make-and-model abbreviations. Since older and heavier vehicles are less well represented in the matched data set, the actual fuel economy of the Vermont fleet is likely lower than the values shown here.

Table 3-4. EPA Fuel Economy for Vehicles Registered in Vermont, 2011–2015

Year	Registered Vehicles	Vehicles with MPG Estimates	Average City MPG	Average Highway MPG	Combined MPG	
					Average	Std Dev
2011	586,422	85.0%	18.1	24.2	20.3	5.7
2012	578,415	85.6%	18.4	24.5	20.7	6.1
2013	552,665	85.8%	18.7	24.8	20.9	6.5
2014	564,591	86.4%	19.1	25.3	21.4	7.1
2015[1]	583,770	86.6%	19.4	25.6	21.7	7.3

Source: VDMV, 2015.
[1] As of May 2015, all other values as of yearend.

In addition, the realized fuel economy for Vermont drivers depends on the distance that each vehicle is driven. If lower-MPG vehicles are driven over longer distances than more fuel-efficient vehicles fuel consumption is higher than if more fuel-efficient vehicles are driven preferentially. The 2009 NHTS suggests that highly fuel-efficient vehicles may be driven less than less fuel efficient vehicles. For example, HEVs are driven only about 5,000 miles per year as compared with the statewide average of 10,275 miles per vehicle per year (USDOT, 2010).

One method for estimating the realized fuel economy in Vermont is dividing the annual VMT by the annual fuel sales in the state. Table 3-5 shows the MPG values that result from this approach.

Table 3-5. Realized MPG (VMT/Fuel Sales)

	2011	2012	2013
MPG[1]	18.3	18.9	18.6

Sources: FHWA, 2014; VLJFO, 2015.
[1] Annual VMT divided by combined annual gas and diesel sales.

4 Transportation Fuel Consumption

The transportation sector continues to be the largest consumer of energy among all sectors in Vermont as shown in Figure 4-1. Though the industrial sector is the largest consumer of energy nationally, this is not the case in Vermont. Vermont is one of 17 U.S. states that consumes more energy in the transportation sector than in any other sector (U.S. EIA, 2015).

Nonetheless, Vermont's per capita transportation-sector energy use is below the national average, at 78.4 million Btu annually in 2013. Per capita transportation-sector energy consumption in all four of the rural comparisons states is above the national average, as shown in Figure 4-2.

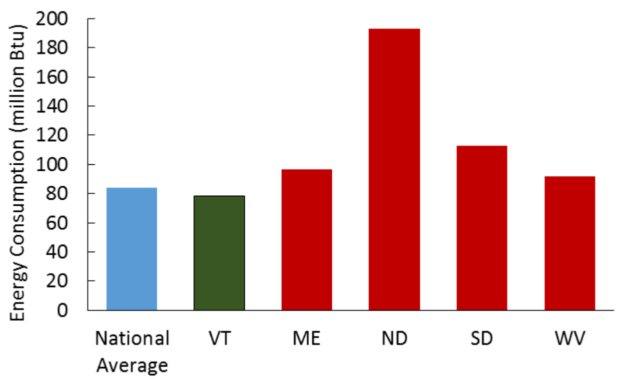

Figure 4-2. 2013 Per Capita Transportation Sector Energy Consumption (U.S. EIA, 2015)

Petroleum-based fuels accounted for well over 90% of the total energy used by the Vermont transportation sector in 2013. Including blended ethanol and biodiesel, gasoline and diesel accounted for 76.6% and 19.9% percent of Vermont's total transportation energy usage respectively, while jet fuel accounted for an additional 2.6% (U.S. EIA, 2013). Nationally, ethanol and biodiesel account for approximately 5% of total transportation energy use (U.S. EIA, 2015). It is likely that these fuels make up a slightly larger percentage of total energy use in Vermont since the state uses a comparatively low share of aviation fuel. The variety of fuels consumed, their shares of total

VT TRANSPORTION FUEL CONSUMPTION

Overview: The transportation sector is responsible for 37% of total fuel consumption in Vermont, as shown in Figure 4-1. More than 90% of all of the energy used for transportation in Vermont is derived from petroleum fuels.

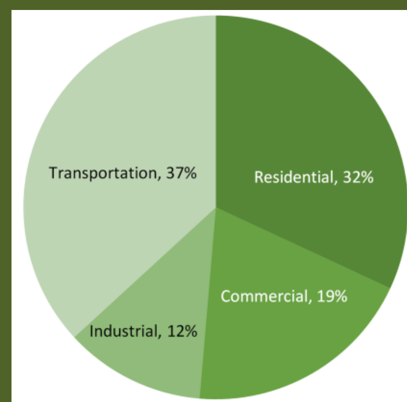

Figure 4-1. Vermont Sectoral Energy Consumption, 2013 (U.S. EIA, 2015)

Status of Alternative Fuel Sales: With the exception of ethanol, sales of alternative fuels are not well documented at the state level.

Growth in the number of PEV registrations and public PEV charging stations (up by more than 250% since the 2013 Profile), indicate a growing role for electricity as a transportation fuel.

Vermont Gas sales data show CNG use for transportation increased rapidly from 2010 to 2012 but has been relative stable since then.

transportation energy use, and historic consumption levels are presented in Section 4.1. Fuel use is a direct function of the types of vehicles operated and their levels of utilization.

4.1 Petroleum-Based Fuels

As shown in Table 4-1, fuel for ground transportation in Vermont is nearly exclusively derived from petroleum fuels. Compressed natural gas (GNG) represents a small but growing part of the fuel mix and is discussed in Section 4.4

Table 4-1. Fuels Sales for Ground Transportation in Vermont, 2005–2014

	2005	2008	2010	2011	2012	2013	2014
Gasoline	360	336	332	328	319	320	308
Diesel	67	62	62	62	63.6	62.6	68.6
Biodiesel	0.054	0.392	--	--	--	--	--
CNG	--	0.015	0.025	0.054	0.104	0.143	0.146

Note: Gasoline, diesel, and biodiesel sales are reported in millions of gallons. CNG sales are report in millions of gallons of gasoline equivalent.

Sources: VLJFO, 2015; White, 2009; Vermont Gas, 2015.

Gasoline sales have fallen steadily since 2007, as illustrated in Figure 4-3. Note that gasoline and diesel sales in Table 4-1 and Figure 4-3 include ethanol and biodiesel sold in blended form. This downward fuel sales trend mirrors the fall in total and per capita VMT over this period. It may also reflect improvements in the fuel efficiency of the Vermont vehicle fleet.

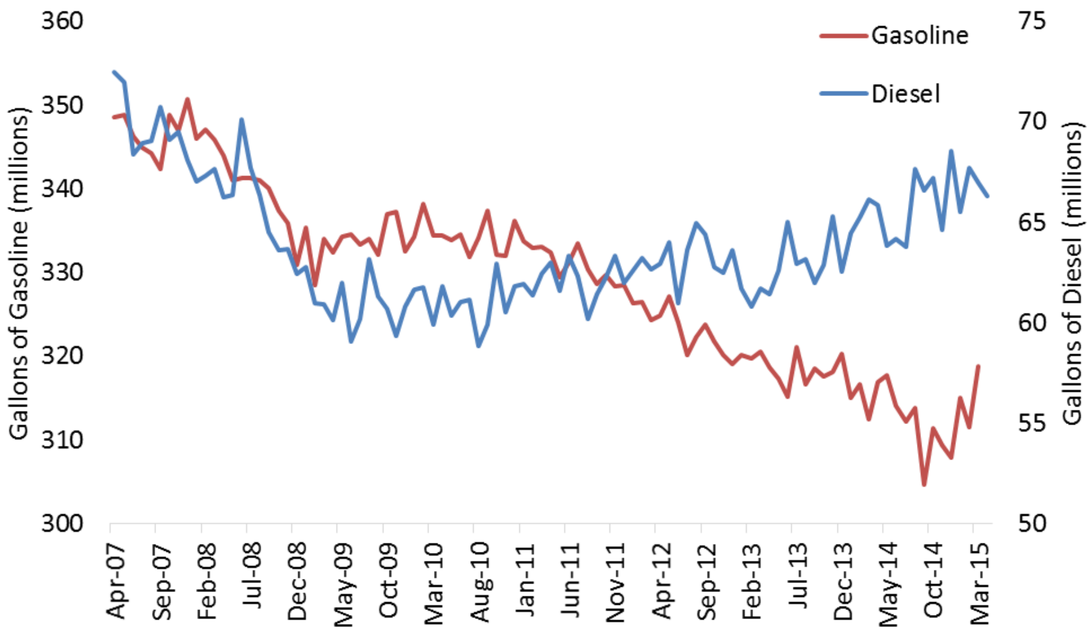

Figure 4-3. Vermont Gasoline and Diesel Sales, Rolling 12-Mo. Total, 2007–2015 (VLJFO, 2015)

4.2 Biofuels

The two primary transportation biofuels are ethanol and biodiesel. Ethanol is produced from sugars in organic materials such as corn, sugar cane, or cellulosic feedstocks. Biodiesel is chemically processed from either raw feedstock or waste vegetable oil.

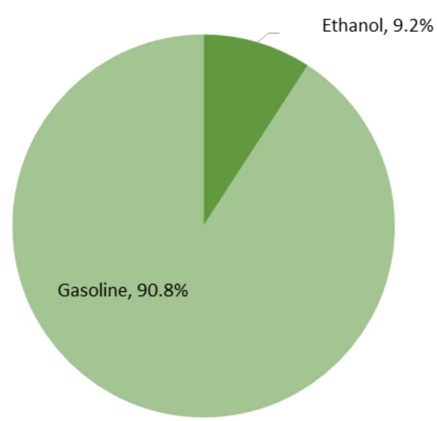

Figure 4-4. Vermont Ethanol and Gasoline Sales, 2013 (U.S. EIA, 2015; VLJFO, 2015)

Ethanol sales are tracked at the federal level in order to ensure compliance with the National Renewable Fuel Standard (RFS) that was passed in 2007. It is sold primarily in blended gasolines. In 2013, 29.4 million gallons of ethanol were consumed in Vermont (U.S. EIA, 2015). This is equal to just over 9% of "at the pump" gasoline sales as shown in Figure 4-4.

Similar tracking is not required for biodiesel sales. A 2009 study estimated Vermont's transportation biodiesel use at approximately 76,000 gallons, or 0.02% of the total transportation fuel portfolio in 2008 (White, 2009).

4.3 Electricity

As discussed in Section 3, PEV registration has increased rapidly in recent years. PEVs can be charged at home outlets or at public charging stations. As of June

2015, there are a total of 70 public electric charging stations in Vermont, an increase of 51 charging stations since 2013. Of these stations, 10 are Level 1, 62 are Level 2, and 14 are DC Fast charging.

There are currently no reporting requirements for either home-based or public charging, so it is not possible to track transportation electricity consumption completely. Two providers of public charging stations, Green Mountain Power and ChargePoint, have voluntarily provided charging data through the Vermont Clean Cities Coalition. Detailed use data is available at several locations with more advanced charging equipment. A sampling of data for five of these EV charging locations is presented in Table 4-2.

Table 4-2. Sample of Electricity Demand at Vermont PEV Charging Stations

	EV Station Location	Charging Episodes	Total Energy Usage (kwh)	Total Charge Time (hrs)	Mean Charge (kWh)	Mean Charge Time (Min)
Level 2 Charging	St. Michaels College, Winooski (2/6/14–2/6/15)	236	652	230	2.8	58
Level 2 Charging	Healthy Living, S. Burlington (3/14/14–3/14/15)	1,124	3,407	929	3.0	49
Level 2 Charging	City Hall, Montpelier (4/5/14–4/5/15)	1,180	4,649	1,437	3.9	73
Level 2 Charging	VSECU, Montpelier (6/22/14–6/8/15)	268	2,140	603	6.4	110
DC Fast	VSECU, Montpelier (6/22/14–6/8/15)	209	1,758	122	6.6	27

Sources: GMP, 2015; ChargePoint, 2015.

Aggregate charging data for all 49 ChargePoint stations, representing 80 ports, are provided in Table 4-3.

Table 4-3. Aggregate electricity demand at ChargePoint PEV charging stations in VT

Charging Station Type	Charging Episodes	Total Energy Usage (kwh)	Mean Charge (kWh)	Mean Charge Time (Min)
Level 1	331	562	1.7	1033
Level 2	13,015	81,597	6.27	107
DC Fast	2,054	11,530	5.61	23

Source: ChargePoint, 2015.

4.4 Compressed and Liquid Natural Gas

Utilization of natural gas as a transportation fuel is on the rise as can be seen in the monthly CNG sales shown in Figure 4-5. Overall CNG sales in 2014 totaled 145,519 gasoline-gallon equivalents (GGEs). Growth in sales of CNG for transportation fuel increased dramatically between late 2010 and 2012 but has been comparatively stable since then. Liquefied Natural Gas (LNG) was introduced into the state fleet in 2015. LNG provides similar power as diesel, and because it has more energy per gallon enables vehicles to travel further on a tank than CNG.

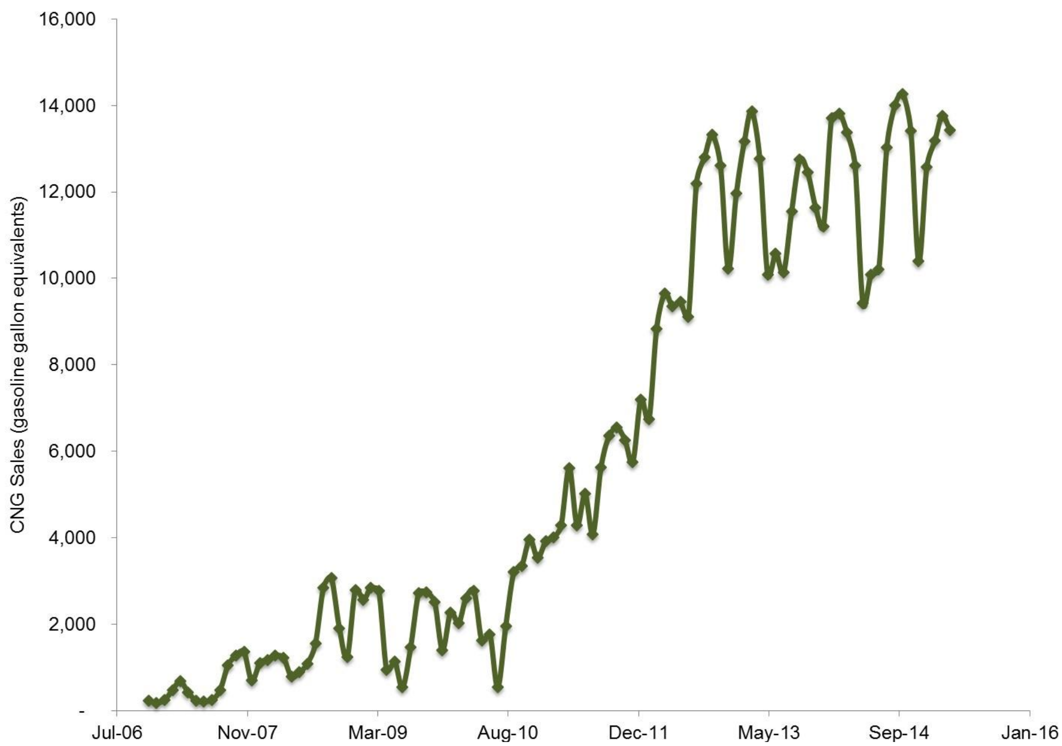

Figure 4-5. Monthly CNG for Transportation in Vermont, 2006–2015 (Vermont Gas, 2015)

The CNG fleet currently consists of five commercial fleets, made up primarily of heavy-duty vehicles and nine Honda Civics, the only current CNG passenger vehicle registered in Vermont. These fleets are served by four CNG filling stations, all located in Chittenden County.

Table 4-4. Vermont CNG Fleet

Fleet Operator	CNG Vehicles
University of Vermont	9 Buses
City of Burlington	3 Recycling Trucks
	1 Honda Civic
Casella Waste Systems	9 Waste Trucks
	2 Dual-Fuel Waste Trucks
Vermont Gas Systems	8 Honda Civics
	6 Service Vans
Green Cab	1 Passenger Van

Omya is the only Vermont fleet utilizing LNG. Omya exclusively uses this fuel in their heavy-duty fleet operations.

Although lower tailpipe emissions factors and lower fuel costs make CNG an attractive alternative to petroleum, limited geographic availability of natural gas supplies and fueling infrastructure inhibit statewide adoption of CNG. Additional obstacles include the initial cost of the vehicle technology, lower fuel economy relative to gasoline, and additional space requirements for on-board fuel storage systems.

5 Freight Transport

The transport of commodities and goods to, from, within, and through Vermont is an essential component of the state economy. The state's freight network consists of the highway system, 11 rail lines, airports, and pipelines. On average, the energy intensity of rail (320 Btu per ton-mile) is considerably lower than for trucking (1,390 Btu per ton-mile) (Grenzeback et al., 2013), though the specific energy intensity of each mode depends on a number of factors including utilization levels and the commodity being transported. As of 2011, rail carried 6.6 million tons of freight in Vermont (VTrans, 2015b).

Collecting freight data is challenging given the proprietary nature of the movement of goods, and the quality of freight flow estimates varies considerably depending upon mode choice and type of commodity. The Freight Analysis Framework (FAF), produced by Oak Ridge National Laboratory, is a primary source of freight information for Vermont and many other states. At the state level, FAF estimates freight movements that originate within, end within, or travel entirely within each state. FAF does not provide estimates of pass-through freight traffic (VTrans, 2015b).

The freight data presented here are drawn primarily from the Vermont State Rail Plan—2015 (VTrans, 2015b) and supplemented with information from version 3.5 of the FAF (FAF3.5), specifically its provisional state data for 2012 (ORNL, 2015). Pipeline freight conveyance is not considered in the Profile.

5.1 Vermont Rail Freight Infrastructure

The state rail network consists of 578 total miles of rail bed, all of which is available for freight service and which is serviced by short line and regional railroads (VTrans 2015b). A map of the current rail system is shown in Figure 5-1.

5.2 Commodity Flows

As of 2011, transport of 39 million tons of freight originated and/or terminated in Vermont.

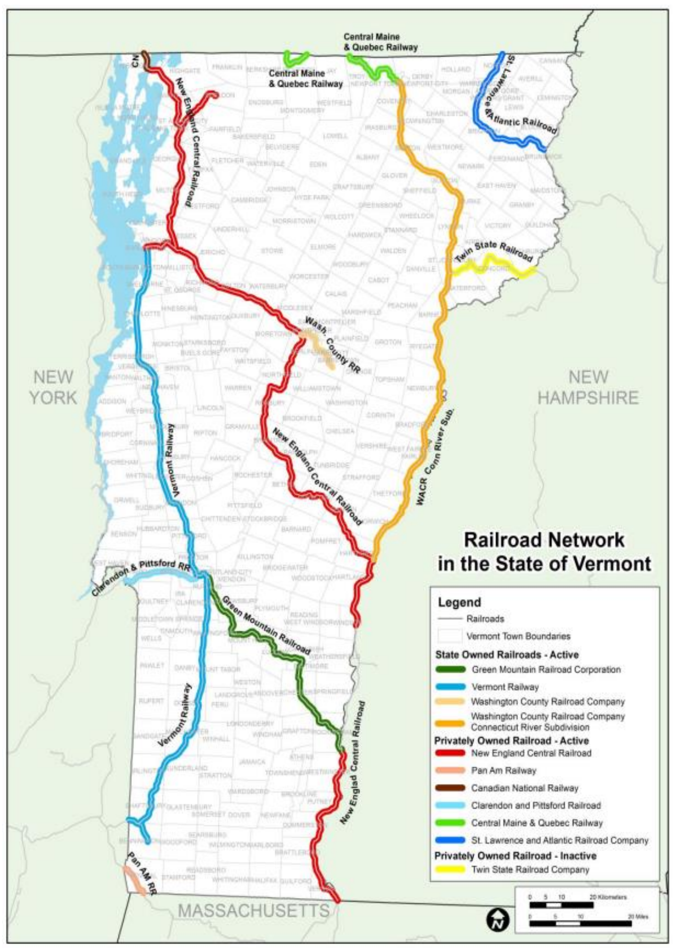

Figure 5-1. Vermont's Rail Network (VTrans, 2015b)

This volume includes inbound and outbound freight movements as well as all freight movements internal to the state. Freight that passed through Vermont and neither originated or terminated in the state is not included in this number.

Trucking was the dominant mode of transport for all freight movements, accounting for 91% of the total freight tonnage transported. Rail accounted for 5% of all freight tonnage. Rails' share of inbound (7%) and outbound freight (9%) transport was considerable higher than its share of transport within the state (2%). A complete modal breakdown of all freight movements in thousands of tons is shown in Table 5-1.

Table 5-1. Freight Movement in Vermont by Mode, 2011

Mode	Intrastate	Inbound	Outbound	Total
Truck	15,383	11,990	7,740	35,113
Rail	326	961	775	2,062
Multiple Modes/Mail	5	107	75	187
Air	0	3	2	5
Other	900	338	260	1,498
Total	16,614	13,399	8,852	38,865

Note: All values in thousands of tons.
Source: VTrans 2015b.

Based on analysis of the Surface Transportation Board's 2011 Confidential Carload Waybill Sample, through traffic in the Vermont rail system was estimated at close to 4.6 million tons, meaning that overall 2011 rail tonnage is estimated at 6.6 million tons (VTrans, 2015b). This number is projected to increase to 10.3 million tons in 2035.

The top 10 commodities moved in Vermont, measure by total tonnage, are shown in Figure 5-2 (ORNL, 2015).

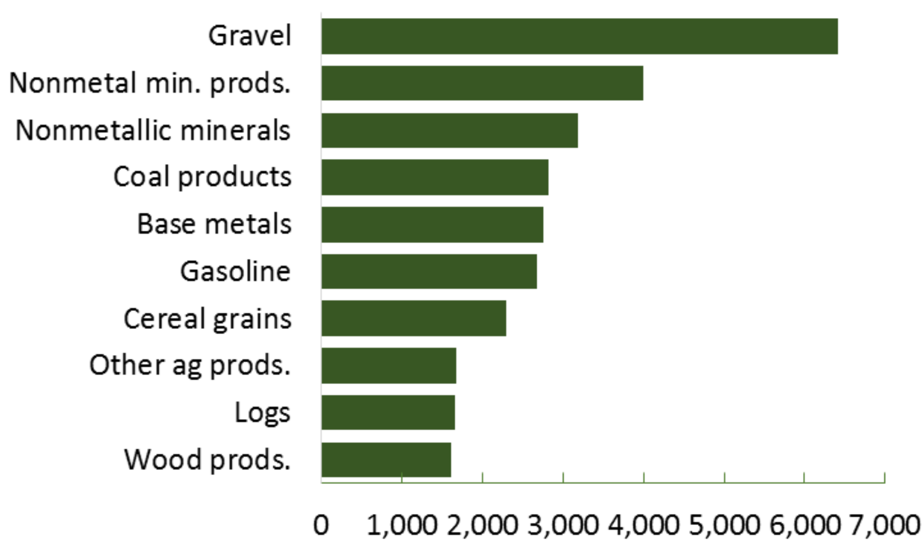

Figure 5-2. Top Freight Commodities by Weight, All Modes, 2012 (ORNL, 2015)

FAF3 forecasts that freight tonnage originating and/or terminating in Vermont will increase from 39 million tons to 62 million tons by 2035. This represents an increase of 59% over 2011 levels. Mode share is not projected to change significantly over this period (VTrans, 2015b).

5.3 Future Freight Enhancements

Vermont's reliance upon trucking reflects an overall national trend as well as a lack of intermodal terminals to facilitate shipments of containers and trailers on flat car rolling stock. Standardized containers that can be exchanged between rail cars and flatbed trucks allow for a greater proportion of freight travel to be captured by non-highway modes. Currently, there are no intermodal facilities for making these types of container transfers along Vermont's relatively underutilized rail network, despite a significant proportion of Vermont's employment centers being located proximate to rail facilities. There are at least five trans load facilities, but these only facilitate the transfer of bulk material or smaller shipment transfers from rail to truck, not container transfers (VTrans, 2015). Enhancement of Vermont's rail system—including "286" track upgrades to allow for heavier car loads and faster running speeds, removal of obstructions that limit access to double-stacked container cars, and development of intermodal facilities—will make rail more competitive with trucking and facilitate a shift to lower energy-intensity freight modes.

6 Progress toward CEP Transportation Objectives

The CEP sets out 12 long-term, transportation objectives, generally with 2030 target dates, to support transportation goals 1 and 2—reducing transportation sector energy and petroleum use. The state's progress toward reaching each of these goals are assessed here.

In order to conduct this assessment, the change in each metric is compared to the average annual rate of change required to hit the CEP target. For example, the CEP calls for the state to add 2,284 park-and-ride parking spaces by 2030. In order to achieve this objective, the state must add on average of 120 spaces per year. When the average number of new parking spaces is at or above 120 spaces per year, the state is on pace to meet the CEP target. When the average number of new parking spaces falls below this rate, the state is lagging behind the CEP target.

For many of these metrics, progress toward achieving the CEP objective is likely to lag in the early years due to the need for upfront investments and the slow pace of behavioral change. Metrics related to the vehicle fleet may be particularly slow to make progress given the long active life of cars and trucks. Thus cases where the state is currently lagging in achieving a particular objective should not be taken to mean that the objective cannot be achieved. Overall, most metrics are moving in the direction of the CEP objectives, but many are moving at a slower pace than will be required to hit the CEP target. Updated data needed to evaluate progress toward some objective are not available in the two-year time frame between the 2013 and 2015 Profiles.

Some of the objectives are also difficult to measure given current data collection requirements. In these cases, additional data collection to support evaluation of the metric or revisions to the objective are suggested.

6.1 Objective 1: VMT Growth

Objective: Keep VMT annual growth rate to 1.5% (half of the national average) for that portion controlled by the state.

Current Status: Exceeding CEP target.

- The average annual change in VMT from 2011 to 2013 was -0.18%.
- 2011 Baseline: 7.141 billion miles
- 2013 Value: 7.116 billion miles

Metric: Average annual increase in VMT from the base year to the current year, as a percentage.

Data Sources: VMT collected by VTrans as part of the Highway Performance Monitoring System.

Possible Objective Revisions: The 2011 objective calls for limiting growth in the portion of VMT that is controlled by the state; i.e., VMT excluding through-traffic. However, separate VMT data is not collected for through-traffic. Revising this metric to include all statewide VMT, as it is assessed here, would bring the objective more closely in line with current data collection practices.

6.2 Objective 2: Per Capita VMT

Objective: Hold VMT per capita to 2011 base year value of 11,402.

Current Status: Exceeding CEP target.

- Per capita VMT in 2014 was 11,356, below the 2011 baseline of 11,402.

Data Sources: VMT collected by VTrans as part of the Highway Performance Monitoring System; USCB population estimates.

6.3 Objective 3: Reduce SOV Commute Trips

Objective: Reduce share of SOV commute trips by 20% by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 79.2%
- 2014 Value: 82.6%

Achieving the CEP target will require an average decrease in SOV commute share of 1.1% per year from 2011 through 2030. SOV commute share increased by an average of 1.13% from 2011 through 2014.

Data Sources: American Community Survey

Possible Objective Revisions: Targeting a reduction of SOV travel for all trip purposes might help the state achieve its transportation-energy reduction goals more effectively since commute trips comprise less than 20% of vehicle trips. Tracking this broader objective would require regular collection of state-level mode data from a comprehensive travel survey such as the NHTS.

6.4 Objective 4: Increase Bike/Ped Commute Trips

Objective: Double the bicycle and pedestrian share of commute trips to 15.6% by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 7.6%
- 2014 Value: 6.5%

Achieving the CEP target will require an average increase in bicycle/pedestrian commute share of 0.4% per year from 2011 through 2030. Bicycle/pedestrian commute share fell by an average of 0.34% from 2011 through 2014.

Data Sources: American Community Survey

Possible Objective Revisions: Targeting an increase in bicycle and pedestrian travel for all trip purposes might help the state achieve its transportation energy reduction goals more effectively since commute trips comprise less than 20% of vehicle trips. As noted previously, tracking this broader objective would require regular collection of state-level mode data from a comprehensive travel survey such as the NHTS.

6.5 Objective 5: Double Carpool Commute Trips

Objective: Double the carpooling-to-work share to 21.4% of commute trips by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 10.6%
- 2014 Value: 9.5%

Achieving the CEP target will require an average increase in carpooling commute mode share of 0.6% per year from 2011 through 2030. Carpooling commute mode share fell by an average of 0.38% from 2011 through 2014.

Data Sources: American Community Survey

Possible Objective Revisions: Targeting an increase in carpooling for all trip purposes might help the state achieve its transportation energy reduction goals more effectively since commute trips comprise less than 20% of vehicle trips. As noted previously, tracking this broader objective would require regular collection of state level mode data from a comprehensive travel survey such as the NHTS.

6.6 Objective 6: Increase State Park-and-Ride Spaces

Objective: Triple the number of state park-and-ride spaces to 3,426 by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 1,142 spaces
- 2015 Value: 1,380 spaces

As of 2015, there are approximately 1,380 state park-and-ride spaces, representing an average increase of 60 spaces per year since 2011. This falls below the average annual increase of 120 spaces per year needed to achieve the CEP objective.

Data Source: VTrans Municipal Assistance Bureau

6.7 Objective 7: Increase Transit Trips

Objective: Increase public transit ridership by 110%, to 8.7 million annual trips by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 4.58 million rides
- 2014 Value: 4.84 million rides

In FY 2014, transit ridership exceeded 4.8 million trips, representing an increase of approximately 90,000 riders per year since FY 2011. This falls below the average annual increase of 238,500 riders per year needed to achieve the CEP objective.

Data Source: VTrans

6.8 Objective 8: Increase Passenger Rail Trips

Objective: Quadruple passenger rail trips to 400,000 Vermont-based trips by 2030.

Current Status: Progress lagging target.

- 2011 Baseline: 91,942 boardings and alightments
- 2014 Value: 1,007,688 boardings and alightments

In FY 2014, 1,007,688 boardings and alightments took place at Vermont rail stations, representing an increase of 5,200 per year since FY 2011. This falls below the average annual increase of 6,000 boardings and alightments per year needed to achieve the CEP objective.

Note: Passenger rail ridership is measured as the *combined* boardings and alightments at Vermont Amtrak stations. This is consistent with the CEP objective but counts trips that begin and end at Vermont stations twice, so should not be equated with the *number* of rail trips in Vermont.

Data Source: VTrans

6.9 Objective 9: Increase Rail-Based Freight

Objective: Double the amount of rail freight tonnage in the state from 2011 levels by 2030.

Current Status: Longer-term data required.

- 2011 Baseline: 6.6. million tons

The most recent estimate of rail tonnage in Vermont, for 2011, was completed in 2015 (VTrans, 2015b). Additional data is needed to evaluate trends in rail freight tonnage.

Data Source: The Freight Analysis Framework; Surface Transportation Board's Confidential Carload Waybill Sample.

Possible Objective Revisions: Tracking freight mode share in ton-miles, rather than raw tonnage, provides more information about the energy required for freight transport. This objective could be revised to be measured in ton-miles.

6.10 Objective 10: Improve Fleet Fuel Economy

Objective: Improve the combined average fuel economy (in MPG) of the Vermont vehicle fleet to meet the national average fuel economy set by the federal CAFE standards, or improve it by 5%, whichever is greater, by 2025.

Status: Progress lagging target

- 2011 Baseline: 20.3 mpg
- 2015 Value: 25.6 mpg

The federal CAFE standard for 2025 is 54.5 mpg. In order to reach that target, the fuel economy of the Vermont fleet must increase by an average of 2.4 mpg per year for the period from 2011 through 2025. Fleet fuel economy improved by an average of 1.3 mpg per year from 2011 through 2015.

Data Source: Vermont DMV vehicle registration data; EPA fuel economy figures.

6.11 Objective 11: Increase Registration of Renewably Powered Vehicles

Objective: Ensure that 25% of all vehicles registered in Vermont are powered by renewable sources by 2030.

Status: Progress lagging target

- 2011 Baseline: PEVs constituted 0.0% of Vermont vehicle fleet
- 2015 Value: PEVs constituted 0.2% of Vermont vehicle fleet

Using PEVs as a proxy for registration of renewable powered vehicles, an average annual increase in PEV registrations of 1.3% of the vehicle fleet is required from 2011 through 2030. PEVs increased by an average of 0.05% of the Vermont vehicle fleet between 2011 and June 2015.

Suggested Objective Revision: Renewably powered vehicles are difficult to define. Many vehicles can run on both renewable and non-renewable energy sources. For example, an EV could charge with electricity generated from wind power or with electricity generated by natural gas plants. Likewise, a diesel vehicle can drive on 100% biodiesel, 100% conventional diesel, or a mixture of the two. Without additional fuel sales data, it is difficult to track this metric.

Revising this objective to target a specific percentage of VMT (such as 25%) that is powered by a renewable energy source would be more consistent with current vehicle technology. Assessing this revised objective would still require additional data collection on sales of biodiesel and electricity as transportation fuels.

6.12 Objective 12: Increase Biodiesel and CNG use in Medium- and Heavy-Duty Fleets

Objective: Increase the number of medium- and heavy-duty vehicles powered by biodiesel or CNG by up to 10% by 2030.

Status: Additional data required to evaluate this objective.

As with objective 11, this objective is challenging to measure since a diesel vehicle can drive on 100% biodiesel, 100% conventional diesel, or a mixture of the two. Therefore it is difficult to track this metric without tracking biodiesel sales.

Suggested Objective Revision: Revising this objective to target a specific percentage of medium- and heavy-duty VMT (such as 10%) that is powered by biodiesel or CNG would be more consistent with current vehicle technology. Assessing this revised objective would still require additional data collection about sales of biodiesel as transportation fuels.

7 Recommendations for Metrics, Data, and Modeling

This section contains a set of recommendations for the state that will improve our ability to track progress toward the goals and objectives of the CEP. The recommendations have been collated from the previous sections and compiled according to the following categories:

- Expanding/improving data collection for existing metrics
- Recommended additional metrics
- Future iterations of existing data sources needed
- New data needed
- Improved and new modeling needed

7.1 Expanding/Improving Data Collection for Existing Metrics

- Expanding objectives 3–5 to consider mode share for all trip types, as opposed to the mode share for commute trips only, would increase the impact of shifting from SOV to carpool or active transportation trips. Tracking mode share across all trips would require regular collection of state-level mode data from a comprehensive travel survey such as the NHTS.
- Improvements in the acquisition and quality control of the vehicle-registration data from the DMV are needed to improve the fidelity of several metrics used in this study. Current reporting from DMV includes the class of each vehicle that is registered, but the coding of this class parameter and other variables has been inconsistent. Improved coding of the vehicle class to more accurately identify diesel, CNG, and electric vehicles would result in more accurate data for the Profile.

7.2 Additional Metrics Recommended

- **In-Use MPG**: Tracking *In-Use MPG*, as opposed to *EPA sticker MPG*, would provide a more accurate measure of fleet-wide fuel economy. The Energy Information Administration (EIA) has developed and implemented an In-Use MPG estimate for vehicle fleets in the NHTS (U.S. EIA, 2011). In-Use MPG is imputed in two steps. First, the commonly reported EPA *Composite MPG* of each vehicle is adjusted based upon on-road testing to yield an *On-Road MPG*. The On-Road MPG is further adjusted to reflect differences in vehicle performance based upon seasonal differences and annual miles driven, to yield the In-Use MPG.

  The adjustment process assumes that vehicles with a higher annual VMT are used for a higher proportion of longer trips, with fewer stops and higher speeds, than lower-annual-VMT vehicles. It is recommended here that In-Use MPG be used in computing the fleet-wide fuel economy, as it more accurately reflects the fuel economy experienced by Vermont drivers.

- **Transit Energy-Intensity**: Tracking the energy intensity of transit services on a Btu-per-passenger-mile basis using actual use data from Vermont's transit authorities is recommended to provide a clearer picture of transits contribution to reducing transportation energy use.

- **Park-and-Ride Space Utilization**: Measuring and tracking the occupancy of spaces at each park-and-ride is recommended to provide a better measure of the utility of park-and-ride facilities.

- **New Development Density**: Tracking the density of new development will be necessary to track progress against the strategy related to transit-supportive development in the CEP. Measuring the total area of transit-supportive zones (see Belz et. al., 2010) that fall within Census urban areas would be one method of tracking the impact of new development of density.

7.3 Future Data Collection and Reporting Needs

Future collection and reporting of the primary data sources used for the selected metrics is imperative for continued monitoring of the state's progress toward the goals and objectives of the CEP. The following data sources must continue to be available at their current level:

- The National Household Travel Survey (NHTS) (next scheduled for 2016), with a supplemental add-on similar to the one conducted for Vermont in 2009
- Statewide Coverage of Annual Average Daily Traffic counts
- The Population Estimates Program of the U.S. Census Bureau
- The Vermont Travel Model, Base Year 2010 (next scheduled update for 2016)
- State of Vermont Department of Motor Vehicle driver's licensing data and vehicle registration data (annual cycle)
- Ridership reports from Vermont's 10 bus-transit authorities
- The Commodity Flow Survey and Freight Analysis Framework
- Federal Highway Administration annual summaries of roadway utilization from the Highway Performance Monitoring System
- Vermont Legislative Joint Fiscal Office annual report of gasoline and diesel sales, and monthly reports of Amtrak ridership and revenue

7.4 New Data Needed

- In order to measure the energy intensity of a transit bus, the length of the transit trip, and the average occupancy of the vehicle are needed, along with the vehicle make, model, and year. Some of this data could come through a coordinated rider survey administered to all of the transit providers in the state, connecting specific riders with routes, origins, and destinations.

- An improved understanding of bicycle and pedestrian miles traveled (BPMT) in Vermont would require a formalized, structured program of cyclist and pedestrian counts throughout the state, particularly for counties other than Chittenden, which already has a fairly comprehensive program.
- A better understanding of the displacement effects of passenger rail travel in Vermont can be gained through a rider survey of passengers on the Ethan Allen and the Vermonter lines. The focus of the survey would be the relationship between Amtrak use and private passenger vehicle use by riders of Amtrak, including the factors that influence their decisions to use passenger rail.
- In order to effectively track progress on park-and-ride utilization, it is necessary to improve the tracking of the specific number of parking spaces available at each lot. Tracking use of park-and-ride lots statewide would involve week-long observations focused on the peak periods of use but including all seven days of the week, repeated three to four times per year. These observation periods can be supplemented with user intercept surveys that are focused on connecting the use of facility with specific origins, destinations, and modes.

7.5 Improved Modeling Needed

- A model that connects the actual make and model of each vehicle in Vermont from the DMV registration data with its use (in miles) in the current year will improve upon the current estimate of statewide fleet fuel efficiency that does not account for the annual mileage of each vehicle. Current use of the vehicle may be obtainable through vehicle inspection records, which commonly note the odometer reading on the inspected vehicle.
- A modified annual estimate of VMT per driver can be made, which excludes a representative portion (about 2%) of the FHWA-based value to account for pass-through travel, based on the results of the 2009 NHTS.
- Incorporating a bus-transit sub-module into the Vermont Travel Model would allow us to quantify average occupancies and trip lengths for specific fixed routes, which could then be linked to specific vehicles from the providers, leading to new metrics of average energy intensity for transit buses in Vermont and total transit-passenger miles of travel in Vermont.
- An effective statewide program and bike and pedestrian counts could be used to develop a model of total biking and walking miles travelled in Vermont.
- The displacement of privately owned vehicle miles of travel by Amtrak rail ridership can be identified and tracked with a corridor-based analysis implemented with the Vermont Travel Model.
- Commercial truck freight can be tracked in the Vermont Travel Model if an augmented freight sub-module is incorporated into the Model. The augmented freight sub-module would allow freight movements by truck to be tracked along specific corridors also served by freight rail, so the corridor-specific mode shares can be assessed and tracked.

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