Fall 2012 ES 401 Project Statements
Sustainable Transportation

The 2011 report "Vermont's Transportation Energy Report" notes that at 34%, Vermont's transportation sector represents the largest usage of energy in the state. Further, while Vermont ranks last in the country in terms of total energy usage, Vermont's transportation sector is higher than the national average for the transportation sector (29%). Given that energy usage is tied to greenhouse gas (GHG) emissions, it is not surprising then that transportation is also the largest contributor to the state's GHG emissions, standing at 47%.[1] One contributing factor to these high percentages is the rural character of the state—as classified by the US Census Bureau, the state has only one "Urbanized Area" (Pop. > 50,000) and 16 "Urban Clusters" (pop. between 2,500-50,000), with all but two of these clusters under 10,000 people and the remainder of the state's ~626,000 residents scattered outside of these population clusters.

While we will work to define "sustainable mobility" together as a class, you can begin to get a sense of what this concept might mean for Vermont. One component would obviously be lowering our GHG and other emissions by offering alternatives to single occupancy vehicle (SOV) travel. Other components that we will explore together over the course of the semester include development strategies for reducing total vehicle miles traveled (VMTs), identifying all potential modes of transportation (including human-powered) and the mechanisms for—and benefits of—connecting these various modes, and how to enable this connectivity all the while factoring in safety, accessibility, livability, and equity. What role do various technological and social networking tools offer in helping us achieve sustainable mobility? How do we achieve our goals for Vermont under complicated and often contradictory federal transportation policy?

There are numerous state, regional and local agencies and organizations working on these types of questions for Vermont and you will have the great opportunity to work with several of them as project partners and to interact with many others as you pursue your research. Your direct partners will include the **Vermont Department of Transportation (VTrans)**, the **Addison County Regional Planning Commission (ACPRC)**, **Addison County Transit Resources (ACTR)**, and **Middlebury College**. VTrans has a Public Transit Division as well as a Bicycle & Pedestrian Division and works closely with the 10 public transit service providers in the state, operates several Park-and-Ride facilities, and oversees GoVermont, a free carpool and vanpool matching service. GoVermont represents a great step toward connecting transportation modes, providing rideshare participants with information on bike, pedestrian, bus, train, and ferry options.

ACRPC is authorized by VTrans to undertake transportation planning, inclusive of all modes. They undertake this planning with input from a Transportation Advisory Committee (TAC), whose members include one locally appointed member from each town in the county. In addition to producing a regional transportation plan and undertaking transportation feasibility studies, the ACRPC and TAC are also responsible for, "identifying and prioritizing transportation projects in the region and providing local input and direction to VTrans, the Federal Highways Administration (FHWA), and the state and federal delegations regarding the transportation needs of the Addison county community as seen from the local perspective."[2] The staff at ACRPC offer valuable skills in the arena of spatial analyses and their office is home to Middlebury's only electric vehicle charging station.

ACTR is one of the 10 public service transit providers in the state. They operate an extensive shuttle-bus system offering routes around Middlebury, a "Tri-Town" route connecting Middlebury, Bristol, and Vergennes, as well as the winter shuttle to the SnowBowl and regional connector services to Burlington and Rutland. If

1 http://www.uvm.edu/~transctr/research/trc_reports/UVM-TRC-11-007.pdf
2 http://acrpc.org/programs-services/transportation/

you haven't utilized their services yet, you should before you graduate! In addition to bus service, they offer a Dial-a-Ride program that focuses on "specialized populations including elders, persons with disabilities, low-income families and individuals, as well as the visually impaired."[3] In addition to their commitment to equity and accessibility, they, too, are working toward intermodal connections offering bike racks on their shuttle buses, connections with the GoVermont rideshare program, and most recently, conducting grant-funded research to help area businesses and their employees move towards "smart commuting."

While ACTR has always engaged with local businesses—both to make sure routes are addressing local needs and for funding support—ACTR, ACRPC, and VTrans are beginning to work towards the concept of a Transportation Management Association that would serve as a partnership of private sector businesses and local and state agencies to address transportation issues collectively and help strengthen existing informal relationships. In the midst of all this sits Middlebury College—certainly one of the important private sector players in the region, a destination for a large number of regional commuters, and an entity that grapples with its own transportation issues and opportunities (e.g. transportation around campus and town once students / faculty / staff are on campus and the GHG footprint of our college fleet vehicles and college travel).

As you will read below, all of the above-mentioned entities are excited to work with you as you engage several research questions that offer the opportunity to advance sustainable mobility at the local, regional and state levels.

[3] http://actr-vt.org/what-is-dial-a-ride/

1. Understanding and Enhancing Connectivity for Smarter Commuting
Partners: ACRPC & ACTR

The High Meadows Fund has awarded ACTR a grant to support a Smart Commute pilot program in Addison County, and they are working with Middlebury College, Vermont Coffee Company, the Vermont Community Foundation, and the National Bank of Middlebury as the businesses that will participate in the pilot. Their pilot program is modeled off of a successful Smart Commute Program in the Upper Connecticut River Valley, and the overall goals of such programs are reducing Vehicle Miles Traveled (VMT) for the commute-to-work sector. What is innovative about the Smart Commute program is its central focus on both individual and institutional behavioral analysis to indentify barriers and motivations, as well as its intended outcome of developing "workplace transportation programs" that provide specific plans tailored to a specific business and its employees needs. While ACTR's work with pilot businesses will be well underway, part of your research will help them identify the next round of businesses to work with after the pilot.

More broadly though, the key research need for ACRPC and ACTR is to work with several existing datasets which—through a variety of analyses—can provide insights for enhancing connectivity and providing options for smarter and more sustainable commuting. This will not only help the Smart Commute program, but it will also advance ACRPC's Travel Demand Management (TDM) goals for regional transportation.

These datasets include:

- Longitudinal Employer-Household Dynamics (LEHD) data from the US Census Bureau that identify a given individual's location of residence and location of employment (at the "block" level). ACRPC has also developed a beta-version of a web tool that utilizes the LEHD data to identify the most likely route from home to work.
- Way to Go Vermont survey data, which includes commute distances and modes for participants in a statewide week-long event that encourages non-single occupancy vehicle (non-SOV) commuting
- GoVermont rideshare data which includes ride-matching activity summaries
- VTrans Public Service Indicator Reports providing number of boardings per day
- Middlebury College employee commuting data from surveys conducted by the Office of Sustainability Integration, as well as the Human Resources Office.

The primary goal of your analyses will be to identify clusters and patterns in the data (e.g. clusters of people living in close proximity and commuting to the same / proximate places of employment) and comparing those patterns to existing infrastructure for non-SOV travel. This comparison will illuminate areas of existing connectivity and help prioritize areas where additional resources and infrastructure could have the largest impact. Once you have identified any clusters, patterns, and gaps in connectivity, additional research questions include:

- What are the optimal means for making connections where they are needed – adding additional bus routes, adding or relocating Park-and-Rides, establishing rideshare cohorts, adding bike lanes or sidewalks, installing end-of-trip infrastructure (racks, showers, etc.) to encourage multi-modal bike/ped connections, etc.? What are the pros/cons of these various options?
- For Park-and-Ride locations in particular, begin by referencing maps of existing park-and-ride locations and existing parking lots (which could serve as potential new locations), and inventorying proposed locations. In addition to what your data analysis leads you to identify as optimal locations, consider adding a community survey component for case study towns (see below) to gather information on

preferred locations and the closest arterial intersection people would be willing to travel to for a Park-and-Ride.

- Resources are always involved in establishing these additional connections – can you present a compelling case for enhancing connectivity to those area businesses that rise to the top in terms of commuter destinations (outside of those already participating in the Smart Commute pilot)? What would be the benefits to them if they participated in the Smart Commute program and/or became members of a regional TMA and/or supported these connections financially? Your ideas could inform the content of focus group discussions with regional entities representing area businesses later in the semester in conjunction with Group 2.

While your work at the pattern/cluster level should be county-wide, several towns may be ideal for case-studies in how to make the needed connections. In particular, residents of several towns, including Vergennes, Bristol, Weybridge, Orwell, Shoreham, and Bridport have expressed interest in identifying ways to enhancing sustainable mobility to ACRPC and ACTR.

Over the course of your work, it will also be useful to highlight data gaps and needs that might be addressed by a regional TMA (see project 2).

Your work will help set the stage for the Smart Commute Program which ultimately would be open to employers of all sizes across the county.

2. Design a Rural Transportation Management Association (TMA) for Addison County

Partners: ACTR and Ross MacDonald, VTrans Public Transit Coordinator/GoVermont Program Manager

The National Center for Transit Research defines Transportation Management Associations as "organized groups applying carefully selected approaches to facilitating the movement of people and goods within an area. TMAs are often legally constituted and are convenient ways for private and public sectors to partner to solve transportation problems."

Ideal models include diverse coalitions of stakeholders from both the public and private sectors, all who have a core interest in transportation demand management (TDM), enhancing mobility, and reducing carbon emissions. Similar to this class, bringing together these diverse perspectives to address county-level transportation issues allows for unique and synergistic approaches and solutions.

While TMAs are common in urban areas, there are fewer models for rural areas, where perhaps the need is even greater—the diffuse nature of rural development patterns tends to lead to an even greater dependence on personal vehicles.

Addison County Transit Resources has developed a concept sheet providing background on TMAs and pitching the benefits for Addison County, and is in active dialog with VTrans Public Transit Coordinator, Ross MacDonald. There is strong interest at the conceptual level, and the next step is to define structural and functional parameters. Your charge is to address the following research questions regarding rural TMAs in order to identify and design the optimal structure and function for an Addison County TMA:

- What are the strengths and weaknesses of existing rural TMAs? Are there models elsewhere in the country that Addison County can learn from? Which models seem most applicable to Vermont and Addison County communities, in particular?

- Sustainable sources of funding are key to programmatic success of TMAs. Typically, TMAs are funded through membership dues and fees for services from participating businesses and organizations, and by grants. ACTR and VTrans are particularly interested in you developing a model of funding and fee structures for potential business partners.
- As you formulate your Addison County design, it will be important to ground your ideas through discussions with community entities representing area businesses – i.e. Better Middlebury Partnership, Chambers of Commerce, Addison County Economic Development Corporation, Bristol Downtown Community Partnership, Five Town Area Business Council, etc. – as proxies for how individual businesses might respond. Your questions should gauge reaction in two areas: likelihood of engagement and what messages would most resonate with area businesses in terms of why they should get involved (e.g. value to employees, taking a leadership role on this issue, etc.) Coordinate your discussions with Group 1, who will also have an interest in meeting with regional entities representing area businesses.
- How would employee incentives or disincentives (e.g. parking fees) support the structure and function of a TMA? All Earth Renewable in Hinesburg offers an interesting starting example for alternative commuting incentives.
- While TMAs can focus on a variety of modes of transportation, they commonly focus on public transit. ACTR and VTrans are interested in including all modes of transportation into the Addison County TMA and are particularly interested in your research and ideas for what a "Bicycle Coalition" component of a TMA could and should look like. Consider how existing Vermont models—e.g. the Vermont Bicycle and Pedestrian Coalition and Local Motion—could be expanded into Addison County to limit duplication of effort.
- Lastly, while TMAs are made up of a variety of stakeholders, the TMA itself may require staffing. What are the full and part-time staff needs would be necessary to keep the TMA moving forward? Draw from your research into existing TMAs, as well as your ideas for Addison County programs that a TMA could advance.

Your work will lay the groundwork for an Addison Co. TMA and will be a model for other TMAs in the state. Your results should be presented in the form of a whitepaper for policy-makers and planners at the state, regional, and local levels.

3. Bicycle and Pedestrian Planning

Partner: ACRPC

Among their many services, the Addison County Regional Planning Commission helps "guide and coordinate change and development in the region in accordance with present and future needs and resources" through their regional planning processes. Transportation is one of the sectors covered by the regional plan, as well as most of the local town plans. A close read of "Chapter 6: Transportation" in the most current regional plan will give you a good overview of transportation accomplishments, needs, and opportunities at the county level.

The regional plan has a relatively brief section on bicycle and pedestrian issues which refers back to the "2002 Addison County Regional Bicycle and Pedestrian Plan". While there have been more current bicycle and pedestrian plans for certain projects and towns within the county (Bristol and Lincoln in 2011, Cornwall, Vergennes, and Ferrisburg in 2006), the ACRPC is beginning the process of updating the county-level plan.

While the 2002 plan approached issues on a town-by-town basis, identifying amenities and needs within each town, they would like to take a more regional view in the updated version, considering connectivity amongst towns, as well as bike/ped connections with other modes of transportation (e.g., ride a bike to a bus stop).

To assist ACRPC with their bicycle and pedestrian planning, your project charges include the following:

- Working with the LEHD data described for Group 1's project statement, identify towns where there are significant numbers of residents commuting to businesses within their own town. These so-called "live and work" communities are ideal locations for establishing a bike / pedestrian commuting culture and might benefit most from a bike/ped plan that would establish the needed connections and infrastructure to promote this form of commuting.
- For the towns that you identify through the above process, inventory and update bike/ped assets (e.g. sidewalks, shoulders, bike lanes, crosswalks, etc.), as all plans must begin with a basic understanding of what currently exists. This should be done in consultation with local communities and their initiatives (Safe Routes to School, etc.)
- Your inventory of assets will likely identify room for improvement. Further, can you identify areas where a given improvement would allow a connection to a larger existing transportation network to achieve the desired intermodal and regional connectivity? Conduct intercept surveys at certain locales that you identify within your towns to gauge interest and demand for the bike/ped improvements that you are proposing. Point counts of cyclists and pedestrians could also provide compelling evidence of demand for infrastructure on a particular route.
- To continue moving towards the goal of a more connected and multi-modal perspective, you work will involve an emerging open-source program called Open Street Map. One of this program's functionalities is a Trip Planner that allows an individual to chart a route based on their desired mode of transportation (similar to the walk / car / public transit option in Google Maps). This modality-based routing tool is accomplished by coding routes as suitable for driving, biking, walking or as having bus service. Currently, bicycle and pedestrian suitability and preferred routes are not all coded in Open Street Map for Addison County. This means that even if walking the college path network to get from Weybridge Street to the Athletic Center would be an optimal pedestrian route (and even if the route appears on the map) it would not appear as a pedestrian-preferred option in the Trip Planner. As a starting point for making these additions, work within your selected towns to code routes for bicycle and pedestrian suitability.
- The Open Street Map software can also be used to generate hypothetical maps and routing scenarios that reflect the bike/ped improvements you are proposing, or to visually compare multiple bike/ped scenarios in your selected towns. Such hypothetical maps could be included as support for your proposal and also used for the intercept surveys to gauge citizen interest and preferences.

4. Transitioning Middlebury College's Fleet to Electric Vehicles

Partner: Middlebury College

There is burgeoning interest in Vermont in to identify what role electric vehicles (EVs) can play in mitigating greenhouse gas—and other—emissions from conventional internal combustion engine (ICE) travel. This spring, The Vermont Energy Investment Corporation (VEIC) began a collaboration with the Rocky Mountain Institute, the Vermont Agency of Natural Resources, the VTrans, and the Vermont Department of Public Service on a project to facilitate the adoption of electric vehicles across Vermont entitled "Project Get Ready" (recently re-branded as Drive Electric VT). This summer, at the New England Governors and Eastern Canadian Premiers conference in Burlington, the regional deployment of electric and alternative-fueled vehicles was a key

component of the environmental working group's platform. The UVM Transportation Research Center has undertaken several studies that are helping the state consider infrastructural (e.g. location and number of charging stations) and grid capacity issues that would need to be addressed for widespread adoption of EVs. The Vermont Legislature included a provision in Act 153 on identifying how EVs might pay into the current transportation system, requiring an analysis of options for "user fees and fee collection mechanisms for vehicles that use energy sources not currently taxed." Lastly, there is strong interest from the Vermont Climate Cabinet and the House and Senate Transportation Committees in tracking the research and new developments surrounding EVs to be aware of areas where state-level policies might be needed to advance or support EVs.

While EVs can be viewed as a technological "fix" (improving the vehicle rather than reducing VMT), they potentially offer significant improvements over traditional ICE vehicles in a rural state where some level of transportation by personal vehicles appears inevitable. During an investigation of their role, important additional considerations include where current single occupancy vehicle (SOV) trips could be shifted to alternative modes or avoided altogether and how to continue to minimize any kind of SOV trip—including ones using EVs.

Recent studies through the UVM Transportation Research Center have looked at projected patterns of EV adoption for individuals throughout the state, and some have argued that businesses and organizations with vehicle fleets might have more resources that allow them to be "early adopters" of EVs, serving as both test cases and models. Your charge in this project is to envision and evaluate the conversion of Middlebury College's fleet to EVs—weighing a variety of issues as outlined below—including whether this conversion would offer a cost-effective means of reducing our GHG emissions on our road to Carbon Neutrality. In 2007, the College's GHG emission portfolio totaled just over 32,000 metric tons carbon dioxide equivalent (mtcde). Fuel for heating, cooling, and cooking was by far the largest portion of that total, contributing 27,644 mtcde. The mobility fleet and transportation (inclusive of air travel) sectors represent 417 and 2751 of the remaining 4356 mtcde respectively. Further, from 2007-2011 the mobility fleet and transportation sector emissions have increased by 12%.

Your research for the proposal for transitioning the College fleet to EVs should include the following:

- For the college rental fleet of vans/minivans/sedans, gather Vehicle Miles Traveled (VMT) and destination data. Considering the range of differing EV technologies (see below) and assuming we install and on-campus charging station or use the current station at the Addison County Regional Planning Commission (ACRPC) office in Middlebury, what percentage of trips could be completed without needing to recharge, and what percentage are of sufficient length to need a recharge, but could be accommodated by installation of new charging infrastructure at key locations. For as many of the other sectors of the college fleet as possible (e.g. internal delivery trucks, MiddRides, Public Safety, golf carts & gators, etc.) identify annual miles traveled through vehicle maintenance records so that miles can be tied to specific vehicle type. The assumption for these vehicles will be that all trips are of short enough duration to operate solely from a college or the ACPRC charging station.
- What are the costs associated with new charging infrastructure—either for on campus or elsewhere? How many vehicles can charge at any given time per charging "station"?
- Utilizing existing models for vehicle energy use and emissions, our known electricity portfolio, and your data on mileage traveled by vehicle type for all sectors, calculate GHG and emissions savings if we electrified the fleet. It will important to factor in here cold-climate charging considerations, as well as the type of EVs you are recommending serve as the replacements. As you dig into the literature you will come across a range of differing technologies including, but certainly not limited to, EVs (electric

vehicles), HEVs (hybrid electric vehicles), and PHEVs (plug-in hybrid electric vehicles). In considering vehicles, give some consideration to the environmental implications of materials mined/used in different types of batteries in order to provide more direct environmental comparisons between the current and proposed fleet.

- You will need to address budgetary issues. Research the College's current vehicle replacement policy and the dollars allocated for those replacements to identify what the funding gap would be. Then provide recommendations for any state, federal, or private funding sources (federal rebates, for example) for EVs to fill this gap. Also consider payback periods in terms of gas vs. electricity savings and maintenance needs.
- Lastly, address grid issues – ideally on campus vehicle charging would occur overnight, when electricity demand is at its lowest, but would this work given how different vehicles are used? Further, a consortium of Vermont utilities working on Smart Meter / Smart Grid installations had approached the College for demonstration projects around net metering at the Solar Decathlon House. Could EVs be a possible source for net metering, as well, as long as vehicles were charged when needed?

As you progress in your research, you may decide to offer a phased proposal for the college—are there components of our fleet that could easily be converted and done first where other conversions might take more infrastructure and more regional collaboration (i.e. getting a consortium of NESCAC schools on board to support charging infrastructure en route to and at all of our respective campuses)? Be creative about how things could work! Your proposal can potentially serve as a model for other schools and businesses in the region. Lastly, as you encounter any challenges in data gathering, be sure to provide recommendations to the College for collecting the needed data for any future project that would aim to decrease emissions from our transportation sectors.