Sustainable Campus Transportation Toolkit

A Toolkit for Best Practices in Sustainable Transportation on Vermont College and University Campuses

Vermont Clean Cities Coalition

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www.sierraclub.org
readme.readmedia.com
www.vtc.edu
www.uvm.edu/vtccc

ABOUT VERMONT CLEAN CITIES

The mission of the U.S. Department of Energy's Clean Cities program is to advance the economic, environmental, and energy security of the U.S. by supporting local decisions to adopt practices that contribute to reduced petroleum consumption in the transportation sector. The Vermont Clean Cities Coalition (VTCCC) brings together stakeholders in the public and private sectors to deploy alternative and renewable fuels, idle-reduction measures, fuel-economy improvements, and emerging transportation technologies. You can visit our website at www.uvm.edu/vtccc.

TOOLKIT OVERVIEW

This toolkit provides Vermont colleges, universities, and institutions with a set of strategies, case studies, and supporting information that may be utilized to improve the sustainability of campus transportation systems. It highlights alternative and renewable vehicle fuels by offering overviews and case studies for each type of fuel. It also describes methods of transportation demand management and fuel-economy improvements, as well as idle-reduction efforts. The information provided in this toolkit will give Vermont colleges a simple yet comprehensive foundation on which to address sustainable transportation practices on and around their campuses.

ACKNOWLEDGEMENTS

Funding for this report was provided by the Vermont Clean Cities Coalition. We greatly acknowledge help from members of the Chittenden County Transportation Management Association (CATMA) and appreciate the information colleges throughout Vermont have shared with us to make this toolkit a success. This guide would not have been possible without the work of our talented VTCCC interns, Kensey Hanson '16 and Alexandra Evarts '13.

Contents

Introduction

Transportation is a major component of social, economic, and environmental consciousness on college campuses. Given the overwhelming threat of climate change and the high cost of fossil fuels, Vermont colleges and universities must begin making changes in order to encourage alternative forms of transportation to, from, and on campus. This toolkit is designed to provide ideas, strategies, policy tools, and case studies highlighting sustainable transportation initiatives on Vermont college campuses that can guide academic institutions away from a transportation system dominated by single-occupancy vehicles (SOVs).

Image from: sustainability.berkeley.edu

College and university campuses are ideal places for transportation management because, while they vary in size, they provide a predetermined space, community, and fleet on which to focus transportation improvement efforts. Academic campuses are also optimal locations for researching and providing educational resources to encourage the use of alternative fuels and transportation. These institutions have great potential to influence the transportation habits of a large community including students, faculty, and staff by encouraging more sustainable practices on and around campus.

Transportation behaviors seen on campuses will likely diffuse into greater parts of society as graduating students carry habits and knowledge with them, which they apply to both their personal and professional daily lives.

As concern for climate change increases, it is vital for college and university campuses to take responsibility for the carbon footprint of their transportation systems. Increasingly, prospective students look at the level of environmental consciousness on a campus to influence their decision to attend a particular college or university. In this way, higher education instituions can take on a special leadership role by providing more sustainable transportation options.

Implementing, encouraging, and actively incentivizing sustainable transportation on campuses are high-visibility and high-impact efforts that create an effective strategy for attracting prospective students, as well as offering highly accessible education on and involvement in environmental issues.

Improving the sustainability of campus transportation systems has the added benefit of making campuses safer for cyclists and pedestrians. Not only does reduced fuel consumption improve air quality, utilizing active transportation gets vehicles off the roads and provides a safer environment to walk and bike around. It also reduces traffic and parking congestion, which improves ease of movement around campus. By applying practices outlined in this toolkit, students and employees will be encouraged to adjust their transportation habits and move away from utilizing SOVs on campus.

The following toolkit is a guide intended to be utilized in initiating the process of improving sustainable practices in campus transportation. We hope this toolkit offers your campus an accessible and constructive outline to establish more efficient transportation systems and practices. The resources offered in this toolkit are meant to encourage your higher education insitution to write its own sustainable transportation action plan and utilize it in order to improve the accessibility, efficiency, and reliability of the campus's transportation system. However large or small the action that is taken, it is important that colleges and universities start to address transportation as a significant component of their sustainability agendas.

Alternative and Renewable Vehicle Fuels

OVERVIEW

A good place to start addressing the campus transportation system is with the campus fleet. Conduct a vehicle inventory of your fleet, including the number and types of alternative fuel vehicles (AFVs) in the campus fleet. Once this inventory is complete, determine the most effective and plausible ways to begin or continue incorporating alternative fuels into the fleet. For instance, will it be more cost-effective to replace a conventional passenger vehicle with an electric vehicle, or to convert a diesel-fueled maintenance truck to biodiesel? Additionally, determine the alternative fuels available near your location. Is there sufficient fueling infrastructure within your area to make an alternative fuel vehicle purchase economical? Consider the trips that will be made with this vehicle and determine whether or not fueling infrastructure exists on these routes. You can use the Department of Energy (DOE) Alternative Fuels Data Center's (AFDC) Alternative Fueling Station Locator to do this, found at www.afdc.energy.gov/locator/stations.

In this section of the toolkit you will find information and resources about various alternative fuels and AFVs. Beyond this, there are a number of resources such as the AFDC and VTCCC to further guide you in your AFV investments.

Table 1: The number and types of AFVs in Vermont college fleets
Note: GEM = Global Electric Motorcar (see image)

VT ACADEMIC INSTITUTIONS	AFVs IN CAMPUS FLEET
Castleton State College	5 hybrid electric cars 4 GEMs
College of St. Joseph	1 GEM
Green Mountain College	1 GEM
Johnson State College	1 biodiesel (B5) bus
Landmark College	5 GEMs
Lyndon State College	3 GEMs
Middlebury College	1 biodiesel (B20) bus
University of Vermont	9 CNG buses 1 hybrid electric bus 19 GEMs
Vermont College of Fine Arts	1 GEM

Image from: www.jsc.edu

Image from: www.polaris.com

PROMOTING ALTERNATIVE FUEL VEHICLES ON CAMPUS

- Reserve convenient parking spaces for AFVs and post visible and recognizable signage at these parking spaces.
- If electric vehicle charging stations are available, offer the electricity free of charge.
- Host events to market newly purchased AFVs and attend the VTCCC Odyssey Day.
- Publicize new AFV purchases on the school website, including information about emission reductions and cost savings.

BIODIESEL

OVERVIEW

Biodiesel can be used in almost any vehicle that runs on diesel fuel. It is a renewable fuel that is predominantly domestically produced. It can be made from a variety of organic materials including algae, oilseeds such as soybeans, new and used vegetable oils, and animal fats. Biodiesel can be used in its pure form or in a blend with petroleum diesel. These blends are named for the percentage of biodiesel in the fuel. For example, a blend with 10% biodiesel is called B10. While biodiesel may have similar characteristics to petroleum diesel, it burns cleaner and is biodegradable and non-toxic, making it overall safer for environmental and human health.

JOHNSON STATE COLLEGE: THE BADGER BULLET

At Johnson State College, during the fall and spring semesters, students have access to Burlington on the Badger Bullet, a biodiesel-powered bus (pictured on the righthand side of the previous page). The college teamed up with Smugglers' Notch and The Buzz radio station to purchase this 14-seat bus equipped with a Chevy turbo-max diesel engine that runs on B5 biodiesel.

COST CONSIDERATIONS

Since biodiesel does not require major engine modifications, the cost of switching to biodiesel is relatively low. Many fleet managers have determined that biodiesel is their least-cost strategy to comply with federal and state regulations in comparison to other alternative fuels. Additionally, many local producers of biodiesel either match or beat existing diesel prices. See page 9 for biodiesel-use incentives.

BIODIESEL IN COLD WEATHER

The colder climate of Vermont has been noted to be a barrier to the use of biodiesel. However, biodiesel can be used in cold weather, despite its tendency to gel up at low temperatures. The smaller the percentage of biodiesel in the blend being used, the better it performs in cold temperatures. The B5 biodiesel blend used in the Johnson State College Badger Bullet Bus is a small enough percentage to function effectively in Vermont's cold climate. Some other suggestions for biodiesel use in cold weather include:

- Using high quality biodiesel fuel
- Blending with kerosene
- Blending with diesel that has been treated with cold weather additives
- Using block and filter heaters to warm engine and fuel
- Storing your vehicles indoors
- Using additives designed for use with biodiesel

BIODIESEL FUELING STATIONS IN VERMONT

There are currently two public fueling stations in Vermont and four that provide biodiesel wholesale (B20 and above):

Public Fueling

- Bourne's Energy: Morristown
- Black Bear Biodiesel: Plainfield

Wholesale

- Cota & Cota: Bellows Falls; Brattleboro; Jamaica; Ludlow; Springfield; Upper Valley
- D&C Transportation: Orleans
- Fred's Plumbing & Heating: Derby; Lyndonville; Morrisville
- Champlain Oil Company: South Burlington; Perkinsville

NATURAL GAS

OVERVIEW

Natural gas offers many environmental and energy security benefits. It produces significantly lower amounts of greenhouse gas emissions than gasoline and diesel. There are two forms in which natural gas is used as a vehicle fuel: compressed natural gas (CNG) and liquefied natural gas (LNG).

COST CONSIDERATIONS

In most places where CNG is sold as an engine fuel, it costs less than gasoline. Natural gas vehicles initially cost more than gasoline- or diesel-fueled vehicles, but the low cost of the fuel itself is less than conventional fuels on a per-gallon basis. See page 9 for incentives for using natural gas.

3 TYPES OF NATURAL GAS VEHICLES

1. **Dedicated:** Vehicle runs solely on natural gas.
2. **Bi-Fuel:** Vehicle can operate on natural gas as well as either conventional gasoline or diesel.
3. **Dual-Fuel:** Vehicle combines natural gas as the main fuel with diesel fuel for ignition.

NATURAL GAS FUELING STATIONS IN VERMONT

There is currently one public fueling station in Vermont that provides CNG:

City of Burlington
645 Pine St.
Burlington, VT 05401

UNIVERSITY OF VERMONT: COMPRESSED NATURAL GAS BUSES

UVM currently operates nine CNG buses. One of the most difficult challenges with the use of natural gas vehicles in Vermont is the lack of fueling stations within the state. Fortunately for UVM and Chittenden County, the Burlington Department of Public Works allows the UVM buses and other public and private fleets to refill at their fast-fill CNG station in downtown Burlington. Until more fueling stations are developed within the state, using natural gas as a transportation fuel may be limited.

Image from: www.uvm.edu

ELECTRICITY

OVERVIEW

Vehicles that have the capability to be fueled by electricity are referred to as electric-drive vehicles (EVs). These vehicles use electricity from a battery, either as their primary power source or as a supplementary source to improve fuel efficiency. These batteries can be recharged by being plugged into the electric grid or by electricity-generating features in the car such as regenerative braking.

COST CONSIDERATIONS

EVs range in price according to their type. Currently, the suggested retail prices of EVs range from about $20,000 to $85,000. While fuel costs are low for EVs [about $1 per gallon gas equivalent (GGE)], the purchasing cost for the vehicles is generally higher than conventional vehicles. However, there are federal tax credits available to mediate the cost of purchasing an EV (see page 9).

EV CHARGING STATIONS IN VERMONT

There are currently 113 public electric vehicle charging stations (EVSE) within the state of Vermont. This number is constantly increasing, so it is important to check the AFDC Alternative Fueling Station Locator for the most up-to-date map. Eight colleges throughout Vermont offer EV charging to their college communities. Drive Electric Vermont's map to the right displays the locations of public EV charging stations in Vermont.

3 TYPES OF ELECTRIC VEHICLES

The AFDC's definitions for the three types of electric vehicles are as follows:

1. **Hybrid Electric (HEV):** HEVs are primarily powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The battery is charged through regenerative braking and by the internal combustion engine and is not plugged in to charge.

2. **Plug-In Hybrid Electric (PHEV):** PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged into an electric power source to charge the battery as well.

3. **Electric (EV):** EVs use a battery to store the electric energy that powers the motor. EV batteries are charged by plugging the vehicle into an electric power source. GEMs, as seen in the image on page 2, are passenger or utility neighborhood EVs, somewhat like a golf cart.

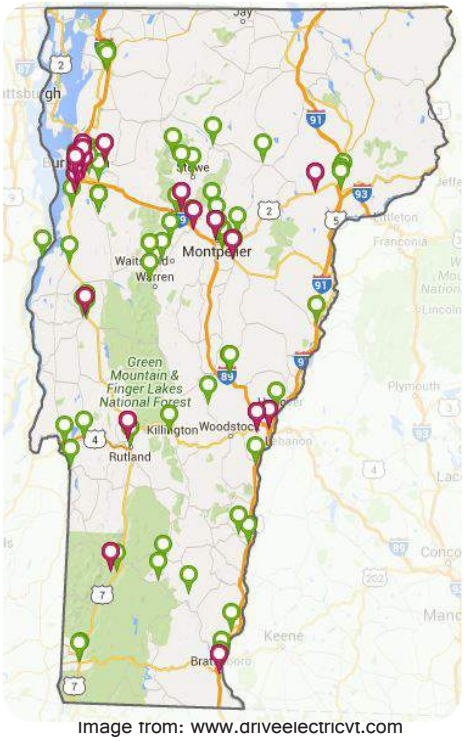


Image from: www.driveelectricvt.com

ELECTRICITY (CONT.)

LANDMARK COLLEGE: THE FIRST ELECTRIC VEHICLE CHARGING STATION

In August 2015, the new Nicole Goodner MacFarlane Science, Technology & Innovation Center was completed at Landmark College. As part of the project, the college installed an EV charging station on the outside of the building that is accessible to the college campus community.

http://www.landmark.edu/

CASTLETON STATE COLLEGE: SOLAR ELECTRIC VEHICLE CHARGING STATION

Image from: www.castleton.edu

In May of 2014, Castleton State College introduced the installation of a new solar array and EVSE. The array is composed of 36 280-watt ground-mounted solar panels connected to a level two dual-port EVSE. This energy efficiency project was made possible by a grant from Green Mountain Power and support from the Castleton Class of 2014 and Student Government Association. It was part of the college's Green Campus Initiative, which focuses on implementing solutions to reduce the college's carbon footprint.

UNIVERSITY OF VERMONT: HYBRID ELECTRIC BUS

In addition to UVM's nine natural gas buses, the school has had a hybrid electric bus since 2012. The bus uses regenerative breaking to recharge the battery of the hybrid electric system. The bus is modeled like all other buses on campus, except for the large lightning strike painted on the side, which represents its electric power source.

Image from: www.uvm.edu

PROPANE

OVERVIEW

Propane is the third most used fuel globally after gasoline and diesel. Currently, about 190,000 vehicles are powered by propane in the United States. Propane, also known as liquefied petroleum gas (LPG) or auto gas (when used in vehicles) is a byproduct of natural gas processing and crude oil refining. Propane vehicles operate similarly to petroleum vehicles in regards to their power and speed capabilities but, unlike petroleum, propane is odorless, colorless, and non-toxic. In fact, propane has 40% lower carbon monoxide emissions than gasoline, which is 64% better than Environmental Protection Agency (EPA) standards. More information can be found through the Propane Education and Research Council: www.propanecouncil.org.

COST CONSIDERATIONS

The cost of a gallon of propane varies, but it generally costs less than a gallon of gasoline. The price of propane is adjusted seasonally due to the fact that propane is used as a heating fuel in the U.S., therefore the price will likely increase in the winter.

The fuel economy of propane vehicles is slightly lower than petroleum vehicles, but the maintenance costs of a propane vehicle are much lower because it burns so cleanly. While propane vehicles can be more expensive than comparable petroleum vehicles, there are federal tax credits available to offset their extra costs (see page 9). When compared with diesel, propane vehicles are a better investment. While diesel vehicles have escalated costs and complicated emissions, propane vehicles have low upfront fuel and refueling infrastructure costs, experience less downtime caused by weather and servicing, and have a lower cost of ownership.

Image from: www2.cortland.edu

The incremental costs for propane buses tend to be less than CNG buses. It is cheaper to convert light-duty gasoline powered vehicles to run on propane rather than purchasing vehicles that are bi-fuel or dedicated for propane use only.

OFF-ROAD APPLICATIONS

Applying propane in off-road vehicles on college campuses is a great investment due to cost and health considerations. Utilizing propane in lawn mowers rather than gasoline or diesel can reduce greenhouse gas emissions by 15% and carbon monoxide emissions by 40%. Additionally, diesel fuel emits dangerous amounts of particulate matter while propane effectively reduces this threat to human health. John Deere offers a variety of propane lawn mower models that can be utilized on your campus: www.deere.com/en_US/industry/commercial/our_offerings/fuel_solutions/fuel_solutions.page.

PROPANE FUELING STATIONS IN VERMONT

There is currently one public propane fueling station in Vermont that provides propane as a vehicle fuel:

U-Haul
460 Riverside Ave.
Burlington, VT 05401

ALTERNATIVE FUEL PRICE DATA & INCENTIVES

NATIONAL AVERAGE PRICE JULY 2015

Pricing is a significant factor when it comes to deciding what type of fuels to use to power your vehicles. As gasoline and diesel prices rise, alternative fuels appeal more to fleet managers and consumers with personal vehicles. Of course, fuels are constantly fluctuating in price based on location, time of year, and political and economic status. Over the long term, alternative fuel prices are much more stable than petroleum-based fuels. Environmental benefits and costs must be considered when making an informed decision about which type of fuel would be best to use in your fleet or vehicle.

Table 2: National average price of vehicle fuels in July 2015
Note: GGE = Gasoline Gallon Equivalent

FUEL	PRICE
Biodiesel (B20)	$2.93/gallon
Biodiesel (B99-B100)	$3.55/gallon
Electricity	$0.12/kWh
Ethanol (E85)	$2.36/gallon
Natural Gas (CNG)	$2.12/GGE
Propane	$2.90/gallon
Gasoline	$2.82/gallon
Diesel	$2.93/gallon

Figure 1: Clean Cities Alternative Fuel Price Reports, July 2015

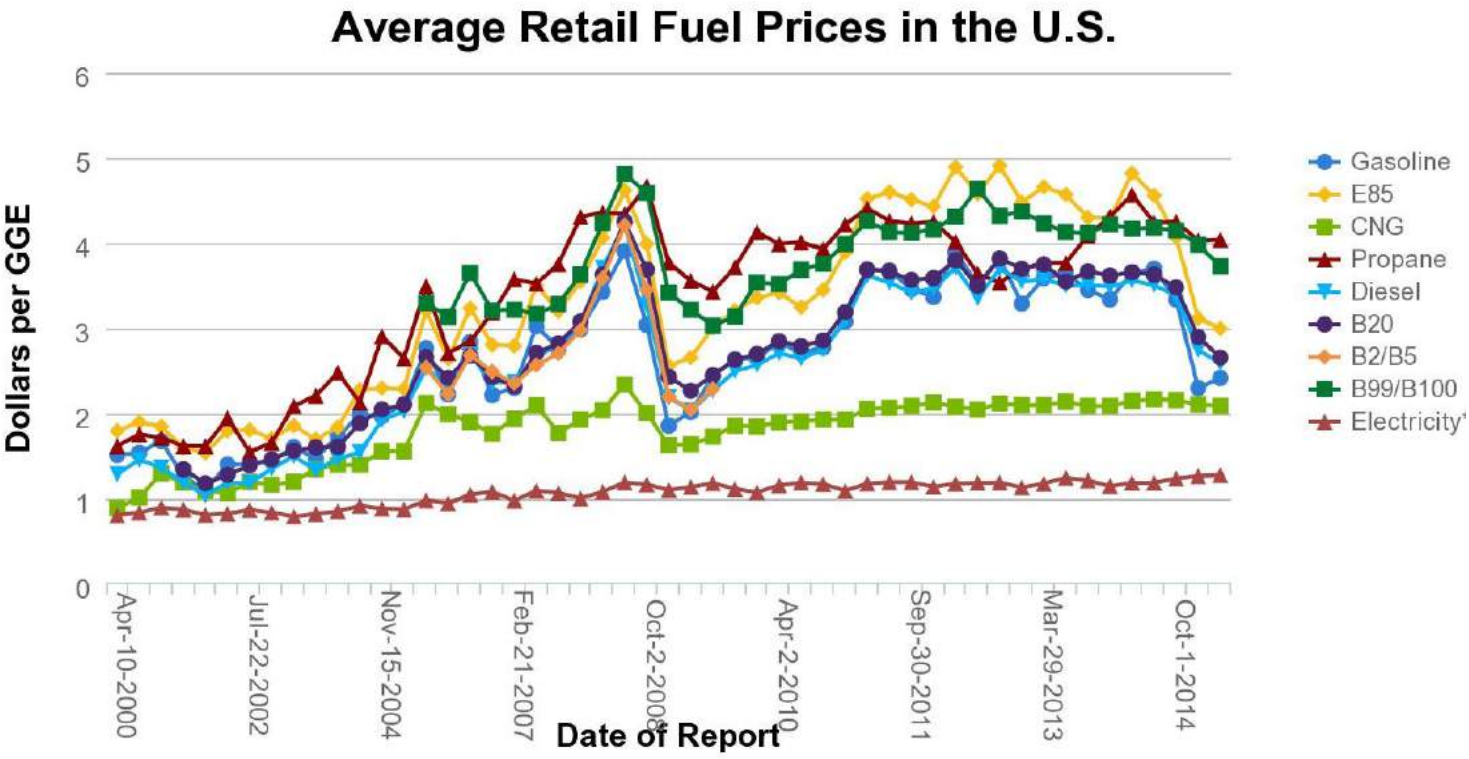


Table 3 on the following page shows a list of incentives for the alternative fuels listed in this toolkit that are applicable to the use and research of alternative fuels on university and college campuses. Below the title of the incentive on the lefthand side of the table is a list of alternative fuels to which the incentive can be applied. The AFDC has a comprehensive list of federal and state laws and incentives found here: www.afdc.energy.gov/laws.

Table 3: Federal incentives for the use of alternative fuels

FEDERAL INCENTIVES

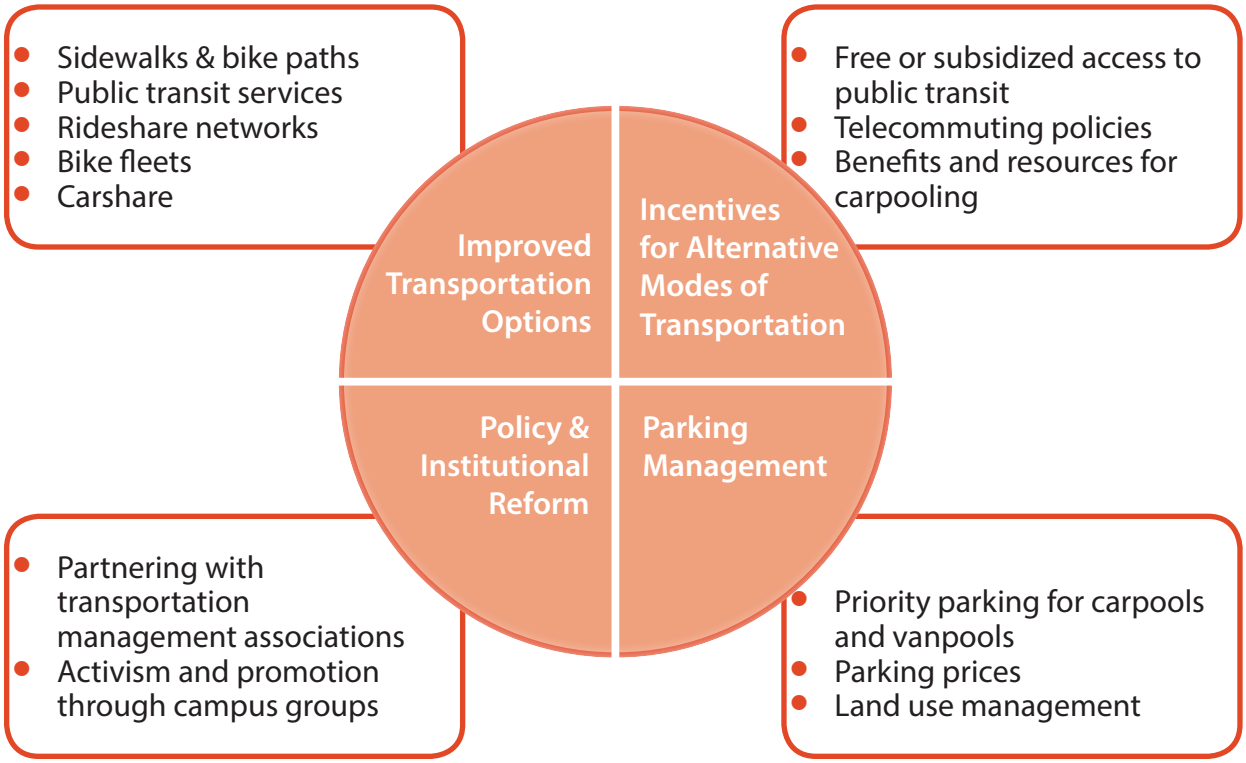
INCENTIVE	DETAILS
Alternative Fuel Tax Exemption Propane Natural Gas	Alternative fuels used in a manner that the Internal Revenue Service (IRS) deems as nontaxable are exempt from federal fuel taxes. Common nontaxable uses in a motor vehicle are: on a farm for farming purposes; in certain intercity and local buses; in a school bus; exclusive use by a nonprofit educational organization; and exclusive use by a state, political subdivision of a state, or the District of Columbia. This exemption is not available to tax-exempt entities that are not liable for excise taxes on transportation fuel.
Qualified Plug-In Electric Drive Motor Vehicle Tax Credit Electricity	A tax credit is available for the purchase of a new qualified plug-in electric drive motor vehicle that draws propulsion using a traction battery that has at least five kilowatt hours (kWh) of capacity, uses an external source of energy to recharge the battery, has a gross vehicle weight rating of up to 14,000 pounds, and meets specified emission standards. The minimum credit amount is $2,500, and the credit may be up to $7,500, based on each vehicle's traction battery capacity and the gross vehicle weight rating. The credit will begin to be phased out for each manufacturer in the second quarter following the calendar quarter in which a minimum of 200,000 qualified plug-in electric drive vehicles have been sold by that manufacturer for use in the United States.
Improved Energy Technology Loans Propane Biodiesel Electricity Natural Gas	The U.S. Department of Energy (DOE) provides loan guarantees through the Loan Guarantee Program to eligible projects that reduce air pollution and greenhouse gases, and support early commercial use of advanced technologies, including biofuels and alternative fuel vehicles. The program is not intended for research and development projects. DOE may issue loan guarantees for up to 100% of the amount of the loan for an eligible project. For loan guarantees of over 80%, the loan must be issued and funded by the Treasury Department's Federal Financing Bank.
Biodiesel Education Grants Biodiesel	Competitive grants are available through the Biodiesel Fuel Education Program (Section 9006) to educate governmental and private entities that operate vehicle fleets, the public, and other interested entities about the benefits of biodiesel use. Eligible applicants are nonprofit organizations or institutes of higher education that have demonstrated knowledge of biodiesel fuel production, use, or distribution; and have demonstrated the ability to conduct educational and technical support programs. This program is funded through fiscal year 2018 (verified February 2014), but is subject to congressional appropriations thereafter.
Low- and Zero-Emission Vehicle Research, Demonstration, and Deployment Funding Propane Biodiesel Electricity Natural Gas	Financial assistance is available to local, state, and federal government entities; public transportation providers; private and non-profit organizations; and higher education institutions for research, demonstration, and deployment projects involving low- or zero-emission public transportation vehicles. Funding may cover up to 80% of project costs, with a required 20% non-federal cost share requirement. Eligible vehicles must be designated for public transportation use and significantly reduce energy consumption or harmful emissions compared to a comparable standard vehicle.

Transportation Demand Management

OVERVIEW

Transportation demand management (TDM) is the practice of strategies used to reduce the need for travel, especially in SOVs. TDM addresses a variety of solutions, including walking, biking, ridesharing, utilizing public transit, and teleworking. TDM specifically offers solutions for commuting, whether it be to work, class, a meeting, or an event. These strategies reduce greenhouse gas emissions, and can also improve safety as well as save time and money. Some great resources for commuters and employers in Vermont include the Chittenden Area Transportation Management Association (CATMA) in Chittenden County found at catmavt.org, Vital Communities in the Upper Valley found at vitalcommunities.org, and Go! Vermont across the state found at www.connectingcommuters.org.

Figure 2: TDM overview with sectors of implementation



This figure shows the amount of space a group of 69 people take up when using SOVs, a public transit bus, bikes, or simply standing as walking commuters.

www.citymetric.com

WALKING

OVERVIEW

Walking is a prevalent mode of transportation around college campuses. In terms of transportation demand management, walking is a great option when your destination is fairly closeby. Walking commuters are generally willing to walk anywhere from a quarter to one mile, or five to 15 minutes. Most college campuses are not more than one mile in diameter. Many times, people will drive somewhere he or she easily could have walked to. It is important to survey your college community to discover the reasons people choose to drive instead of walk and develop incentives to help mitigate this practice, such as monthly prizes or some other form of acknowledgement for those who make the effort to walk.

> "Restore human legs as a means of travel. Pedestrians rely on food for fuel and need no special parking facilities."
>
> -LEWIS MUMFORD *American Historian*

EVALUATION OF INFRASTRUCTURE

In order for walking to be a successful and efficient way of getting to, from, and around your campus, effective infrastructure must be in place. This includes sidewalks, crosswalks, ramps, staircases, bridges, and lighting where needed. Not only does this infrastructure make it easier to travel as a pedestrian, it also makes it safer. Additionally, it is important to consider any infrastructure that will make your campus easily and safely accessible by handicapped individuals. Another important piece of safety infrastructure is the Blue Light system, which pedestrians can utilize when they are feeling threatened or unsafe. A red button is simply pushed and the police should appear at the location within a matter of seconds. You can do an evaluation of your campus's pedestrian network in order to gather information on the accessibility of your campus by foot. A couple of good tools include the Walkability Audit Tool by the Center for Disease Control found at www.rollins.edu/greenspaces/orlmetro-aug16/CDC%20Walkability%20Audit%20Tool.pdf and the How Walkable is your Neighborhood? tool by Health by Design found at www.healthbydesignonline.org/documents/WalkabilitySurvey_HbD.pdf. Use these tools to evaluate the walkability of your campus and brainstorm ideas to improve its pedestrian network.

BIKING

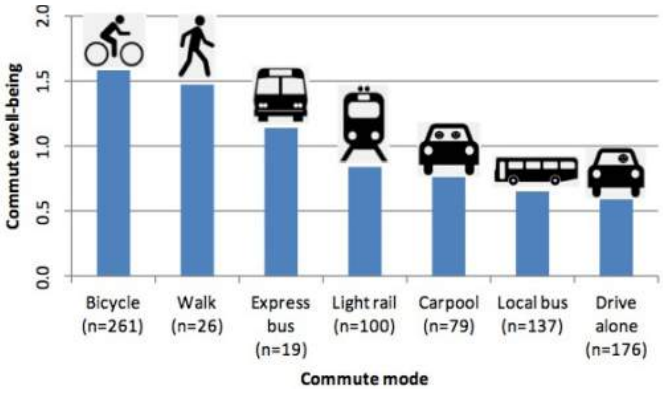
OVERVIEW

Biking as a form of commuter transportation has an amazing amount of benefits. A bike requires no fuel other than your own energy, so it costs nothing to use a bike other than for occasional maintenance. Electric-assist bikes do exist as an incentive to encourage commuters to bike, especially in hilly areas. A number of resources exist for this in Vermont, including Go! Vermont's bike program, which you can find at www.connectingcommuters.org/biking. A bike commuter gets daily exercise and does not add to greenhouse gas emissions and air pollution. Biking can even be faster than driving a motor vehicle because you are able to avoid slow traffic during rush hour. Finally, bike commuters have been proven to be the happiest out of all modes of commuter transportation. A survey taken at Portland State University in 2012 showed that commuters who got to work or class using their own power (i.e., walking or biking) had the highest commuter well-being, and among the two, bikers were the happiest (see **Figure 3** on the following page).

BIKING (CONT.)

A wonderful resource for bike commuters as well as other active-transportation enthusiasts is Local Motion, a non-profit organization advocating and making efforts towards improving the safety and accessibility of Vermont for active transportation. You can find more information at www.localmotion.org.

Figure 3: Variation in commuter well-being by mode, from bikeportland.org



BIKE REPAIR

Some students rely on their bikes to get around their college campus, and bike repairs can be somewhat expensive for a college student's budget. Many colleges offer free or discounted bike repairs on campus in order to make bike maintenance accessible and affordable. This practical service encourages more people to use their bikes rather than their cars. Many times these bike shops are run by students, which offers both an educational and work-study opportunity. Some colleges have outdoor repair stations placed around their campus that students can access for free for simple maintenance tasks, such as tire inflation (shown above).

Image from: urbanvelo.org

BIKESHARE

A bikeshare is a fleet of bikes that is made available for a certain community to use. Bike fleets can work very well on a college campus for students who do not have a bike of their own. They are generally offered for free or at a low cost, are equipped with safety features such as a helmet and a light, and can be taken out for a few hours to a few months at a time. This is an excellent way to offer low-cost and low-maintenance individual transportation for students. Some questions to consider when determining which bikeshare model would fit your campus best include:

- Who will be using the bikes? (Students, employees, or both?)
- What is an adequate number of bikes for your campus bikeshare system?
- What type of parking or storage will be needed and where will it be located on campus?
- Who will conduct fleet maintenance and program administration?
- Where will funding for the program come from?

CHAMPLAIN COLLEGE: CHAMPRIDES BIKESHARE

In May 2015, Champlain College established their ChampRides bikeshare program made up of nine bikes. Students and employees can use these bikes for free with their Champlain College cards for up to four hours at a time and only need to complete an online waiver beforehand. The fleet is a mixture of mountain bikes, cruiser bikes, and city bikes in a variety of sizes. Each bike is equipped with a key, a lock, and a helmet for the rider. Along with this project, Champlain College drafted an Active Transportation Plan in the spring of 2015 to address walking, biking, skateboarding, and wheelchair transportation on campus.

BIKING (CONT.)

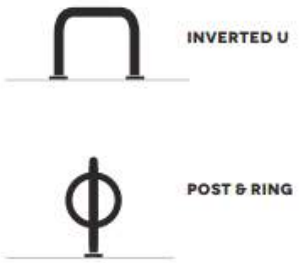
BIKE PARKING & STORAGE

Bike parking and storage are critical parts of making bicycle transportation on campus successful. After all, students, employees, and visitors need a safe place to store their bikes while they are busy on campus. These storage options can be short-term, long-term, designed for bikeshare programs, or designed for individuals' personal bikes. A few key elements are vital to consider when installing bike storage, such as location and security, but bike parking and storage options can be fairly simple.

The Association of Pedestrian and Bicycle Professionals recently revised their guide in 2015 titled "Essentials of Bike Parking: Selecting and installing bicycle parking that works": c.ymcdn.com/sites/www.apbp.org/resource/resmgr/Bicycle_Parking/EssentialsofBikeParking_FINA.pdf. This guide provides a clear outline of bike parking and storage options that can help your school determine which type would best fit its needs.

SHORT-TERM PARKING

The main factors that must be considered for short-term bike parking are location, ease of use, quantity, and security. Short-term parking is generally used for personal bicycles or community members using bikes from the bikeshare program on your campus. The aspect of location includes a collection of considerations: proximity to the destination, visibilty, and accessibility. A typical benchmark for short-term parking is 50 feet or less from the destination. Establishing weather-protected parking, such as a simple overhead roof, can encourage daily use. Additionally, lighting is necessary to establish a safe and visible parking location. Racks must be sturdy, well-anchored, and visible to the public to deter bicycle theft. Certain rack designs, such as wave and ladder racks, are ineffective and should be avoided. Finally, the quanitity of bike racks should reflect their usage by the number of people utilizing the destination. Bike corrals, or collections of bike racks, are useful for locations being utilized by many people. A corral can fit 8 to 12 bikes in the same amount of space only one car can be parked.



LONG-TERM PARKING

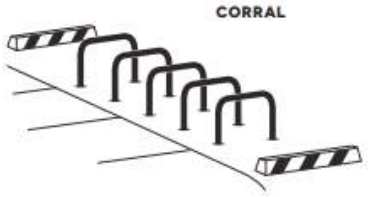


Image from: www.apbp.org

The main factors that should be considered for long-term bike parking are shelter, security, location, and quanitity. Long-term parking on college campuses is generally utilized by students parking their personal bikes near or in their residence halls or for the storage of bikeshare fleets. These storage facilities may be used during academic breaks or during the winter months. Because these facilities are less visible than outdoor bike corrals, appropriate signage help people locate long-term parking and ulitmately encourage more people to use their bikes. Security and weather protection are vital to the success of long-term bicycle storage in order to avoid theft or damage by people or weather events. These facilities are generally a single room for multiple bikes, which students and campus employees can access with a specific key, access card, or key code. Because multiple bikes may be stored in one room, it is necessary to create a design that offers easy access to all parts of the room as well as the option of locking each bike to its own rack to ensure security. Bike corrals or vertical wall racks do a nice job of fulfilling both of these necessities.

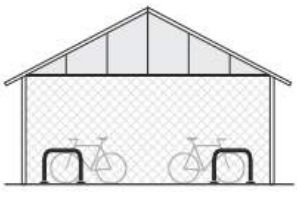


Image from: www.apbp.org

RIDESHARING

OVERVIEW

Ridesharing refers to either car or vanpooling. The people involved in a rideshare generally live and work or go to class in the same area, or pass a Park and Ride location on their way to their destination. Visit this link to see what Park and Ride locations are along your commute: parkandrides.vermont.gov. The benefits of utilizing ridesharing include using less gasoline, saving money, reducing traffic congestion, and improving air quality. Additionally, it gives you the opportunity to have great conversations with your colleagues! Some campuses have incentives such as priority parking for those who carpool or for carshare cars, which encourage people to take advantage of these opportunities.

CARPOOLING

Carpooling is a simple solution to save money on commuting, reduce wear on your vehicle, and reduce overall emissions. Depending on the number of people involved in the carpool, the cost of gasoline will be reduced for each person. When alternating each driver's car, no single car will have to make the daily drive. Carpooling can be effective even without your own vehicle to share. Go! Vermont and Zimride by Enterprise offer several ways to set up a carpool, calculate your savings when you carpool, and offer a guaranteed ride home in case of any last-minute changes to your transportation plan. You can find these resources on each of their websites: www.connectingcommuters.org/carpool and zimride.com.

VANPOOLING

You can set up a vanpool with your colleagues if there are more than five people involved in the commute. Go! Vermont offers vans for a low monthly cost per rider, which covers everything: gas, insurance, and repairs. Each rider typically saves 60% of their commute costs when compared with an SOV. You can set this up at Go! Vermont's website: www.connectingcommuters.org/vanpool.

CARSHARE

A carshare program consists of a fleet of vehicles that can be rented for a short period of time, often by the hour. Carshare programs are useful on college campuses, especially those in rural areas, as they offer students and employees without cars the option of using a vehicle when necessary. These programs take cars off the road, which mitigates traffic congestion and lessens air pollution through tailpipe emissions. There are a number of companies that offer carshare programs. On Vermont college campuses, the most prevalent are CarShare Vermont (www.carsharevt.org) and Zipcar (www.zipcar.com).

Some tips for implementation of a carshare program on your campus include:

- Marketing the idea through events and outreach
- Providing administrative support and finding a campus group to lead the effort
- Reserving parking spaces for carshare vehicles
- Offering free or subsidized carshare memberships for the campus community

MARLBORO COLLEGE: U-HAUL CARSHARE

In February 2013, Marlboro College became the location for a U-Haul CarShare program made up of one car. This program seemed necessary for the college because of its rural location with limited access to public transportation. Students and employees can become a member of the program for $25, schedule to use the car anywhere from a day to a month in advance, then pay around $5 per hour to use the car. This program has provided convenient and accessible transportation for Marlboro College students and employees.

PUBLIC TRANSIT

OVERVIEW

Public transit provides affordable transportation for a number of people traveling in the same direction. Utilizing public transit often means taking advantage of a network of trains, buses, and shuttles in the area. This type of transit is reliable and predictable; it arrives at pick-up and drop-off locations at the same time daily. Public transit also gives commuters an opportunity to relax or do work during the ride. Buses and shuttles are the most prevalent forms of public transit in Vermont, such as the Chittenden County Transportation Authority (CCTA) and Green Mountain Transit Agency (GMTA). The map below shows Vermont transportation services by each region served. Many colleges offer subsidized or free bus passes in order to encourage students and employees to utilize public transit. Take a look at public transit operating near your campus and consider your options.

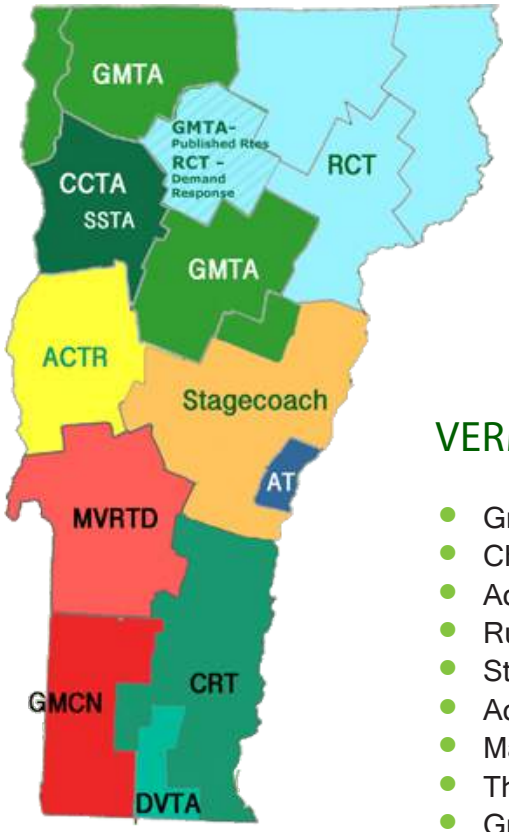


Image from: www.vpta.net

COMMUNITY COLLEGE OF VERMONT: PUBLIC TRANSIT ACCESSIBLE

The Community College of Vermont (CCV) has 12 locations throughout Vermont. Being accessible to students throughout the state is something very important to the college, so they do their best to make public transit convenient for the college community at discounted prices. Additionally, a criterion for the school when siting new buildings is the accessibility of the location by public transit, with the aim to make it convenient for the college community to get around and reduce parking congestion at CCV's locations.

Image from: www.stridecreative.com

VERMONT PUBLIC TRANSPORTATION

- Green Mountain Transit Agency (GMTA): gmtaride.org
- Chittenden County Transportation Authority (CCTA): cctaride.org
- Addison County Transit Resources (ACTR): actr-vt.org
- Rural Community Transportation (RCT): www.riderct.org
- Stagecoach Transportation Services: www.stagecoach-rides.org
- Advance Transit (AT): www.advancetransit.com
- Marble Valley Regional Transit District (MVRTD): www.thebus.com
- The Current (CRT): crtransit.org
- Green Mountain Community Network (GMCN): www.greenmtncn.org
- Deerfield Valley Transit Association (DVTA): www.moover.com

TELEWORK

OVERVIEW

Telework, or telecommuting, involves allowing employees or students to work from a remote location or call into meetings or classes from where they currently are. Telework is a simple solution to transportation demand management as it requires no transportation whatsoever. This includes video conferencing, calling into meetings, remote work, and online classes. Not only does this eliminate the need for transportation, it also improves safety and saves time. Using any form of transportation has its risks, and when your work or class does not require it, those risks are eliminated. Additionally, instead of making an hour commute to the location of the event, a person can use this hour for other work and call in just as the event is starting.

BEST PRACTICES

In order to make telecommuting successful, it is important to utilize best practices. The following are examples of methods to optimize telework at your school.

Fit the Job: Not all jobs work well for telecommunication. Managers should determine which jobs are appropriate for telework.

Skills & Qualification: Employees and students must meet performance standards, such as the ability to work independently, in order to be a successful telework candidate.

Address Supervisor Resistance: Trust must be established between the employee or student and the manager, as many managers believe supervision is only possible at the office.

Meeting Attendance: Teleworkers have the ability to be present at meetings and conferences through conference calls and video conferencing.

Telework Policy: Institute a teleworking policy at your school in order to develop a plan that is understood by all employees.

Calculate Savings & Effectiveness: Calculating employee and workplace savings by using Global Workplace Analytics' Workplace Savings calculators (globalworkplaceanalytics.com/calculator) can determine the benefits of telework on your campus.

COMMUNITY COLLEGE OF VERMONT: THE VALUE OF TELEWORK

As mentioned earlier, CCV has a variety of locations between which employees must collaborate. Conference calls are highly valued by the college in order to do this. Since teleconferencing has become a prominent method of communication between locations, the school has been able to save a significant amount of money that otherwise would have been used to reimburse employees for travel.

DID YOU KNOW...?

According to Global Workplace Analytics (globalworkplaceanalytics.com), "if those employees who held telework-compatible jobs (50% of the workforce) and wanted to work at home (79% of the workforce) did so just half the time...the economic benefit would total over $700 billion a year". Consumers would gain back two to three weeks worth of free time per year otherwise lost to commuting, businesses would save over $11,000 per employee per year, and the U.S. would reduce greenhouse gas emissions by 54 million tons. This is equivalent to taking 10 million cars, or the entire New York State workforce, off the road for a year.

Fuel Economy

OVERVIEW

The fuel economy, or fuel efficiency, of a vehicle addresses the relationship between the distance traveled and the amount of fuel consumed by the vehicle, or miles per gallon (MPG). A vehicle that can travel many miles on a small amount of fuel has a good fuel economy, or high MPG. There are many variables that can affect the fuel economy of a vehicle, such as the type of vehicle, the way a person drives the vehicle, and the way a vehicle is maintained. A high fuel economy can save a person money and reduce greenhouse gas emissions. The U.S. Environmental Protection Agency offers resources about regulations and standards related to fuel-economy reporting, data and testing of vehicle MPG, as well as what you can do to improve fuel economy and emissions from your current vehicle. You can find this information at www.epa.gov/fueleconomy.

FUEL ECONOMY TRACKING APPS

Free smartphone apps are available to help track your fuel economy and driving style. These apps assess your driving style and offer tips to make your driving habits more fuel-efficient in order to save money and reduce air pollution. Remember to practice safe driving habits and not let these apps distract you while driving.

Drive Style - Eco meter

Drivee

Driving Curve

FUEL ECONOMY IN COLD WEATHER

Winter driving conditions can reduce your vehicle's fuel economy by 12-22%, or 31-34% for hybrid vehicles. This is due to effects such as increased engine and transmission friction; additional power used for heated seats, window defrosters, and heater fans; decreased tire pressure; increased aerodynamic drag due to dense cold air; and using four-wheel drive. In order to improve your vehicle's fuel economy in cold weather, park your car in a warmer place, such as a garage; minimize idling to warm up your car; use seat warmers, defrosters, and heaters only when necessary; check tire pressure regularly; and remove accessories that increase resistance, such as roof racks.

ACTION STEPS

Simple steps can be taken in order to address the fuel economy of your vehicle or campus fleet. Older vehicles tend to produce more greenhouse gas emissions than newer vehicles across all classes. In fact, 25% of all vehicles, which is made up of the oldest vehicles on the road, causes 90% of the air pollution coming from the transportation sector. As a fleet manager, it is important to recognize the most inefficient vehicles in your fleet and take steps to replace them with more efficient vehicles. The DOE offers a tool that can be used to compare vehicles and their fuel economies: www.fueleconomy.gov/feg/findacar.shtml. Colleges can also address fuel economy on campus through education initiatives, such as requiring or incentivizing campus drivers to take a course detailing methods of efficient driving behavior. Some examples of eco-driving training methods can be found here: www.ecodrive.org/en/what_is_ecodriving-/how_to_learn.

FUEL-EFFICIENT VEHICLES

OVERVIEW

Driving a fuel-efficient vehicle is a reliable way to improve your fuel economy. As new technologies are being developed and new regulations enacted, vehicles are becoming more fuel-efficient. **Table 4** lists the nine most fuel-efficient, non-electric cars of 2015. Additionally, there are pieces of equipment that can be used to outfit your existing vehicle to improve your fuel economy. The website www.fueleconomy.gov offers a variety of suggestions for improving your fuel economy.

Table 4: The most fuel efficient non-electric cars of 2015.

VEHICLE	MPG	PRICE
2015 Toyota Prius c Hybrid	50	$19,540 - $24,475
2015 Toyota Prius Hybrid	50	$24,200 - $30,005
2015 Toyota Prius v	42	$26,675 - $30,935
2015 Ford C-MAX Hybrid FWD	40	$24,170 - $27,170
2015 Honda CR-Z	37	$20,145 - $24,140
2015 Scion iQ	37	$15,665
2015 Audi A3 Diesel	36	$29,900 - $41,050
2015 Ford Fiesta SFE FWD	36	$13,965 - $14,455
2015 Honda Fit	36	$15,650 - $20,925

FUEL CONSERVATION EQUIPMENT

There are equipment and vehicle parts that can be installed to improve fuel economy:

Low Rolling Resistance Tires: Passenger vehicles use 5-15% of their fuel consumption to overcome tire rolling resistance, while heavy trucks use 15-30%. A 5-7% reduction in rolling resistance can increase fuel efficiency by 1%.

Super-Single Tires: Replacing traditional dual tires with one super-single tire saves fuel by reducing the weight and rolling resistance of the tires as well as improving aerodynamics.

Aerodynamic Equipment and Vehicle Design: Aerodynamic equipment, such as airfoils, trailer gap reducers, side skirts, and tails, reduce resistance of a moving vehicle.

Fuel-Tracking Devices and Telematics Systems: Data collection devices, such as the apps mentioned on the previous page and GPS-based telematics systems, can track the fuel consumption of fleets and offer feedback to improve fuel economy.

Speed Control Modules: Speed control modules can be installed in fleet vehicles to prevent vehicles from traveling faster than a specific speed, conserving fuel.

Synthetic Oil: Synthetic oils reduce friction in the engine, thereby improving fuel economy.

FLEET RIGHTSIZING

It is important to evaluate your fleet vehicle needs in terms of size and composition in order to minimize vehicle use, conserve fuel, and save money. Fleet managers should look at vehicle use, quantities, types, mileage, and fuel economy in order to make informed decisions about rightsizing. Making smart vehicle purchases includes transitioning to smaller, more fuel-efficient engines, choosing lighter vehicles, and using alternative fuels and vehicles. This will help improve the efficiency of the fleet as well as save money that would otherwise be spent on fuel in less-efficient fleets. Finally, fleet managers should evaluate trips taken by fleet vehicles in order to ensure they are taking the most efficient trips in terms of route and combine trips, where possible, to minimize vehicle use and vehicle miles traveled.

ECO-DRIVING

OVERVIEW

Eco-driving is an economical way of driving that can make your vehicle 24% more fuel-efficient. It is a set of simple driving habits that result in using less fuel, generating fewer emissions, increasing road safety, and saving money.

ECO-DRIVING PRACTICES

Anticipate Traffic Flow

- Read the road in front of you for traffic changes in order to balance speed fluctuations so that you accelerate and brake smoothly
- Maintain a distance of about three seconds between your vehicle and the vehicle in front of you to avoid sudden braking and wasting fuel

Maintain Steady Speeds

- Drive 55 or 60 MPH instead of 65 to save fuel in order to achieve a 15% improvement in fuel economy
- Shift to a higher gear around 2,000 RPM; the lower the RPM the better the MPG
- Coast when going downhill
- Use cruise control on flat terrain

Avoid Excessive Idling

- Idling wastes fuel and causes engine wear and air pollution, which may lead to respiratory illnesses
- Limit stationary warm-ups to 30 seconds; driving your vehicle gently is the best way to warm up the engine
- Read the next section of this toolkit for more idle reduction techniques

Check Tire Pressure

- Underinflated tires can reduce fuel economy by 3-4%
- Keep tires properly inflated as low tire pressure causes increased friction and rolling resistance, wasting fuel and causing wear to the tires
- Check your tires at least once a month, before driving at high speeds and long road trips, and during cold winter months

Maintain Your Vehicle

- Follow your vehicle's owner's manual maintenance schedule in order to keep your vehicle tuned for it to run most efficiently
- Keep the wheels aligned and replace air filters as recommended

Address Aerodynamics and Weight

- Avoid traveling with unnecessary items in the vehicle or on the roof rack as this makes the engine work harder, consuming more fuel
- Open windows cause aerodynamic drag; use air conditioning (AC) at speeds above 40 MPH to reduce this effect

Consolidate Trips

- Plan ahead to combine trips in your vehicle while running errands
- Consider carpooling when possible
- Be aware of the status of traffic in order to avoid congested routes, especially during rush hour

Consider Extra Energy Costs

- Switch off electrical equipment when it is not needed
- Using the AC in very hot conditions can reduce fuel economy by as much as 25%; park in the shade and air out the car beforehand in order to avoid using unnecessary amounts of AC
- Remember: energy costs money, too!

ECO-DRIVING (CONT.)

ENCOURAGE ECO-DRIVING ON CAMPUS

- Post flyers about eco-driving practices, tips, and facts on campus (you can find materials to print here: www.ncdot.gov/travel/drivegreen and here: www.ecodriver.org/pages/Fuel-EfficientDriving.php)
- Distribute eco-driving brochures and fact sheets at student orientation
- Offer eco-driving information sessions and workshops to students, faculty and staff
- Post visible idle-reduction signs at drop-off/pick-up areas around campus
- Incorporate eco-driving practices into driving certification courses (if your institution offers them)
- Leave eco-driving guides in campus vehicles
- Provide information to students about eco-driving when they pick up their parking passes

ENCOURAGE CAMPUS FLEET OPERATORS TO PRACTICE ECO-DRIVING

- Offer optional eco-driving information sessions
- Require attendance at eco-driving workshops hosted by VTCCC
- Require fleet operators to track and submit daily/monthly average MPG with ScanGauges
- Offer incentives or benefits to fleet operators with the best average MPG results

Image from: geardiary.com

WHAT IS A SCANGAUGE?

ScanGauges gather real-time data for your vehicle. They record current, trip, and total MPG and monitor fuel use, along with a number of other features. VTCCC is equipped with ScanGauges that can be borrowed for eco-driving experimentation.

VEHICLE MAINTENANCE

OVERVIEW

A well-maintained car is more fuel-efficient, produces fewer GHG emissions, and is safer to drive. Getting regular tune-ups, following the manufacturer's maintenance schedule, and using the recommended grade of motor oil will help maintain a high fuel economy for your vehicle, as well as optimize its lifespan. For college fleets, utilizing a maintenance log will help ensure that fleet vehicles are in good shape and therefore getting their best possible fuel economy.

TIRE INFLATION

Tires that are properly inflated last longer and result in better fuel efficiency than those that are not. Each pressure decrease by 1 pound per square inch below the proper tire pressure decreases fuel economy by 0.3%. Fleets can use nitrogen inflation (which is less sensitive to air temperature change), tire pressure monitoring systems, or other technologies to maintain the optimum tire pressure.

VEHICLE MAINTENANCE (CONT.)

MOTOR OIL

Using the manufacturer's recommended grade of motor oil can improve fleet fuel economy by 1-2%. Using synthetic rather than conventional motor oil has many benefits as well. Synthetic motor oil is refined, distilled, and purified, removing impurities from the crude oil. Therefore, it keeps your engine cleaner, better protects your engine from wear, and performs better in extreme temperatures than conventional motor oil.

ENGINE TUNE-UPS

Tuning your vehicle can increase its fuel economy by 4%, while repairing a serious problem can increase fuel economy by up to 40%.

AIR FILTERS

Replacing a clogged air filter on any vehicle can improve both fuel economy and acceleration. When switching from diesel to biodiesel in a vehicle, the air filter may have to be replaced multiple times as the solvent properties in biodiesel tend to clear out deposits left by diesel fuel. Once the initial clean-up is complete, you can return to a normal air filter replacement schedule.

POLLUTION PREVENTION

Vehicle fluids can contribute to pollution, so it is important to practice pollution prevention techniques when maintaining your vehicle. A few basic techniques include:

- Placing drip pans to catch solvents for reuse in order to decrease runoff
- Doing liquid cleaning at a specific location to ensure that residues stay concentrated in one area
- Using rags and mops to clean up spills rather than water

You can find more detailed information on pollution prevention for vehicle repair and maintenance here: www3.epa.gov/region9/waste/p2/autofleet.

Image from: www.vpta.net

BIOBASED PRODUCTS

Additional pollution prevention related to vehicle maintenance includes the use of biobased products such as lubricants, hydraulic fluid, degreasers, antifreeze, greases, oils, and cleaners. Biobased products are derived from natural renewable materials such as agricultural, marine, and forest biomass and are generally biodegradable. Soybean oil is the most widely utilized feedstock for biobased products. These products can help reduce emissions that are dangerous for both environmental and human health.

The United Soybean Board (USB) provides government organizations with the opportunity to demonstrate soy biobased products in their fleets. USB will assist these organizations with selecting appropriate products to test or purchase. To take advantage of this opportunity or learn more about USB, visit www.soybiobased.org.

The BioPreferred program is managed by the U.S. Department of Agriculture (USDA) and aims to increase the use of biobased products by spurring economic development and providing new markets for farm commodities. More information can be found here: www.biopreferred.gov/BioPreferred/faces/Welcome.xhtml.

Idle Reduction

OVERVIEW

Reducing the idling times of vehicles on campus saves money, protects public and environmental health, and increases energy security. Limiting idling time can also reduce engine wear and associated maintenance costs. VTCCC focuses heavily on promoting anti-idling practices to public and private fleets, as well as the general public. Additionally, the non-profit organization Idle-Free VT advocates for idle-reduction and eco-driving practices through advocacy of laws, rules, and regulations. You can view these efforts on their website at idlefreevt.org.

WHY IDLE REDUCTION?

Image from: idlefreevt.org

Idling is Unnecessary: Idling for longer than 30 seconds uses more fuel and emits more carbon dioxide than restarting the engine. The best way to warm your vehicle up is by driving it gently, not by letting it idle for long periods of time.

Idling is Wasteful: Idling gets 0 MPG, wasting fuel and therefore money. Every hour spent idling wastes one-half to a full gallon of gasoline, which contributes to unnecessary fossil fuel use. Idling also puts added wear on your engine, shortening the life of your vehicle and requiring extra maintenance costs.

Idling Pollutes: Idling emits concentrated levels of greenhouse gases and other exhaust chemicals, which add to the adverse effects of climate change and cause negative health impacts such as cancer, heart conditions, and asthma.

Idling is Illegal: On May 5, 2014, a Vermont State Law titled "Prohibited idling of motor vehicles" became effective. This law states that the idling of all motor vehicles must be restricted to 5 minutes during a 60-minute period. Also, Burlington has a no idling ordinance that restricts vehicle idling to three minutes. **Table 5** on the following page lists all Vermont towns that have adopted official idle-reduction efforts. Use this table to see if towns near your college have adopted these policies. Details can be found at idlefreevt.org/local-efforts.html. Other policies exist that are specific to location, type of vehicle, unattended vehicles, and even colleges. If your college does not have an anti-idling policy, you can help raise awareness of the reasons behind why this type of effort would be good for your campus.

GREEN MOUNTAIN COLLEGE: NO-IDLING POLICY

In the Spring of 2011, Green Mountain College approved a no-idling policy on campus that applies to the operation of any vehicle on Green Mountain College property. The policy states that vehicles waiting at pick-up and drop-off areas must turn off their engines, except in extreme weather conditions. Additionally, fleet vehicles must limit idling time for warm-ups to what is recommended by the manufacturer, and delivery vehicles must turn off their engines when making deliveries. The purpose of the policy is to minimize idling time in all aspects of facility vehicle operation. You can read the school's policy here: sustainability.greenmtn.edu/media/392745/gmc%20no%20idle%20policy.pdf.

BEHAVIORAL CHANGES

OVERVIEW

Vermont's passenger vehicles idle for 9.6 million hours annually, resulting in emissions of 36,500 metric tons of carbon dioxide every year. This translates into nearly four million gallons of fuel wasted each year. Vermont's no-idling laws help create behavioral changes in people in an effort to reduce these numbers and improve air quality. However, commitment by individuals to reduce the amount of time they spend idling their vehicles is extremely important. The most successful way to do this is to advocate for idle reduction through education and awareness.

IDLE-REDUCTION STRATEGIES

- Avoid using a remote vehicle starter device
- Avoid using drive-through establishments
- Obey no-idle zones, especially at schools
- Simply turn off the vehicle if stationary for more than a few seconds
- Avoid using the radio, heat, or AC when unnecessary

MIDDLEBURY COLLEGE: REDUCED BUS IDLING

Middlebury College has established a space inside their athletic facility for bus drivers to wait during sports events in order to decrease the amount of time buses spend idling. This is an effective idle-reduction method, especially in the winter when bus drivers need to stay warm, as this decreases the need for long-term idling required to keep bus drivers warm.

IDLEBOX TOOLKIT

IdleBox is a Clean Cities toolkit of print products, templates, presentations, and information resources to assist with idle-reduction projects for fleets. These tools can be used to educate and engage policy makers, fleet managers, and drivers about the benefits of idle-reduction efforts. You can find IdleBox at www1.eere.energy.gov/cleancities/toolbox/idlebox.html. The resources offered in this toolkit can be used to promote idle reduction on your campus and in your campus fleets.

Table 5: Vermont towns with idle-reduction policies

TOWN	POLICY	YEAR INSTATED
Brattleboro	No idling resolution	2007
Burlington	No idling ordinance	2009
Colchester	Idling reduction policy	2011
Dummerston	No idling resolution	2009
East Montpelier	Idling reduction policy	2013
Jericho	No idling resolution	2011
Mendon	Idling reduction policy	2011
Middlebury	Idle-free resolution	2007
Milton	Idling reduction policy	2010
Newfane	No idling resolution	2008
Pittsford	Idling reduction policy	2011
Plainfield	No idilng resolution	2008
Putney	No idling resolution	2007
Richmond	Energy conservation policy	2007
Shelburne	Energy conservation policy	2010
Stowe	Idling target effort	2008
Strafford	Idling reduction policy	2013
Williston	Idling reduction policy	2010
Winooski	Idling reduction policy	2011

BEHAVIORAL CHANGES (CONT.)

PROMOTING ANTI-IDLING ON CAMPUS

While drafting and implementing anti-idling policies sends a message to the community that idling is discouraged, it is rare when idling policies are actually enforced. It has been found that the most successful anti-idling campaigns include regulations that are complemented by anti-idling education and community awareness, such as those resources offered by Idle-Free VT. Research conducted by Natural Resources Canada, a federal agency, found that the combination of both anti-idling signs and individual commitments not to idle were the most effective at schools.

A study tested the effect that one-on-one interventions has on the behaviors of individuals by placing volunteers at locations where idling was most likely to occur. Through car windows, volunteers gave motorists anti-idling pledge cards and "No Idling" decal stickers, asking the participants to make a commitment not to idle.

This strategy could be easily implemented on college campuses. Students involved in transportation or environmental classes or clubs could conduct these one-on-one interventions with motorists on campus. This strategy would expose both the students and motorists to anti-idling education, contributing to behavioral change.

Further anti-idling education and outreach initiatives to conduct on campus include:

- Posting creative anti-idling signage in highly visible areas on campus
- Placing anti-idling decal stickers on university-owned vehicles
- Including anti-idling information in driving certification courses (if offered)
- Including anti-idling information cards in all campus-owned vehicles
- Providing anti-idling information and resources in the transportation section of the college website
- Initiating an "I pledge to not idle" campaign
- Encouraging fleet managers and drivers to take the VT Idle-Free Fleets online training course and pledge found at: www.lung.org/local-content/vermont/our-initiatives/current-initiatives/idle-free.html.

You can visit idlefreevt.org/idling-facts-handouts.html to view, download, and print handouts such as flyers and business cards that offer fast facts about the adverse effects of idling. These resources can be used to promote idle reduction on your campus.

CAMPUS ANTI-IDLING POLICIES SHOULD:

1 Give a Clear Rationale for the Policy

- Why is idling a problem on campus?
- Provide information about idle reduction in order to gain people's interest and support.

2 Be Specific

- To whom and what types of vehicles does this policy apply?
- Where on campus does this policy apply?

3 Provide Guidance

- Is it acceptable to idle in the winter to warm up a vehicle?
- For how long can delivery trucks idle?
- Who needs to be informed of the policy?

4 Send a Positive Message

- Explain the benefits of idle-reduction measures, especially how they relate to the community.

TECHNOLOGIES

OVERVIEW

Equipment exists that helps drivers decrease the amount of time their vehicle spends idling. These technologies are installed on a vehicle or at a location, such as a truck stop, and are designed to provide services to the vehicle that would otherwise require the operation of the engine while the vehicle is stationary. A major reason drivers, especially those of large freight trucks, idle is to run the vehicle's heating, ventilation, and air conditioning (HVAC) system in order to maintain a comfortable temperature inside the cabin. The technologies used with heavy-, medium-, and light-duty vehicles vary due to the fact that each vehicle class uses different levels of fuel to operate. Certain idle-reduction technologies are exempt from the Federal Excise Tax, which is a good incentive to utilize them and decrease idling habits. You can read about this tax exemption at: www.epa.gov/smartway/forpartners/technology.htm.

TRUCK STOP ELECTRIFICATION (TSE)

Single-System Electrification: These systems provide HVAC and internet to heavy-duty vehicles at truck stops. HVAC hoses are connected to the truck windows to function.

Dual-System Electrification or "Shorepower": These systems require both on- and off-board equipment that allow trucks to plug into electrical outlets. This equipment allows truck drivers to utilize an electrical HVAC system while parked at truck stops.

You can find a map of TSE sites in the U.S. at this website: www.afdc.energy.gov/conserve/idle_reduction_electrification.html.

ONBOARD EQUIPMENT

Currently, the following technologies have been verified by the EPA:

Auxiliary or Battery Power Units: These systems provide HVAC and power for electronic devices without running the vehicle's engine, which is useful for vehicles that require power for comfort and communication while stationary. These units are generally powered using batteries, fuel cells, or secondary engines.

Air Heaters: These self-contained systems operate on engine fuel to blow hot air directly into the vehicle's interior. These units address passenger comfort.

Coolant Heaters: These systems are mounted in the engine compartment and use the vehicle's regular heat-transfer system. Fuel from the vehicle's tank is pulled to heat the coolant, which is pumped through the engine to keep it warm while the engine is not running.

Waste-Heat Recovery Systems: These systems operate much like coolant heaters. A small electric pump is connected to the water line, which uses engine heat that would otherwise dissipate to keep the vehicle's HVAC system running after the engine is turned off.

Storage Air Conditioners: Thermal storage and battery-powered air conditioners can be recharged using the vehicle's engine or by being plugged into an external power source. These systems provide AC for the vehicle when the engine is not running.

Automatic Engine Stop-Start Controls: These systems sense a vehicle's interior temperature and turn on to warm or cool the vehicle's cabin when necessary. They are useful for vehicles that spend long periods parked with passengers inside. Another kind of control includes systems that shut the engine off when the car reaches a stationary position. Many EVs, such as the Toyota Prius, come with this technology already installed. This drastically reduces time spent idling at traffic lights.

Writing a Sustainable Transportation Action Plan

Action plans are comprehensive documents outlining the current status, goals, and specific actions of a certain topic. In order to successfully achieve sustainable transportation objectives on college campuses, it will be important for your institution to formulate a plan. This toolkit provides ideas and resources to include in your sustainable transportation action plan, along with strategies for implementation. If your school already has a vehicle transportation plan, you may consider incorporating an active transportation plan to focus on walking, biking, and accessibility of your campus. The following steps offer a basic outline for developing a sustainable transportation action plan.

1 Establish Campus Support

Student, staff, and faculty involvement in the development and implementation of your campus transportation plan is necessary. Consider establishing a small but diverse group within your college community to assist in outreach and education efforts that will be necessary for garnering campus engagement and enthusiasm. There are a number of ways through which you can gain the student participation that you will need to make this plan successful, including:

- Offering courses that focus on sustainable transportation
- Allowing students to submit ideas and recommendations for the sustainable transportation action plan as it is being drafted and updated
- Raising awareness through marketing campaigns and events on campus
- Encouraging students to manage programs such as bike and rideshare boards
- Establishing sustainability clubs that will focus primarily on the development of this plan and the implementation of these actions

2 Evaluate Your Campus Transportation System

In order to set reasonable goals for your campus transportation system, you must first conduct a variety of evaluations, including a transportation emissions survey, vehicle inventory, walk/bikeability evaluation, and commuter survey of your campus. It will also be helpful to review the parking policies on your campus. These evaluations will give you a chance to consider how the transportation sector on campus currently operates in terms of commuting, fleet operation, and getting around campus. See **Figure 1** in the Appendices for a sample evaluation form. Include this evaluation in your sustainable transportation action plan.

In order to garner student engagement and support, you may want to integrate this evaluation into a course or club activity. Assign students the task of working with the transportation services or facilities department on campus to conduct this survey. Involving students in this evaluation will bring awareness to a portion of the student body about the environmental and economic impact of the transportation sector, and in turn will hopefully influence the mobility habits of those students.

3 Set Your Targets

Based on your transportation inventory and data collection in the evaluation process, establish goals for your college's transportation sector. Collaborate with students, faculty, and transportation management officials to set achievable short- and long-term targets. Some examples of targets include emissions targets, commuter modal-split targets, vehicle inventory targets, and fuel targets. See **Table 6** in the Appendices for an example of how to organize your goals. Present your goals using an organized yet comprehensive layout in your

sustainable transportation action plan in order for them to be clearly understood by the college community.

4 FORMULATE A PLAN

A plan of action must be considered in order to make reaching your goals successful. This section of your sustainable transportation action plan should go into great detail for each target, describing what tools, resources, and connections will be necessary to achieve each goal. Some questions to consider include:

- Does your college have the funds to reach this target? If not, are there options for fundraising or grants for the project?
- What outside organizations will your college need to collaborate with or seek help from? How will this communication occur?
- Is there permitting that will need to be done or proposals that will need to be written?
- Who in the college community is responsible for which parts of the action plan? (The planning process can be complex and will require input from many areas of the college community.)

After these types of questions are considered, action steps must be established using this information. Action steps break down each target into manageable efforts that can be tackled one at a time. Taking realistic action steps gradually moves your academic institution toward the success of its larger goals. For example, the goal to increase the number of bike communters on your campus may have the following action steps:

- Improving the bikeability of your campus by installing ramps and network connections where needed
- Researching and installing easily visible and accessible bike corrals outside high-use buildings
- Ensuring that long-term bike storage is secure, conveniently located, and protected from weather

5 IMPLEMENT THE PLAN

Because many of your goals will be time-dependent, it is important to establish an implementation plan outlining which goals to focus on in what time frame. An easy way to do this is through a simple Gantt chart. See **Table 7** in the Appendices for an example of this type of plan. This sample chart focuses on just one example of a sustainable transportation goal: the investment in electric vehicles for the campus fleet. Gantt charts can be made as simple or as complex as necessary in order to include sub-tasks, task categories, and other variables that make the chart comprehensive and well-organized.

6 ENSURE LONGEVITY OF THE PLAN

Ensuring longevity of your institution's sustainable transportation action plan will require a committed group of faculty, staff, and students to be proactive in the efforts necessary to reach its goals. This plan should be reviewed and updated frequently in order to ensure that you are on track and approaching your targets. As students cycle through your college over time, it will be important to have a consistent and reliable team to focus on the action steps being taken each year. Because most of your goals will be projected many years into the future, it will be important to maintain student interest in the project.

The ultimate goal in transforming the campus transportation system is to achieve institutional commitment to a sustainable campus. This means that sustainability must be incorporated into every aspect of the campus transportation sector, including the mission statement of the transportation and parking services department and its daily operation, financial management, and investments. Achieving this goal will require commitment from the entire campus community to work together to make this sustainable transportation action plan successful.

Conclusion

The Vermont Clean Cities Coalition is excited to offer the Sustainable Campus Transportation Toolkit to Vermont colleges and higher education institutions throughout the state. This resource offers a comprehensive perspective on the efforts required to reduce the use of petroleum in college fleets, as well as by student, staff, and faculty commuters on and around college campuses. We hope our guide encourages your academic institution to write its own sustainable transportation action plan to begin evaluating transportation practices to benefit the school. The case studies featured in this document are meant to promote the current practices found on Vermont campuses and provide mentors and resources for those who need them. VTCCC hopes this organized toolkit will become a reliable resource for your college to refer to when working to improve the campus transportation system. We wish you the best of luck in tackling your own sustainable transportation action plan!

ACADEMIC INSTITUTION CLIMATE ACTION PLANS

Many colleges currently have Climate Action Plans (CAPs), which focus on improving the environmental sustainability of the campus. These plans cover all aspects of energy and water consumption, transportation being just a small part of these goals. Writing a sustainable transportation action plan encourages your college to delve deeper into the transportation section of its CAP. Currently, eight out of 25 Vermont institutions have CAPs, and a few have transportation plans. Champlain College updated their Strategic Transportation Plan in 2013, which focuses on improving the efficiency and functionality of all aspects of their campus transportation system and supplements their CAP. You can view that plan here under Transportation Plans towards the bottom of the page: www.champlain.edu/current-students/campus-services/transportation-and-parking.

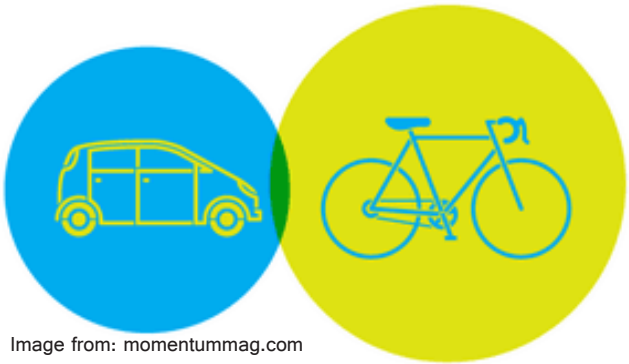


Image from: momentummag.com

APPENDICES

APPENDIX I: Evaluations

Figure 3: Sample campus transportation evaluation survey

CAMPUS TRANSPORTATION EVALUATION

1. What modes of transportation are used by commuters to get to your campus? (check all that apply)
   - ☐ Single-occupancy vehicle (SOV)
   - ☐ Bus/shuttle (public transit)
   - ☐ Walk
   - ☐ Bike
   - ☐ Car/vanpool

2. What methods of transportation demand management (TDM) are currently available to your campus community? (check all that apply)
   - ☐ Bus/shuttle
   - ☐ Bikeshare
   - ☐ Carshare
   - ☐ Telework

3. How many vehicles are on your campus fleet? How many alternative fuel vehicles (AFVs) are on your campus fleet? Evaluate your campus fleet using information such as the make, model, age, and fuel consumption of each vehicle, including off-road vehicles like lawn mowers. This information will be used to see where your college can make the most effective upgrades.

4. What percentage of your campus's total greenhouse gas emissions are coming from its transportation sector? What percentage of these emissions are coming from its fleet? Conduct an evaluation ideally using information about emissions being produced by commuters, fleet vehicles, and modes used to move around campus. You can calculate your college's fleet footprint using the GREET Fleet Footprint Calculator found here: greet.es.anl.gov/carbon_footprint_calculator.

5. Does your campus have alternative fuel stations, such as electric vehicle charging stations (EVSEs)? If so, what kind and how many? If not, evaluate whether or not a need exists and consider possible locations for them.

6. Evaluate the bikeability/walkability of your campus using a tool like the Walkability Audit Tool by the Center for Disease Control found at www.rollins.edu/greenspaces/orlmetro-aug16/CDC%20Walkability%20Audit%20Tool.pdf or the How Walkable is your Neighborhood? tool by Health by Design found at www.healthbydesignonline.org/documents/WalkabilitySurvey_HbD.pdf. Identify any problem spots. Where can you make improvements?

7. Do you have priority parking for AFVs or carpool vehicles? If so, how many and how well are they used?

8. Does your college offer incentives for employees and students who utilize TDM methods to reduce vehicle miles traveled (VMT), such as a gift certificate awarded monthly?

9. Do you have any current idle-reduction efforts on campus, such as advocacy or policies?

APPENDIX II: Target Timelines and Plans

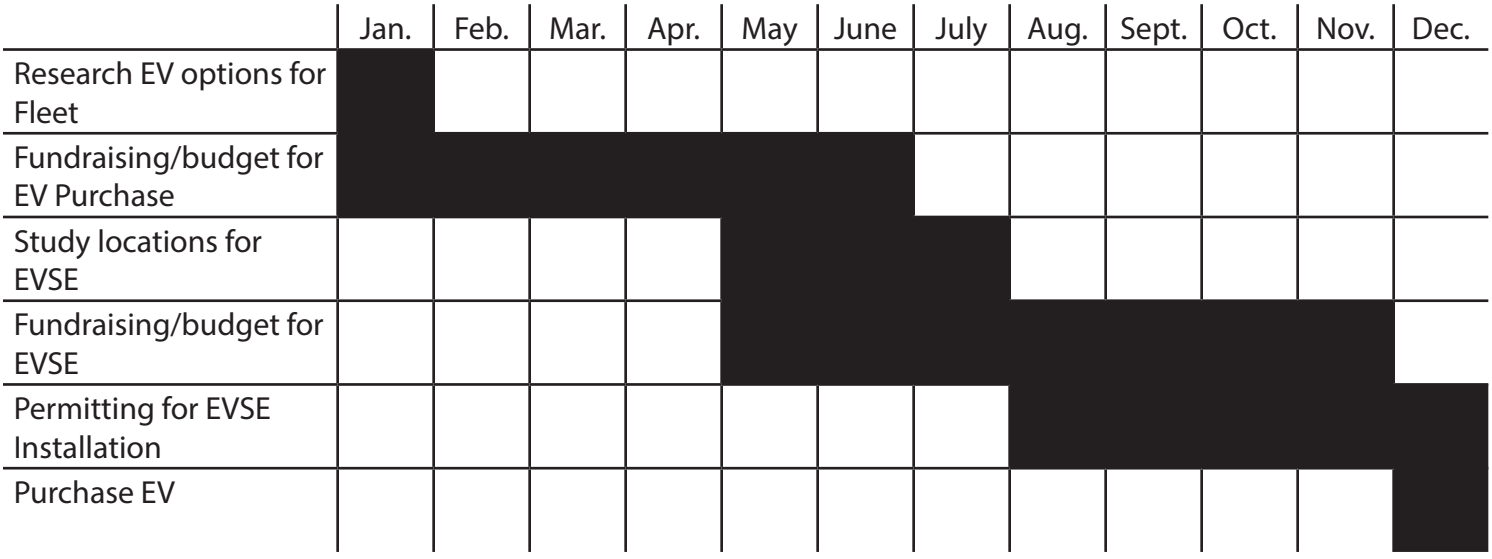
Table 6: Sample campus transportation target table

CAMPUS TRANSPORTATION TARGETS

TARGET SUBJECT	CURRENT DATA	FUTURE GOAL
GHG Emissions from Transportation Sector	10% of total GHG emissions	5% of total GHG emissions by 2030
Student and Employee Public Transit Usage	30% use public transit to get around campus and town	50% use public transit by 2025
Employee Carpool Commuters	20% carpool to work	30% carpool by 2020
AFVs in Campus Fleet	0 AFVs in fleet	10% of fleet use alternative fuels by 2030
Fuel Consumption Reduction in Fleet Vehicles	Vehicles waste 15% of fuel through idling, etc.	Vehicles waste only 5% of fuel by 2020 by using eco-driving measures
Bicycle Parking Accesibility	1 bike corral of 10 bike racks outside each residence hall	1 bike rack for every 3 students outside each residence hall

Table 7: Sample campus transportation implementation plan timeline

CAMPUS TRANSPORTATION ACTION IMPLEMENTATION PLAN



APPENDIX III: Useful Resources
Clean Cities Vehicle Tools and Calculators

Clean Cities offers a wide array of web based tools to help fleets reduce their petroleum use through the Alternative Fuels Data Center. You can view the full list here: www.afdc.energy.gov/tools. Below are select tools featured on the Vermont Clean Cities Coalition website that are particularly helpful to fleet managers seeking ways to reduce their fuel cost and emissions.

Vehicle Cost Calculator (www.afdc.energy.gov/calc): Enter basic information about your driving habits to compare total cost of ownership and emissions for most vehicle models, including those that run on alternative fuels or electricity.

Petroleum-Reduction Planning Tool (www.afdc.energy.gov/prep): Evaluate options and develop a strategy to reduce conventional fuel use and emissions in fleet and personal vehicles.

GREET Fleet Footprint Calculator (greet.es.anl.gov/carbon_footprint_calculator): Calculate your fleet's petroleum use and greenhouse gas emissions footprint, and estimate the impacts of future vehicle purchases.

AFLEET Tool (greet.es.anl.gov/afleet): Calculate a fleet's petroleum use, cost of ownership, and air pollutant emissions.

Heavy- and Light-Duty Vehicle Search (www.afdc.energy.gov/vehicles/search): Find and compare heavy-duty alternative fuel vehicles, engines, and hybrid propulsion systems.

Useful Website Resources

- Vermont Clean Cities Coalition (VTCCC): www.uvm.edu/vtccc
- Alternative Fuels Data Center: www.afdc.energy.gov
- U.S. Department of Energy (DOE): www.energy.gov
- DOE Fuel Economy: www.fueleconomy.gov

Remaining Image Sources

- Dollar sign for "Cost Considerations": www.imagekb.com
- Location symbol for alternative fueling stations in Vermont: www.iconshut.com
- Drive Style - Eco meter icon: www.apple.com/itunes
- Drivee icon: www.apptweak.com
- Driving Curve icon: android.downloadapp.website
- Clean Cities Vehicle Tools and Calculators icons: www.uvm.edu/vtccc

APPENDIX IV: Current Data for Vermont Higher Education Institutions

Table 8: Snapshot of data related to sustainable transportation on Vermont college campuses

Notes: The dash (-) indicates that the school does not track their greenhouse gas emissions.
The asterisk (*) indicates institutions that were unable to participate in this survey.

Vermont Institution	Employees	Students	Fleet Size	AFVs in Fleet	EVSE	Idle Reduction Efforts	% of GHG Emissions	Carshare	Bike Fleet	Parking Fee
Bennington College*										
Burlington College	45	125	3	0	0	Yes	-	Yes	No	No
Castleton State College	300	2,000	31	9	1	Yes	-	No	No	No
Center for Cartoon Studies	12	35	0	N/A	0	No	N/A	No	Yes	No
Champlain College	700	2,297	22	0	1	Yes	5%	Yes	Yes	Yes
College of St. Joseph	110	327	10	1	0	No	-	No	No	No
Community College of Vermont	880	7,000	3	0	0	No	-	No	No	No
Goddard College*										
Green Mountain College	198	637	7	1	1	Yes	2%	Yes	Yes	No
Johnson State College	200	1538	30	1	0	No	-	No	No	Yes
Landmark College	200	485	15	5	1	Yes	3.4%	No	No	No
Lyndon State College	260	1,500	34	3	0	Yes	-	No	No	No
Marlboro College	60	189	15	0	0	No	7-8%	Yes	Yes	No
Middlebury College	1,200	2,500	275	1	1	Yes	3%	Yes	No	Yes
New England Culinary Institute	100	375	2	0	0	Yes	-	No	No	No
Norwich University	700	2,200	18	0	0	Yes	-	Yes	No	No
Saint Michael's College*					1					
SIT Graduate Institute/World Learning	300	130	7	0	2	Yes	-	No	Yes	No
Southern Vermont College*										
Sterling College	50	100	6	0	0	Yes	-	No	Yes	No
University of Vermont	3,917	12,856	246	30	4	Yes	1%	Yes	Yes	Yes
Vermont College of Fine Arts	50	450	3	1	0	Yes	-	No	No	No
Vermont Law School*								Yes	No	Yes
Vermont Technical College*										