The Vermont Transportation Energy Report

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Prepared by:
Jennifer Kenyan
Karen Glitman
Richard Watts, Ph.D.

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

(802) 656-1312
www.uvm.edu/trc

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Disclaimer

The contents of this report reflect the views of the authors, who are 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. This report does not constitute a standard, specification, or regulation.

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1. Introduction

The Vermont Clean Cities Coalition's mission to reduce reliance of imported fossil fuel requires that policy makers have at their disposal relevant and timely data. This report presents data on the status of fuel consumption, vehicle purchases, expenditures on transportation, and travel behavior that can be used as a basis for policy discussions and initiatives. The Vermont Clean Cities Coalition will continue to provide this data on an annual basis.

The Vermont Clean Cities Coalition (VCCC) is funded by the U.S. Department of Energy and the Vermont Department of Public Service. The University of Vermont Transportation Research Center has served as the host of the Vermont Coalition since July 2007. Nationwide there are almost 90 local coalitions representing more than 5,400 stakeholders. Vermont Clean Cities Coalition stakeholders include fleet managers, state and local officials, auto dealers, students and academics. These stakeholders gathered for their annual roundtable in April 2009. The VCCC produces a monthly electronic newsletter which is distributed to a list of more than 600 email addresses. VCCC also hosts and co-sponsors events around the state.

The transportation sector is the largest user of petroleum in Vermont, consuming more petroleum than any other primary end user. This report focuses not only on petroleum use, but also on the vehicle fleet and programs which affect Vermont's overall petroleum use.

2. Transportation Fuel Consumption for Highway Modes

2.1. Transportation Fuel Sales for Highway Modes in Vermont

The transportation sector, including personal vehicles, public transit, trucks, rail, maritime and aviation transportation, is the largest user of petroleum in Vermont, consuming more petroleum than any other end user, including industrial (manufacturing), residential (energy use by homes), and commercial (energy use by commercial buildings).[1]

As shown in Table 2-1, total fuel sales in Vermont have generally been flat between 2004 and 2007, with a drop in 2008. Although biodiesel sales increased sharply from 2004 to 2008, they remain a small portion of overall transportation fuel. Of note, these data do not include the personal production of biodiesel. Biodiesel is not to be confused with ethanol; although ethanol is sold in the state as an additive to gasoline there are currently no E85 (ethanol) fueling stations in Vermont. Ethanol became a 10 percent additive in Vermont's gasoline in 2006. Ethanol production in the U.S. has more than quadrupled since 2002 increasing from 2,130 million gallons to 9,000 million gallons in 2008.[2]

Table 2-1. Fuel Sold in Vermont for Highway Modes (in millions of gallons), 2004-2008

	2004	2005	2006	2007	2008
Gasoline [3]	355	361	344	348	337
Diesel [3]	68.3	68.0	72.2	69.8	63.6
Bio-Diesel [4]	0.06	0.28	.80	1.14	1.25
Total	423	429	418	418	401

In the United States, gallons of gasoline and diesel sold have generally remained flat in recent years. From 2002 to 2005, total U.S. gasoline sales increased by 2.2 percent, slightly less than Vermont's sales increase of 4.3 percent. The percent of change in U.S. total gasoline sales from 2005 to 2008 shows a slight decrease of 4.3 percent [5], compared to a 6.6 percent decrease in Vermont. At both the state and the national level this decrease in gallons of motor gasoline sold has resulted in a decrease in revenue generated by the gasoline tax. Flat gasoline sales result in a decreased value of the gasoline tax raised; because the gasoline tax is a constant value by the gallons sold and not linked, as a percentage, to the cost per gallon, inflation overtakes even small *increases* in revenue generated by modest increases in gallons sold.

Monthly trends, when comparing gasoline sales in the first five months of 2008 to those of the first five months of 2009, as shown in Figure 2-1, continue to indicate that gasoline sales fluctuate from month to month depending on the year, but remain generally flat.

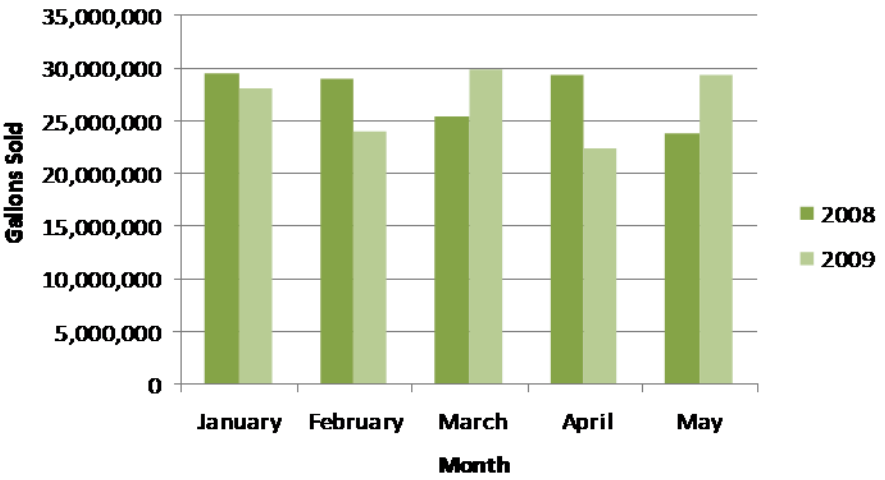
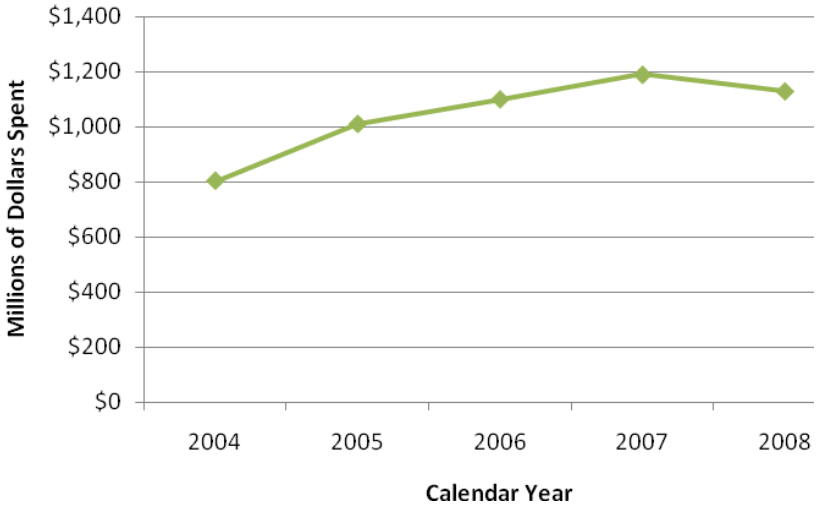


Figure 2-1. Gasoline Sold in Vermont January through May, 2008 and 2009[3]

2.2. Gasoline and Diesel Fuel Prices

In 2008, the amount spent on gasoline and diesel purchases in Vermont continued to be above $1 billion (see *Figure 2-2*). The amount spent on gasoline and diesel in Vermont increased by $623 million from 2002 to 2007. From 2007 to 2008 expenditures decreased slightly from $1.2 billion to $1.13 billion. In six years, in-state spending on transportation fuels has doubled, while gasoline and diesel fuel use has remained almost the same. Most of these dollars are exported out of state to purchase the fuel. In April 2009, for each gallon of gasoline bought in the U.S., 12 percent of the cost was distribution and marketing, 12 percent refining costs and profits, 20 percent Federal and State taxes, and 56 percent crude oil. [6] The reason for the increase in spending is the rapid increase in gasoline prices over the last six years (see *Tables 2-2* and *2-3*).



**Petroleum sales multiplied by average cost of one gallon of regular gasoline in Vermont, 2008.*[3, 7]

Figure 2-2. Total Annual Spending for the Purchase of Petroleum in Vermont, 2004-2008*

The increase in petroleum costs continued more sharply between August 2007 and August 2008, when the average retail price for a gallon of regular unleaded gasoline in Vermont was $2.92 and $3.92, respectively. [7] As shown in Tables 2-2 and 2-3, prices in Vermont have been approximately the national average for gasoline, but slightly more than the national average for diesel.

Table 2-2. Average Annual Costs for the Purchase of Petroleum in Vermont, 2004-2008 [7]

	2004	2005	2006	2007	2008
Gasoline Price/Gallon	$1.88	$2.31	$2.59	$2.81	$3.35
Diesel Price/Gallon	$1.97	$2.58	$2.86	$3.02	$4.13

Table 2-3. Average Annual Costs for the Purchase of Petroleum in the U.S., 2004-2008 [8, 9]

	2004	2005	2006	2007	2008
Gasoline Price/Gallon	$1.90	$2.31	$2.62	$2.84	$3.29
Diesel Price/Gallon	$1.81	$2.40	$2.71	$2.89	$3.81

Figure 2-3 illustrates the gasoline prices for 2009 with prices for the same months in 2007, 2008 and 2009. Prices per gallon of gasoline in Vermont for the first five months of 2009 were the lowest since 2004. [7]

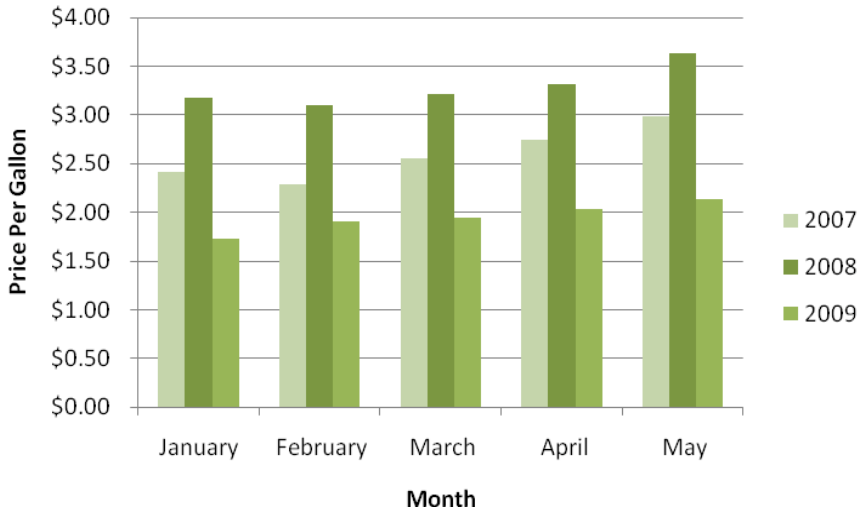


Figure 2-3. Price per Gallon of Gasoline in Vermont January through May, 2007, 2008 and 2009 [7]

Rising transportation energy costs are not isolated but rather directly associated with other increasing costs which affect Vermonters. *(See Section 4 for more discussion on costs).* Figure 2-4 illustrates the trend in the cost of home heating fuels. Although the price per gallon of home heating oil remained relatively flat for much of 2007, Vermonters saw a 31.59 percent increase in fuel oil prices from January 2007 to January 2008, but by late 2008 and early 2009 saw prices return to 2007 levels.[7]

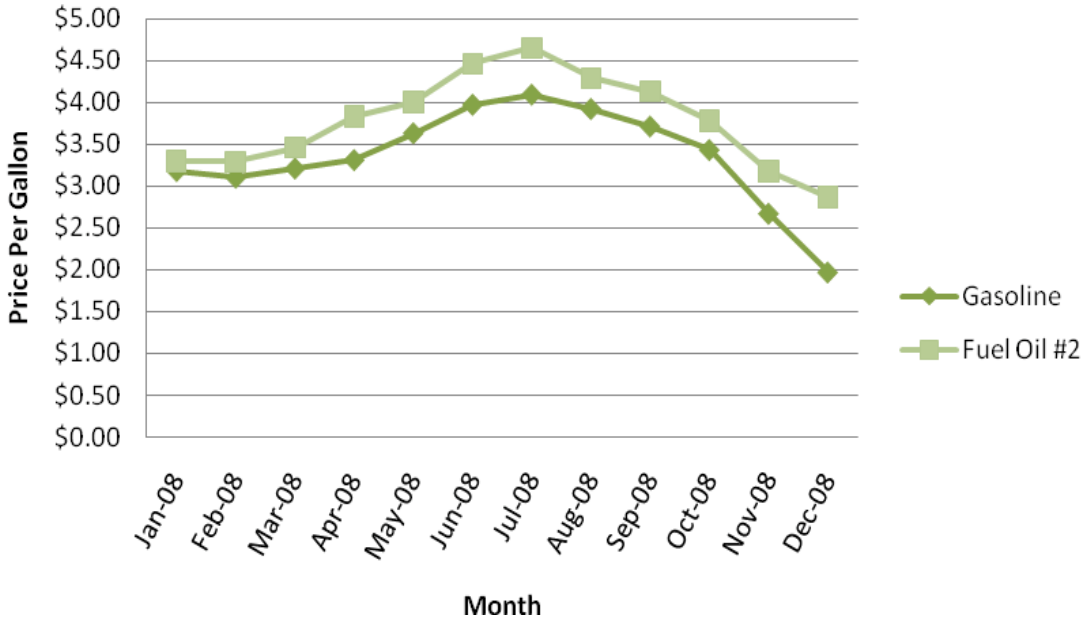


Figure 2-4. Average Costs for Gasoline and Home Heating Fuel (Oil # 2) in Vermont in 2008 by month[7]

Figure 2-5 indicates the overall energy efficiency of different transportation modes. Single occupancy vehicle (SOV) trips are the primary mode of travel by most Vermonters. Shifting some trips to other modes can reduce the overall energy used by the transportation system, as well as reduce individual fuel consumption and transportation expenditures. However, in order for these modal shifts to occur the options must be available. *(See Section 5.)*

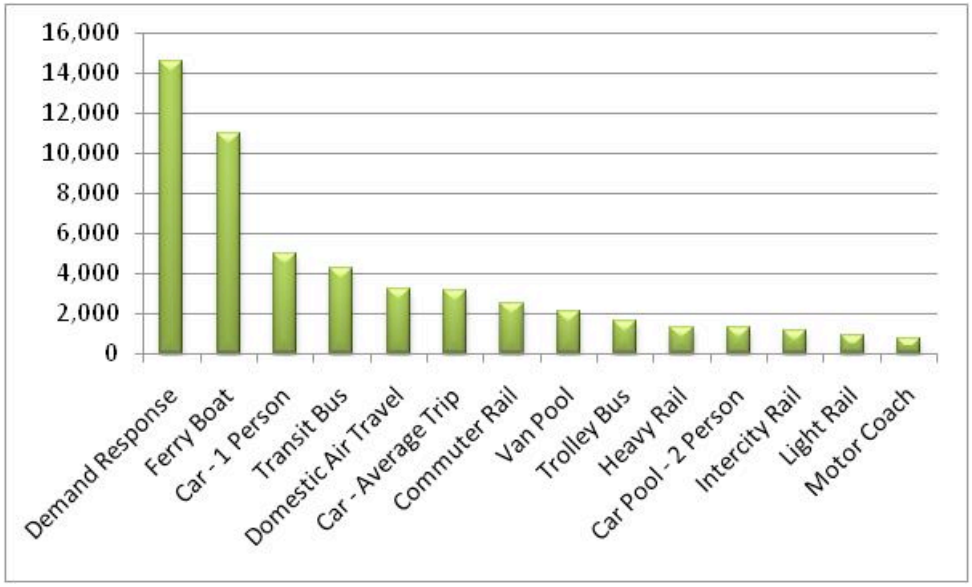


Figure 2-5. Energy Dependency of Modes – BTU per Passenger Mile [10]

3. Vehicles, Travel and Emissions

3.1. Vehicle Fleet

The Clean Cities mission to reduce reliance on fossil fuels is directly related to the vehicle fleet composition. Tracking changes in the vehicle fleet fuel efficiency and the number of vehicles powered by non-petroleum based fuels is an important measure of change.

Vehicle registrations, like the state's population, increased from 2004 to 2006. However, in 2007 vehicle registrations dipped (see *Table 3-1*). From 2004 to 2006, the number of vehicles registered rose by nearly 7,000, or 1.2 percent. In 2007, registrations decreased by approximately 800 (-.14 percent) and by over 4,600 (-.81 percent) in 2008. The number of driver licenses in effect took a major downturn from 2005 to 2006 falling by just over 29,000 (-5.2 percent) but then rose in 2007 by about 6,000 (1.2 percent) and again by nearly 7,000 (1.3 percent) in 2008. As a result of driver licenses increasing and vehicle registrations decreasing in 2007 and 2008, the numbers indicate that although more people possess an effective driver's license they do not necessarily have increasing access to vehicles.

Table 3-1. Vehicle Registrations and Drivers Licenses in Vermont by Calendar Year

	2004	2005	2006	2007	2008
Vehicle Registrations* [11]	568,309	573,470	575,163	574,370	569,728
Driver Licenses [12]	556,821	561,338	532,041	538,372	545,336
Vermont Population [13]	618,794	619,736	620,778	621,254	621,270
Vehicles per licensed driver	1.02	1.02	1.08	1.08	1.04
Vehicle per capita	1.09	1.08	1.08	1.08	.92

*****Registrations include state vehicles, municipal vehicles, trucks, and autos. This table does not include bus, agricultural vehicle dealers, handicap placard, motorcycle, or trailer registration.*

Because raw data is not readily available from public sources, the UVM Transportation Research Center contracted with R.L. Polk & Co., an international firm, to provide Vermont-specific data related to automobile purchases. This data provides the TRC with a unique data set that can be used to better understand trends and directions in Vermont's fleet composition.

The number of new vehicle purchases as shown in Figure 3-1 has continued to decrease from 2004 to 2008. Just over 32,000 new vehicles were purchased in 2008 in Vermont. This is a decrease from previous years and nearly 10,000 fewer than in 2004, a 22.7 percent decrease from 2004 to 2008. Alternately, the sales of used cars in Vermont spiked almost 32 percent from 2007 to 2008, after several years of flat or declining sales.

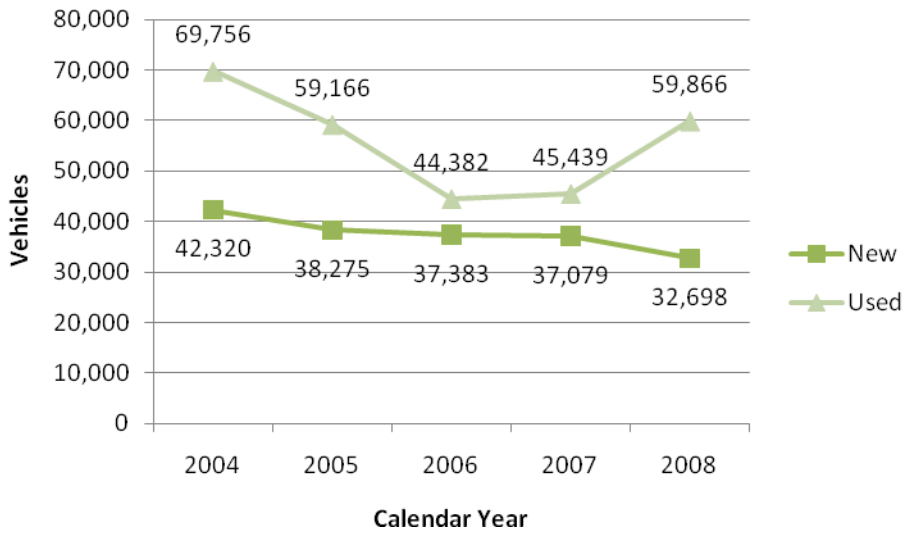


Figure 3-1. Number of New and Used Vehicle Purchases in Vermont by Calendar Year

As shown in Table 3-2, most new vehicles purchased in 2008 were gasoline-powered vehicles (92 percent). Approximately 1 percent were diesel. Of note, more than 1,168 vehicles that run on either ethanol or gasoline ("flex fuel") were purchased in the state, although ethanol is not commercially available for fueling vehicles in Vermont.

There were 974 new hybrids sold in Vermont in 2008 and 4,565 registered in the state—a 25 percent increase in hybrid registrations from 2007 to 2008 (however, hybrid vehicle sales only account for 3 percent of overall new vehicle sales, and less than 1 percent of the overall fleet). As shown in Table 3-3, pure electric vehicles and propane powered vehicles registered in the state decreased between 2005 and 2008 by 14 and 41 percent, respectively. There was a 6.6 percent increase in gasoline powered vehicle registrations from 2005 to 2008.

Table 3-2. New and Used Vehicle Purchases in Vermont by Fuel Type, Percent of Total Sold

Fuel	2006		2007		2008	
	New	Used	New	Used	New	Used
Gasoline	94%	96%	91%	96%	92%	97%
Diesel	2%	2%	2%	2%	1%	1%
Flex fuel (ethanol/gasoline)	3%	2%	3%	2%	4%	2%
Hybrid	1%	<1%	3%	<1%	3%	<1%
Electric	<1%	<1%	<1%	<1%	<1%	<1%
Natural Gas	<1%	--	<1%	<1%	<1%	<1%
Conversion	--	<1%	--	<1%	--	<1%

Table 3-3. Vehicles Registered in Vermont by Fuel Type [14]

Fuel	2005	2006	2007	2008	Percent Change 2005-2008
Hybrids	1,510	2,358	3,651	4,565	202 %
Electric	118	110	106	101	- 14 %
Propane	127	110	93	75	- 41 %
Diesel	27,504	29,161	31,648	32,140	17 %
Gasoline	543,009	542,126	583,568	578,881	6.6 %
Total	572,268	573,865	619,066	615,762	7.6 %

Vehicle registrations in Table 3-3 include private vehicles, trucks, farm trucks, motorcycles, municipal and state vehicles, and buses. Fuel types for vehicles registered in Vermont are self-reported by the registrant, and the Vermont Department of Motor Vehicles does not administer guidelines for reporting fuel type.

3.2 Fuel Economy

Fuel economy is one of two direct links to fuel consumption and thus expenditures. (The other direct link is the total distance or miles traveled which is discussed in Section 3.3.) A vehicle fleet with high fuel economy is less reliant on fossil fuels, which meets the Clean Cities mission. Table 3-4 illustrates that 18 percent of new vehicle purchases in Vermont in 2008 had a combined average fuel economy of 33 miles per gallon (mpg). Nearly 30 percent had an average fuel economy of less than 20 mpg and 26 percent had a combined average fuel economy of just over 20 mpg. (These numbers are based on the EPA's fuel economy rating of each vehicle make purchased within each of these segments in 2008. The percentages do not add up to 100 because only the national top five of 27 selling segments are listed in the table.)

Table 3-4. New Vehicle Purchases in Vermont in 2008 by Top Five Selling Segments

Segment	Avg. Fuel Economy[12]	Range of Fuel Economy in Segment (Lowest to Highest)	Total # Sold in VT by Segment	Total New Car Sales in VT
Basic Economy	33 mpg	VW Rabbit (22) – Toyota Prius (46)	5,779	18%
Full-size Pickup	19 mpg	Chevy Avalanche (14) – GMC Sierra (17)	5,401	16.5%
Mini Sport Utility	21mpg	Land Rover LR2 (15) – Ford Escape Hybrid (27)	4,109	13%
Sport Utility	18 mpg	Infiniti QX56 (14) – Toyota Highland Hybrid (26)	4,162	13%
Upper Middle	23 mpg	Ford Five Hundred (19) – Honda Accord Hybrid (27)	4,278	13%

The Top Five Segments were the only segments to sell over 10,000 new vehicles from 2004-2008. (Average fuel economy of each segment was found by combining the EPA estimated fuel economy for each vehicle purchased in Vermont in that segment in 2008, and dividing by the total to find the average.)

Of the top five selling segments in Vermont, Basic Economy is the most fuel efficient, while Full-size Pickup and Sport Utility are the least fuel efficient. Although the actual average may differ from year to year the basic trend in fuel economy has remained the same from 2004 to 2008. As Table 3-5 shows, from 2004 to 2008 new purchases of the Full-size Pickup and Sport Utility lines have each decreased by 34 percent. The purchase of new Mini Sport Utility vehicles increased by 20 percent from 2004 to 2007, but fell by 12 percent in 2008.

Table 3-5. New Vehicle Purchases 2004-2008 by Top Five Selling Segments in Vermont

Segment	2004	2005	2006	2007	2008	Change 2004-2008	% Change 2004-2008
Basic Economy	5514	5437	5444	5560	5779	265	5%
Full-size Pickup	8204	7335	6572	6970	5401	-2803	-34%
Mini Sport Utility	3903	3937	4634	4665	4109	201	5%
Sport Utility	6329	5704	4937	5231	4162	-2167	-34%
Upper Middle	5864	5191	5327	5061	4278	-1586	-27%

Dealerships typically have available each Model Year (MY) from its release in the fall or winter of the previous Calendar Year (CY) until the end of the MY. For example, in 2008, new MY 2008 vehicles were available most of the CY and MY 2009 vehicles became available in the last quarter of the CY. Also, MY vehicles tend to sell out by the end of their CY, such that there were probably no MY 2007 vehicles sold from dealerships in CY 2008.

As gasoline prices continue to rise (see *Section 2-2*) Vermont hybrid sales have also continued to increase. From 2004 to 2005, Toyota Prius sales (the nation's top selling hybrid) doubled in Vermont, and they did so again from 2005 to 2007 (*see Table 3-6*). However, 2008 saw a drop in overall car sales including a 20 percent drop in Prius sales.

Table 3-6. New Hybrid Electric Vehicle (HEV) Purchases in Vermont by Model, 2004-2008

Model	2004	2005	2006	2007	2008	Total Sold Over 5 Years
Accord	2	34	13	6	2	57
Altima	--	--	--	16	27	43
Aura	--	--	--	4	2	6
Camry	--	--	70	123	78	271
Civic	112	96	91	111	104	514
Escape	17	70	44	30	18	179
GS	--	--	--	1	--	1
Highlander	--	78	160	97	61	396
Insight	4	3	5	--	--	12
LS	--	--	--	--	1	1
Malibu	--	--	--	--	8	8
Mariner	--	1	6	12	7	26
Prius	197	405	503	815	648	2,568
RX300/RX330/RX400h	--	18	13	21	9	61
Tahoe	--	--	--	--	5	5
Vue	--	--	1	19	3	23
Yukon	--	--	--	--	1	1
Total	332	705	906	1255	974	4,172

Fueleconomy.gov ranks vehicles by model year from most efficient to lease efficient based on their EPA rated miles per gallon. As shown in Table 3-7, in Vermont, there were 1,294 new vehicle purchases of models that ranked in the top 10 most efficient based on their EPA rated average miles per gallon for MY 2008, which accounts for just less than four percent of the total new vehicle purchases in 2008. There were a total of 32,698 new vehicles purchased

in Vermont in 2008. None of the vehicles with the worst EPA rated gasoline mileage were purchased in 2008 in Vermont.

The top six most fuel efficient vehicles of MY 2008 were hybrids. The seventh most fuel efficient vehicle was the Smart for Two Convertible and Coup. Of the 11 most efficient, 8 were cars and 3 were hybrid SUVs.

Table 3-7. Top 10 Most Gasoline Fuel Efficient Cars MY 2008 [15]

Vehicle	City/Hwy MPG*	Type	# of New Vehicles Sold in VT (2008)
Toyota Prius	48/45	Car	648
Honda Civic Hybrid	40/45	Car	64
Nissan Altima Hybrid	35/33	Car	22
Ford Escape Hybrid	34/30	SUV	10
Mazda Tribute Hybrid	34/30	SUV	0
Mercury Mariner Hybrid	34/30	SUV	7
Smart for Two Convertible/Coup	33/41	Car	42
Toyota Camry Hybrid	33/34	Car	77
Toyota Yaris	29/26	Car	337
Mini Cooper/ Clubman	28/37	Car	87

Table 3-8. Top 10 Least Gasoline Fuel Efficient Cars MY 2008 [15]

Vehicle	City/Hwy MPG*	Type	# of New Vehicles Sold in VT 2008
Lamborghini Murcielago	8/13	Car	0
Bentley Azure	9/15	Car	0
Bentley Arnage	9/15	Car	0
Ferrari 612 Scaglietti	9/16	Car	0
Bentley Continental GTC	10/17	Car	0
Aston Martin DB9	11/17	Car	0
Jeep Grand Cherokee	11/14	SUV	0
Chevrolet Van	12/15	SUV	0
GMC Savana	12/15	Truck	0
Nissan Titan	12/17	Truck	0

In addition to reducing fuel use, owning a "Greener Car," or, more specifically, a vehicle in the basic economy segment, could save drivers a significant amount of money each year. In Vermont the average highway vehicle miles traveled (VMT) per capita per year is approximately 12,400. [16] Consequently, the owner of a basic economy vehicle in Vermont that gets on average 33 mpg pays $1,503 per year for fuel; while the owner of a sport utility

vehicle in Vermont with an average mpg of 18 pays $2,756 per year for fuel. The national average highway VMT per capita per year is about 10,100, [16] thus Vermonters, because they are driving more, are paying more on average, assuming gasoline prices are the same throughout the country. Nevertheless, a Vermont driver that owns a basic economy vehicle and drives the average 12,400 highway miles each year would still pay less for fuel ($1,503) than the average American driver that owns a sport utility vehicle and drives the average 10,100 highway miles per year ($2,244). (All numbers assume the cost of gasoline equals $4/gallon.)[17]

However, fuel costs are just one piece of the total cost of owning and operating an automobile. As Table 3-9 shows, the driving cost per year by vehicle type ranges from $6,217 for a small sedan to nearly $10,000 for an SUV.

Table 3-9. Driving Costs per Year, 2007 [18]

Type of Cost	Small Sedan	Medium Sedan	Large Sedan	Sport Utility Vehicle	Minivan
Gas and oil/mile	7.4 cents	9.4 cents	10 cents	12.6 cents	10.6 cents
Maintenance/mile	4.5 cents	4.7 cents	5.5 cents	5.5 cents	5.1 cents
Tires/mile	0.5 cents	0.8 cents	0.7 cents	0.9 cents	0.7 cents
Operating costs/mile	12.4 cents	14.9 cents	16.2 cents	19 cents	16.4 cents
Insurance	$968	$955	$1,032	$950	$886
License and registration	$401	$544	$668	$695	$587
Depreciation	$2,461	$3,394	$4,321	$4,531	$3,899
Finance charges	$527	$743	$929	$971	$807
Ownership costs per year	$4,357	$5,636	$6,950	$7,147	$6,179
Total cost for 15,000 miles per year	$6,217	$7,871	$9,380	$9,997	$8,639

3.3. Travel - Vehicle Miles Traveled (VMT) in Vermont

Vehicle miles traveled (VMT) are key data for highway planning and management, and are a common measure of roadway use. Along with other data, VMT are often used in estimating congestion, air quality, and potential gasoline-tax revenues, and can provide a general measure of the level of the nation's economic activity. [12]

VMT is one of the two factors for vehicle petroleum use (the other being vehicle fuel economy discussed in section 2.2). As Table 3-10 shows, vehicle miles traveled per person declined between 2004 and 2008. Of note, however, is that these numbers are estimates. Because the source of these numbers is often permanent and rotating automatic counters on roadways from which data are acquired and VMT estimates derived, the accuracy varies. The length of road by class and location is used with the spot traffic volume counts and estimates of the total length or miles of road that the counters represent. Reducing VMT would clearly reduce use of petroleum, but alternatives for travel, especially in a rural state, are limited. *(See Section 5.)*

Table 3-10. Vermont and US Average Annual VMT by Calendar Year (in millions), 2004-2008

	2004	2005	2006	2007	2008
Vermont[20]	7,717	7,611	7,688	7,529	7,126
U.S. [21]	2,930,238	2,971,785	3,004,246	3,009,492	2,923,205

As Table 3-11 shows, commuters in Vermont were on par with the national average for driving alone, car pooling, and using motorcycle, bicycles and other means, but were below the national average in use of public transportation and had a higher than average number of workers who work at home and who walk to work. [22]

The Census Journey to Work data was last collected in 2000. In 2008, the Vermont Agency of Transportation, Chittenden County Metropolitan Planning Organization and the UVM Transportation Research Center jointly sponsored an "add-on" survey of 1,500 Vermont households with the National Household Transportation Survey. This data will be available in fall 2009. No accurate data currently exists for the miles of travel by non-motorized means.

Table 3-11. Journey to Work, 2000 [22]

	Drove alone	Carpooled	Public transportation	Walked	Motorcycle, bike, other means	Worked at home
Vermont	75.2%	11.9 %	0.7 %	5.6 %	0.9 %	5.7 %
US	75.7 %	12.2 %	4.7 %	2.9 %	1.2 %	3.3 %

It is important to note that journey to work trips comprise only 22.1 percent of all trips. Table 3-12 indicates the breakdown of all trips by trip purpose.

Table 3-12. National Trip Statistics by Trip Purpose [23]

Trip Purpose	Share of Trips	Share of vehicle-miles traveled	Trip length (miles)	Trip duration (minutes)
To/from work	22.1 %	27.0 %	12.1	22.3
Work-related business	4.1 %	8.4 %	20.3	30.9
Shopping	21.1 %	14.5 %	6.7	14.4
Other family/ personal business	24.7 %	18.7 %	7.5	15.2
School/ church	4.9 %	3.7 %	7.5	15.8
Medical/ dental	2.2 %	2.2 %	9.9	20.7
Vacation	0.4 %	1.8 %	47.4	59.6
Visit friends/ relatives	6.3 %	9.4 %	14.9	24.4
Other social/ recreational	13.7 %	13.2 %	9.6	18.2
Other	0.5 %	1.0 %	18.1	31.4

3.4. Vehicle Tailpipe Emissions Data

Approximately 20 lbs of CO_2 is produced for every gallon of gasoline consumed (Vermont Agency of Natural Resources, Air Pollution Division). Figure 3-2 illustrates that, as a percentage, the transportation sector is the largest contributor of Vermont's CO_2 emissions (57 percent).

Whereas electricity generation makes up 42 percent of total U.S. CO_2 emissions, electricity does not account for any of Vermont's CO_2 emissions. This is largely due to Vermont's electrical

generation being CO_2 neutral. In the United States, transportation accounts for 33 percent of the CO_2 emissions from fossil fuel combustion. (*See Figure 3-3*)

On an absolute ton per person basis, Vermont transportation emissions of carbon are only slightly higher than national averages (based on VMT). However, in terms of a Vermont policy focus for reducing greenhouse gas emissions, the large percentage of emissions being generated by the transportation sector makes it an important focus within the state.

In addition, the combination of land use, development patterns and limited public transit result in long distances traveled by single occupant vehicles in Vermont.

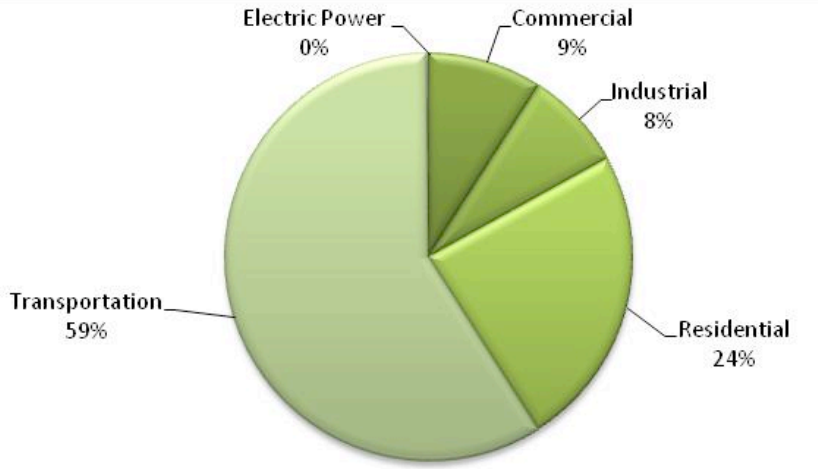


Figure 3-2. Vermont CO_2 Emissions from Fossil Fuel Combustion - Million Metric Tons CO_2 ($MMTCO_2$) by Sector, 2007 [24]

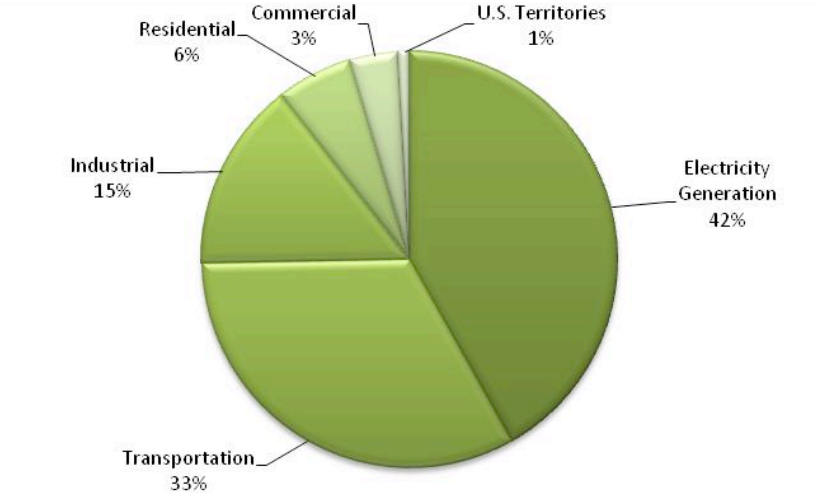


Figure 3-3. U.S. Greenhouse Gas Emissions by Sector, 2007 [25]

The transportation sector accounts for 33 percent of overall energy use in Vermont, compared to 28 percent nationally. This may also be a result of fewer transportation options and a smaller industrial and commercial sector than in other states.

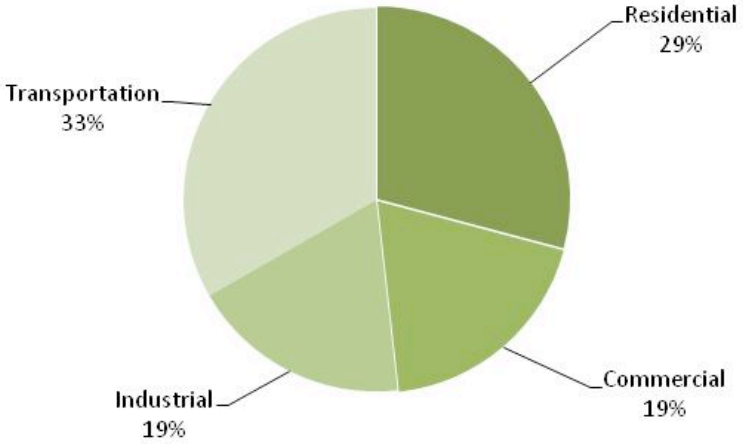


Figure 3-4. Vermont Energy Use by Sector, 2006 [26]

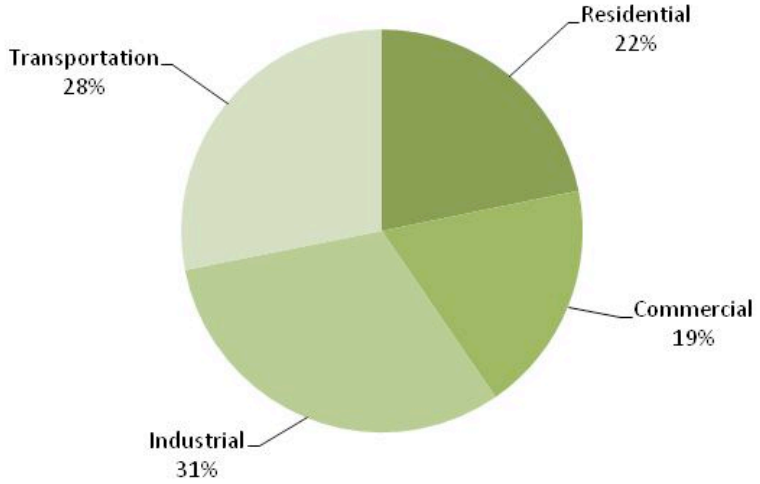


Figure 3-5. U.S. Energy Use by Sector, 2008 [27]

4. Programs that Impact Transportation Fuel Use

4.1. State Expenditures on Transportation

Table 4-1 outlines Vermont's transportation expenditures by program for five fiscal years. The State of Vermont's overall transportation expenditures increased between 2004 and 2007, and decreased slightly in 2008. Certain increases within that budget promote strategies and physical infrastructures that reduce petroleum dependence and reliance on SOVs. The table below includes selected traditional transportation spending items (for comparison) and line items for categories that may reduce reliance on SOV (shown in bold). The percent of funds expended on public transit has remained relatively constant. The percent of funds expended for pedestrian and bicycle facilities as well as park and ride facilities has also remained generally constant, although expenditures on Pedestrian and bike facilities decreased from 2 percent of overall expenditures in 2004 to less than 1 percent in 2008. Rail expenditures as a percent of overall expenditures dipped in 2005 and 2006 and then returned to 2004 levels in 2007 and 2008. Spending for options, as a percentage of the overall Vermont Agency of Transportation budget, decreased from fiscal years 2004 to 2005, and then increased slightly in 2006, but decreased again in 2007, and in 2008 remained below 2004 levels.

Table 4-1. Total Vermont Agency of Transportation Expenditures by Fiscal Year, 2004-2008 [28]

Budget line items*	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Paving & maintenance	28 %	27 %	28 %	29 %	33 %
Roadway	13 %	16 %	15 %	14 %	10 %
Bridges (incl. maintenance)	6 %	10 %	8 %	9 %	6 %
Town Programs	16 %	16 %	15 %	17 %	17 %
Finance, Planning, DMV	12 %	11 %	11 %	12 %	12 %
Public transit	**4 %**	**4 %**	**4 %**	**4 %**	**5 %**
Pedestrian & bike	**2 %**	**1 %**	**1 %**	**1 %**	**<1 %**
Park & ride	**<1 %**	**<1 %**	**<1 %**	**<1 %**	**<1 %**
Multi-modal	**<1 %**	**<1 %**	**<1 %**	**<1 %**	**0**
Rail	**3 %**	**2 %**	**2 %**	**3 %**	**3 %**
Total transportation expenditures in Millions	$300	$328	$338	$388	$385.5
% for options	**9.9 %**	**7.4 %**	**8.3 %**	**8.1 %**	**9 %**

**Items in bold within the table are considered line items for alternatives to the SOV. This table does not include all budget categories.*

The Office of Vermont Health Access (OVHA), part of the Agency of Human Services, also contracts a number of public transit providers for Non-Emergency Medical Transportation (NEMT). NEMT is a covered service for eligible beneficiaries enrolled in traditional and Primary Care Plus Medicaid and the Dr. Dynasaur programs. As shown in Table 4-2, transportation spending by OVHA has increased by 41% from 2004 to 2008.

Table 4-2. Medicaid Transportation Expenditures, FY 2002-2008 [29]

	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Expenditures	$6,287,195	$6,722,540	$9,424,484	$9,900,218	$10,663,296

4.2. Municipal Expenditures on Transportation

Vermont municipalities submit an annual town highway plan (TA-60s) to one of nine district transportation offices, reporting revenue (including state, local, and special funds) and expenses, including general maintenance, special maintenance, construction, bridges, etc. The available plans were collected and compiled from the district offices by the authors of this report. Some municipalities report their highway plans by the fiscal year and others by calendar year. For the purpose of this report, the calendar year and fiscal years were combined by the end year, e.g. CY 2004 and FY 2004 combined. Table 4-3 indicates that municipal spending has steadily increased each year from 2004 to 2008, with an overall increase of nearly 44 percent. However, not all reports were available for each of the 279 municipalities reporting. The percent of reports collected are reported in the table. Additionally, municipal revenue includes state funds so there is some overlap between the total municipal spending and state spending.

Table 4-3. Municipal Expenditures on Transportation, 2004-2008

	2004	2005	2006	2007	2008
Total Spending	$92,823,323	$102,183,617	$110,442,570	$127,887,551	$133,540,597
Percent of Municipalities Reporting	69.80%	79.56%	76.30%	81.36%	77.78%

4.3. School Expenditures on Transportation

The Vermont Department of Education also tracks transportation expenditures for pupils by local school districts. As shown in Table 4-4, between the 2003-2004 and 2007-2008 school years, transportation expenditures increased by over 29 percent, while total miles traveled decreased by 2 percent. The increase in cost parallels the increase in fuel cost. These costs are borne by local property taxpayers as part of their overall school taxes.

Table 4-4. School Transportation Data, 2003-2008 [30]

	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	Percent Change 2003-2008
Number of Buses	1,110	1,099	1,194	1,084	1,176	6.0 %
Number of miles traveled	12,401,971	12,986,370	12,199,177	10,902,941	12,103,914	-2.0 %
Total expenditures	$37,465,731	$41,164,027	$42,243,897	$44,684,921	$48,388,374	29.2 %

5. Programs that Impact Transportation Fuel Use

5.1. Transit Ridership

Increased transit ridership can result in reduced petroleum use, especially if the transit mode is heavily used or at full capacity. Figure 5-1 shows the passenger miles per gallon of fuel by mode based on the actual passenger numbers reported to the National Transit Database in 2005. [31] These numbers reflect actual usage and not potential usage for each non-SOV mode.

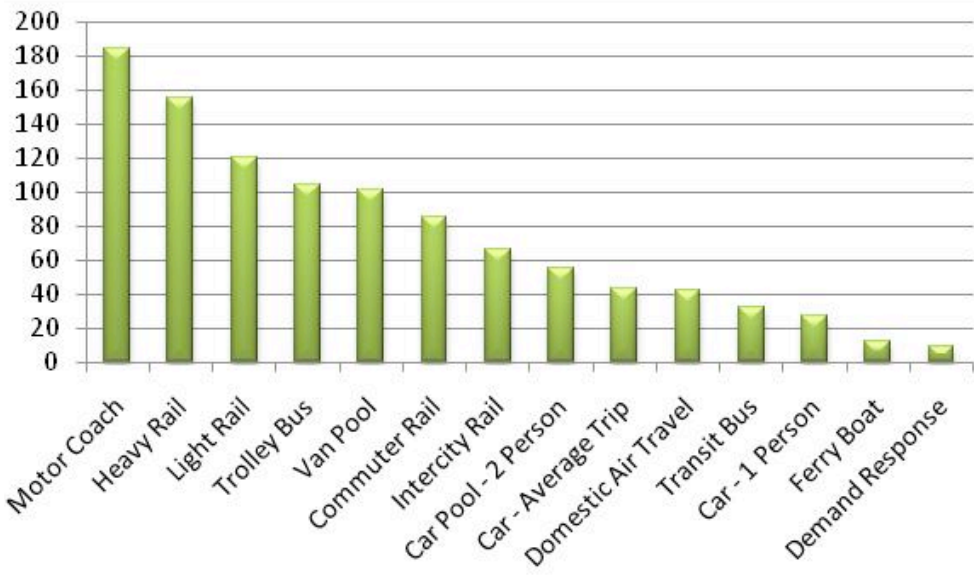


Figure 5-1. Passenger Miles per Gallon of Fuel by Mode [32]

Tables 5-1 and 5-2 illustrate data from Vermont's major transit agencies as well as Amtrak's Vermont rail services. The Chittenden County Transit Authority (CCTA) operates 20 different fixed route services. Green Mountain Transit Agency (GMTA) operates 20 fixed service routes in Washington and Lamoille counties. There are 13 transit operators in Vermont which operate a number of fixed route and shuttle services throughout Vermont. Figures were collected directly from transit providers where available. Figures were not available for Special Services Transportation Agency or the Network (NVPTN).

A number of factors may influence ridership numbers. For example, in 2006, Marble Valley Regional Transit District re-instituted fares on their city fixed route services, leading to a monthly decline of ridership by roughly 10,000 riders per route, per month for the following six months, until ridership began to rebound. Other factors affecting ridership may include (but are not limited to) re-configuration of services or routes, change in operation hours, fare changes, low tourism rates, regional job loss, and reduction of services.

Table 5-1. Bus Ridership for Vermont Transit Providers, FY 2004-2008

Transit Provider	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	Change FY 2004-2008
CCTA	1,799,699	1,887,104	2,009,371	2,120,751	2,233,481	24 %
GMTA	176,935	228,490	237,287	243,244	297,160	68 %
Addison County Transit	--	--	109,282	117,860	124,337	14 %
Advance Transit (fixed route)	278,704	300,419	353,536	389,367	456,393	64 %
Brattleboro Beeline	42,602	43,866	50,652	57,800	71,515	68 %
Connecticut River Transit	--	24,297	34,066	39,408	52,391	116 %
Deerfield Valley Transit	160,603	177,528	199,410	182,286	207,835	29 %
Green Mountain Community Network (started 2007)	--	--	--	--	58,396	--
Marble Valley Regional Transit District	741,424	830,765	751,311	628,882	597,277	-19 %
Rural Community Transit	--	162,003	208,329	215,692	239,537	48 %
Stagecoach	85,282	90,572	93,708	95,476	97,681	15 %
SSTA	--	--	--	--	--	--
Network (NVPTN)	--	--	--	--	--	--

Amtrak offers the Vermonter service between Washington, D.C. and St. Albans, Vermont as well as the Ethan Allen Express service between Albany, New York and Rutland, Vermont. These daily services stop at 11 stations in Vermont and one train runs in each direction daily on each of these routes. Table 4-6 contains a sum of passenger use at all Vermont stations.

Table 5-2. Total Vermont Amtrak Station Boardings and Alightings, FY 2004-2008 [33]

FY 04	FY05	FY06	FY07	FY08	Change 2004-08
59,860	57,121	64,647	72,822	82,216	37%

5.2. Transportation Demand Management

Transportation Demand Management or *TDM* refers to various strategies that change travel behavior (how, when and where people travel) in order to increase transport system efficiency and achieve specific planning objectives. [34]

The concept of TDM has its origins in the 1970s and 1980s, as a result of the hard economic impacts resulting from the sharp increase in crude oil prices during the 1973 oil crisis and the 1979 energy crisis. As long lines appeared at gasoline stations in the United States, the need to provide for alternatives to single occupancy commuter travel in order to save energy, improve air quality, and reduce peak period congestion, thus reducing travel costs and lost time, became self-evident. [35]

Today these goals remain the same, and they are now part of the effort to reduce greenhouse gas emissions from urban transportation. However, the range of measures "has broadened to encompass the desire to optimize transportation system performance for commute and non-commute trips and for recurring as well as non-recurring events." [35]

Way to Go! is an annual week-long program held each May which markets alternatives to the SOV to Vermont commuters and schoolchildren. It is organized by the CCMPO, VTrans, CATMA, CCTA, the Lake Champlain Committee, Local Motion, Vermont RideShare and the 10 Percent Challenge. Participation is voluntary and the results are self-reported by registrants, but not verified. There has been a steady increase in program participation between 2005 and 2009. Registrants (Table 5-3) report information regarding their regular commute as well as their intended alternative commute during the week of Way to Go!. Based on differences in trip characteristics, fuel savings is calculated and communicated to the registrant. The total gasoline gallons saved varies depending on the alternative modes participants pledge to use. Totals for the estimates are listed in the second row of Table 5-3. In addition to the fuel savings, the Chittenden County Metropolitan Planning Organization reports saving 236,813 miles, 213,000 pounds of transportation pollutants (including 206,000 pounds of carbon emissions, and $33,000 in total transportation costs. [36]

Table 5-3. Way to Go! Results, 2005-2009 [36]

	2005	2006	2007	2008	2009
Number of registrants	628	1,175	1,880	2,738	3,552
Total gasoline gallons saved	2,437	3,780	12,385	9,640	10,516

Safe Routes to School is an international movement that has taken hold in communities throughout the United States. The concept is to increase the number of children who walk or bicycle to school by funding projects that remove the barriers that currently prevent them from doing so. Those barriers include lack of infrastructure, unsafe infrastructure, and lack of programs that promote walking and bicycling through education/encouragement programs aimed at children, parents, and the community. [37]

In 1969, 15 percent of students were driven to school in a personal vehicle in the U.S. In 2008, 75 percent of students were driven to school in a personal vehicle in the U.S. [38]

Providing options for children to get safely to school is another means of reducing VMT and improving public health. In Vermont, the federal program is administered by VTrans and encourages schoolchildren to walk and bike to school on a regular basis.

Table 5-4. Schools Participating in Safe Routes to Schools Programs by Region, 2007-2008 [39]

Region	2007	2008
Bennington County Regional Commission	1	1
Chittenden County Metropolitan Planning Organization	12	12
Central Vermont Region Planning Commission	4	4
Rutland Regional Planning Commission	7	7
Two Rivers Ottauquechee Regional Commission	1	1
Windham Regional Commission	5	4
Total # of Schools Participating	30	29

Anecdotal evidence shows that, with each year, more individuals are beginning to look for alternatives to the single occupancy vehicle (SOV), but in order to really understand the changes in transportation energy use more empirical research must be done. For example, we hear stories of park and ride lots in the state reaching capacity nearly every day; however official state counts are only taken once a year in November. As shown in Table 5-5 the data that are collected in November each year support the suggestion that people are in search of alternatives as many of these lots have neared or gone above full capacity for the past 2 years. In fact, lots in the towns of Bradford, Richmond, Springfield and Weathersfield have gone well above capacity. In 2008, the Springfield lot was at 196 percent capacity. In 2008, the Richmond lot was at 143 percent capacity. Note that the Randolph park and ride was expanded by 74 spaces in 2008.

Table 5-5 Vermont Park and Ride Facilities Usage, 2006-2008 [40]

	Percent Capacity		
FACILITY	2006	2007	2008
Barre Town (East)			10%
Barre Town (South)	47%	50%	82%
Berlin	57%	78%	68%
Bradford	78%	135%	117%
Bristol	20%	30%	50%
Cambridge	32%	37%	37%
Charlotte			
Colchester	29%	44%	46%
Ferrisburgh - Vergennes		17%	25%
Georgia		92%	92%
Hartland	73%	63%	70%
Manchester	7%	10%	3%
Middlesex	50%	46%	63%
Montpelier	45%	58%	69%
Morrisville-Stowe	17%	50%	
Randolph	140%	133%	24%
Richmond	108%	103%	143%
Royalton	27%	40%	87%
Sharon	75%	83%	92%
Springfield	188%	167%	196%
St. Albans	53%	55%	77%
St. Johnsbury	60%	37%	60%
Thetford	16%	40%	48%
Waterbury	53%	65%	103%
Weathersfield	102%	120%	136%
West Danville	35%	18%	41%
Williamstown	75%	92%	71%

There are a number of organizations in Vermont communities working to reduce transportation energy consumption and emissions at the state, regional, and community level. GoVermont is a commuting and ridesharing resource administered by the Vermont Agency of Transportation for commuters who want to reduce the cost and environmental impact of driving. The program features a free carpool or vanpool matching system, and offers a "Guaranteed Ride Home" reimbursement for participants who share a ride two or more days a week and need an alternative ride home in case plans unexpectedly change. [41]

CarShare Vermont (CSVT) is a Burlington-based nonprofit organization launched in December 2008. Members have access to a network of vehicles located throughout the city and pay for use of vehicles based on how much they drive. Since launching with 8 vehicles (4 Toyota Priuses, 4 Subaru Imprezas), CSVT has added 313 members and 10 business members ranging in size from small firms to large organizations. There are 6 pods (pick-up locations, sometimes with more than one vehicle). The fleet-wide utilization rate is currently about 3 revenue hours per day. Average reservation length is 3 to 4 hours, and average mileage is 8-9 miles per reserved hour. [42]

Hinesburg Rides administers three programs to facilitate individual access and mobility to transportation, while also addressing the impacts of driving on air quality and climate change by offering alternatives to driving alone. Hinesburg residents volunteer to offer rides for fellow residents to doctors' appointments, therapy, grocery stores, and other errands through the Volunteer Driver Program. The Commuter Carpool Program matches residents to share rides to and from work, and the Local Employer Transportation Program works with local employers to coordinate various initiatives to provide better commuting options, such as vans, carpools, and buses. [43]

5.3. Eco-Driving and Idling

Eco-driving is a strategy to reduce greenhouse gas emissions, fuel consumption and crash rates by understanding and altering driving styles and maintaining vehicles.[44] Eco-drivers avoid making "jackrabbit" starts and stops, drive the speed limit, avoid idling, keep their tires properly inflated, and keep excess weight out of their vehicle, among other measures The city of Denver conducted a pilot program to increase eco-driving by city employees, as well as citizens and municipal trash truck drivers. The city ran the pilot with 400 drivers and reduced monthly CO_2 emissions by 15 percent per vehicle, while improving fuel economy by 10 percent. Eco-driving can result in up to a 33 percent improvement in gas mileage, reducing greenhouse gas emissions, air pollution, dependence on foreign oil, and the amount of money a driver spends on fuel.

Reducing idling as a way to reduce fuel consumption and greenhouse gas emissions is a strategy that can also save consumers money. One definition of vehicle idling is defined as leaving a vehicle turned on when it is not in motion for more than 10 seconds. The impacts to vehicle owner of idling include decreased fuel efficiency and increased engine wear. Fuel does not fully combust when a vehicle is idling and thus fuel residue can condense on cylinder walls, contaminate oil, and damage engine components. Depending on the vehicle, the idle fuel burn rates vary. In general, idling for one hour burns nearly one gallon of gasoline. [45] A gallon of gasoline produces nearly 20 pounds of CO_2 during combustion. Reducing idling by five minutes a day would translate to individual savings of more than $150 per year in fuel savings, and a reduction of 885 pounds of CO_2 emissions. If Vermont vehicles reduced idling by five minutes per day, the overall CO_2 emissions reduction would exceed 50,000 tons in a year.

Since 2007 Vermont presently has had a law prohibiting the idling of school buses for more than five minutes on school property, although there is currently no data on the legislation's impact.

6. Non-Highway Modes

6.1. Aviation

There are 16 airports currently operating in Vermont. Ten are state-owned, one is municipally-owned, and five are private. [46]

Commercial airlines serve Vermont at the Burlington International Airport (BTV) in Burlington and the Southern Vermont Regional Airport in Rutland. Seven commercial airlines currently operate out of BTV, and Table 6-1 indicates the number of passenger enplanements and deplanements from 2004 to 2008. Overall passenger travel (boardings and disembarkments) increased by nearly 20 percent during this time period.

Table 6-1. Passenger Enplanements and Deplanements at Burlington International Airport, 2004- 2008[47]

	2004	2005	2006	2007	2008	Percent Change 2004-2008
Enplanements	634,798	691,585	690,568	707,395	759,021	19.5 %
Deplanements	632,201	679,949	687,172	703,350	757,942	19.9 %

Nearly 18 operators also move freight through BTV. Table 6-2 indicates that the amount of freight exiting the state decreased by 16 percent, whereas total freight entering the state increased by three percent from 2006 to 2008 (this data does not include mail).

Table 6-2. Freight Enplanements and Deplanements at Burlington International Airport in Pounds, 2006- 2008 [47]

	2006	2007	2008	Percent Change, 2006 - 2008
Enplanements	8,409,521	8,717,061	7,084,389	-16 %
Deplanements	13,022,053	12,723,597	13,415,789	3 %

Despite an increase in passenger travel at BTV, overall fuel purchases decreased by almost 21 percent between 2007 and 2008, as shown in Figure 6-1.

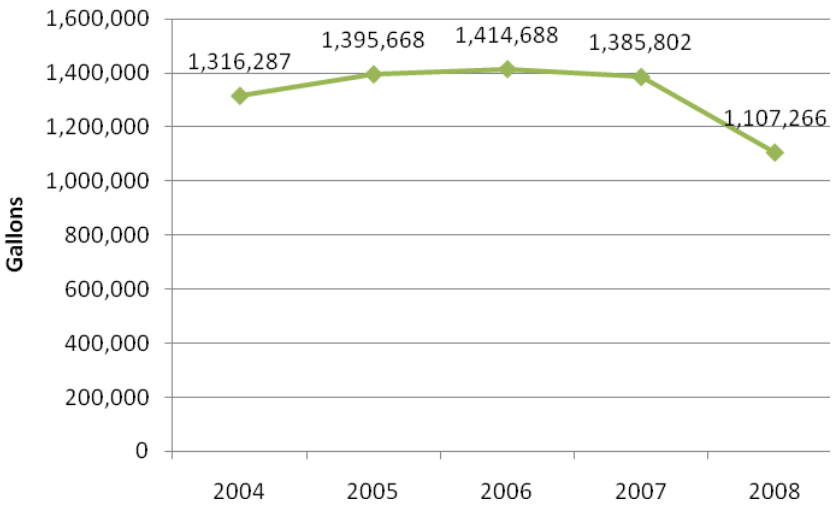


Figure 6-1. Fuel Purchased at Burlington International Airport in Gallons, 2004-2008[47]

Total jet fuel sales in Vermont are withheld by the Energy Information Administration to avoid disclosure of individual company data.[48]

6.2. Freight Rail

The Vermont Agency of Transportation does not collect or track fuel use or goods movement by rail in Vermont. Rail lines are leased to private operators, who pay a set dollar amount per ton of goods shipped on lines. Operators are not obligated to report the amount of goods moved. According to VTrans, there are nine active freight rail operators in the state, on 749 miles of railroad right-of-way. Of this, approximately 453 miles were owned by the state as of 2006.

According to the Vermont State Rail Policy Plan, freight rail traffic originating and terminating in Vermont decreased by 21 percent from 1992 to 2002; however, freight originating in Vermont increased from 430,000 tons in 1992 to 764,360 tons in 2002 (attributed to increased shipments from Omya, Inc. in Florence, Vermont). Freight rail tonnage is expected to increase between 44 and 55 percent by 2020, with an annual increase of 2.4 percent per year from 2006-2011.[49]

6.3. Ferries

Ferry services on Lake Champlain, between Vermont and New York, are operated by the Lake Champlain Transportation Company (LCT). LCT operates eight ferries at three crossing points on Lake Champlain daily for commuters and visitors. Data on ridership and fuel use are not publicly available. [50]

6.4. Bicycle/Pedestrian

As noted in Figure 2-5, walking and bicycling are the least energy-dependent modes of travel. In Vermont, there is little data available on this mode of travel. In 2005, the University of Vermont Center for Rural Studies partnered with the Vermont Department of Health to take an inventory of public resources in Vermont municipalities that support and promote public health. Table 6-3 indicates the type of resource, average miles of resource per municipality, and the percent of municipalities providing bicycle or pedestrian resources in Vermont.

Table 6-3. Bicycle and Pedestrian Resources in Vermont Municipalities, 2005 [51]

Public Resource	Average miles	Percent of municipalities providing resources
Sidewalk	4.1	41.5 %
Bicycle lanes	0.4	8.1 %
Off-road bicycle/ pedestrian paths	1.9	21.5 %
Foot paths (hiking and walking trails)	3.2	37.8 %

7. Conclusion

The transportation sector received a great deal of attention in the United States, and in Vermont, in 2008. In Vermont, transportation fuel prices peaked in July 2008 at $4.09/gallon for regular unleaded gasoline and $4.98/gallon of diesel fuel. Fuel sales and vehicle miles traveled dipped over the course of the year, and the current economic recession was worsening. While the recession continues to be an ongoing challenge for the U.S., as well as Vermont, the first half of 2009 shows some return to historical transportation trends. However, the fallout from gas prices and sales in 2008 continues to be of interest as we consider how the reaction to these changes affected individual transportation behavior.

Transportation represents the largest source of Vermont's greenhouse gas emissions (57 percent) and is the largest user of energy by sector (33 percent). Understanding Vermont's transportation energy use is critical to tackling the challenges presented by global climate change, dependence on foreign oil, future energy demands, public health and the implications for accessibility and mobility.

Increases in public expenditures on transportation seem to follow the same trend line as energy costs. Annual spending for the purchase of petroleum in Vermont is up 30 percent from 2004 to 2008. In this same five-year period, Vermont witnessed a nearly 30 percent increase in total pupil transportation spending, a 46 percent increase in reported municipal expenditures on transportation and a 28 percent increase in expenditures by the Vermont Agency of Transportation. Total surface transportation spending in Vermont by public sector entities in 2008 was over $500 million.

As this year's report shows, Vermonters and Americans responded to increased transportation energy costs by reducing vehicles miles traveled (VMT). Vermont saw a 2 percent decrease in miles traveled by school buses between 2004 and 2008, and decreasing gasoline purchases to pre-2002 levels. While VMT has dropped both in Vermont and nationally, it is not clear whether this means people are making fewer trips, or whether they are meeting their mobility needs through other means such as walking, biking, public transit and/or car pooling. Vermonters find themselves quite dependent on the automobile, with limited options to the single occupancy vehicle—only 41.5 percent of municipalities in Vermont report providing sidewalks (on average 4.1 miles of length), 8.1 percent report providing bicycle lanes (average length of .4 miles) and 21.5 percent report off-road bicycle/pedestrian paths (average length of 1.9 miles). In 2008, the number of vehicles per capita in Vermont was less than one per person, the lowest since the Vermont Clean Cities Coalition began keeping track in 2004.

The Vermont vehicle fleet composition continues to grow more fuel efficient, with a 202 percent increase (from 2005 to 2008) in hybrid vehicles registered in the state of Vermont (although they remain a small portion of the total fleet). New vehicle purchases of full-size pick-up and sport utility vehicles each saw a 34 percent decrease from 2004 to 2008.

As the price of transportation and home heating fuels increases, Clean Cities' goal of reducing our society's reliance on fossil fuels becomes more pertinent. Clean Cities Coalitions promote diversity in the transportation system including the use of alternative fuels, modes, and programs—such as anti-idling campaigns—that cut down on petroleum use. It has become apparent in Vermont, and

around the nation, that fuel prices are having a tremendous impact on individuals and governments' abilities to make ends meet. Although limited, there has been increasing evidence that travel behavior is changing—increased transit ridership and a shift in the type of vehicles purchased being two examples. Now, more than ever, it is evident that relying on one source of energy to move ourselves and our goods is no longer feasible—Clean Cities Coalitions exist to drive that point home, but, more importantly, to help move the transportation sector into a future far less dependent on fossil fuels.

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