The mission of the UVM Transportation Research Center is to conduct innovative interdisciplinary research, education and outreach programs that advance sustainable transportation systems.

The transportation industry is a major economic sector, and keeping it vibrant is critical to Vermont’s economy and our quality of life. The Transportation Research Center provides an excellent example of how UVM can partner with communities to advance Vermont and New England.

— Daniel Fogel
UVM President
Message from the Director

This past year was filled with tremendous growth at the UVM Transportation Research Center. It has been a privilege to host hundreds of individuals at our events and to work with so many different groups both within Vermont and beyond our borders.

In the fall of ‘07, Dr. Richard Watts and I taught our second offering of our new transdisciplinary course, Critical Issues for Transportation in the 21st Century, to 23 graduate students enrolled in five different Colleges. By spring of ‘08, one of these students who had not directly majored in transportation had accepted a position with a leading transportation consulting firm, establishing that our university research and education programs are indeed attracting new talent to professional service in the transportation sector. Coincidentally, in April the outreach team at our center was awarded a large competitive grant to focus on workforce development for the transportation sector in northern New England.

The Center’s research capacity has grown this past year with large increases in staff, graduate students and equipment. We’ve received the donation of a plug-in hybrid electric vehicle for field studies and equipment for the Transportation Air Quality Lab, both of which have created significant excitement.

Within the transdisciplinary research teams that we’ve built, new relationships have been sparked and existing ones have deepened. In March, these teams joined me to present our strategic vision and interim results to the US DOT during their site visit to Burlington. The visitors were impressed by our collaboration and invited me to present our “Signature Research Project” process to a national gathering of University Transportation Centers in San Jose, California in June, ‘08.

Our external partnerships have also grown this past year, resulting in new grants and awards related to the energy and environmental aspects of transportation. Of equal importance is the recognition of our unique role as a university-based Center to the increasingly significant issue of sustainable transportation. Our work on the complex interconnections between community, mobility, public health, energy and environment is certainly timely.

While 2007-2008 consisted of building and growth, we are looking ahead to a year of research results. These results will no doubt enrich the ongoing conversation we share with you on how to develop a sustainable transportation system for our communities, both local and global.

Sincerely,

Lisa Aultman-Hall
Director, UVM TRC
Mobility requires energy, but not all energy sources are created equal in terms of social, environmental and financial costs. The complex questions regarding future transportation energy use require bridges across disciplines that bring researchers, educators and students together. In Vermont, transportation produces 44% of the state’s greenhouse gas emissions.

RESEARCH PROJECT: Modeling Plug-In Hybrid Electric Vehicle Impacts

On February 21, UVM received a new PHEV—a modified Toyota Prius donated by Central Vermont Public Service (CVPS)—which TRC researchers are using to explore how a new generation of hybrid cars, which recharge from a standard electric outlet, perform in the cold, hilly conditions of Vermont.

Bob Young, president of CVPS, presented the vehicle to UVM’s President Dan Fogel and TRC director Lisa Aultman-Hall, as part of CVPS’s Plug ‘n Go™ program. PHEV’s can reduce driving costs and air pollution by substituting off-peak electricity for gasoline.

In this study, funded by the US DOT and Vermont...
Utilities, volunteer drivers will use the PHEV for their regular daily travel, and from these trips, data will be collected about carbon emissions, electricity use, local variations in the electrical supply, and performance over differing distances and driving styles. The research also includes an on-going effort to determine the capacity of Vermont’s electric grid to handle 50,000, 100,000 or 200,000 plug-in hybrids.

“The first phase of this work,” said Dr. Richard Watts, Principal Investigator, “indicates that the Vermont electric grid could handle 200,000 PHEVs charged at night under direct utility control.”

**OUTREACH PROGRAM:**
**Vermont Clean Cities Coalition**

The mission of the 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 state of Vermont initiated its Clean Cities program in 2001 and on July 1, 2007, the UVM TRC became host for the Coalition. Since then, the Vermont Clean Cities Coalition has sponsored or co-sponsored the following events:

- Public Transit Roundtable (September 2007)
- Biodiesel Workshop (October 2007)
- Annual Stakeholders Meeting (April 2008)
- Vermont Clean Car Show (April 2008)

Other Clean Cities activities include publishing a twice monthly e-newsletter, writing grant proposals, producing the annual “Vermont Transportation Energy Report,” maintaining databases and providing representation to the federal Clean Cities program of the US Department of Energy. More information about the program can be found online at www.uvm.edu/~cleancty.

**STUDENT PROJECT:**
**Mapping Policy Drivers: Discourse Networks in the Formation of Vermont’s Transportation Energy Policy** – Elaine Wang, Master’s Degree Candidate, RSEN

Transportation accounts for about a third of the energy that Vermonters use, more than any other sector. Most of this transportation energy relies on out-of-state petroleum, the use of which generates an array of policy issues.

![Elaine Wang](image)

A comparative case study approach was used to examine how Vermont policy makers frame the issue. Data sources included surveys, interviews, participant observation, and documents. Analysis concentrated on points of divergence and convergence within and between policy makers. The study also provided recommendations as to how gaps in understanding may be remedied to improve transportation energy policy for environmental sustainability.

**OTHER PROJECTS OF NOTE:**
(Funded by US DOT)

- **Multi-Scale Model of the U.S. Transportation Energy Market for Policy Assessment** – Drs. Margaret Eppestein, Jeff Marshall, and Donna Rizzo, CEMS
- **Mechanical and Economic Performance of an Electric Car Utilizing the Zebra Battery Technology in Vermont** – Dr. Walter Vartuhe, CEMS
- **Estimating An Incentive Elasticity of Demand for Non-motorized Transportation** – Dr. Jane Kolodinsky, CDAE
- **Carbon Life-cycle Analysis of Organic Versus Conventional Biofuel Crop Production for Canola and Sunflower Crops Grown in the Northeast** – Eleanor Campbell, Master’s Degree Candidate, RSEN
- **Industry-Partnered Senior Design Projects on Alternative Energy** - Dr. Michael Rosen, CEMS
- **Facilitation of Behavior-Based Efficiency Opportunities in Vehicular Operations Through Retrofit Information Feedback Systems** - Dr. Laura Solomon, Department of Psychology
TRANSPORTATION + ENVIRONMENT

Transportation networks and vehicles have a profound impact on the air, water and land systems. Yet, we lack complete information upon which to pursue best practices for programs and policies to minimize or eliminate these effects. University research is critical to filling these knowledge gaps.

The focus of this US DOT-funded project, led by Dr. Britt Holmén, is to quantify “real-world” emissions from hybrid versus non-hybrid vehicles. State-of-the-art micro-simulation models can replicate vehicle activity, fuel economy and emissions. Unfortunately, the factors used by such models are often based on data from laboratory tests conducted under ideal conditions. Existing emissions databases do not account for factors such as road grade and temperature. This project will collect tailpipe emissions data—including ultrafine particles (which pose a public health concern), carbon dioxide gas, and other air toxins—using on-board sampling while people drive on the real road network.

Dr. Holmén explains the tailpipe adapter used to gather emissions data to a student.
The second part of this project focuses on public understanding of emissions. The project’s behavioral scientists from CDAE and Sociology will first create a baseline defining public knowledge of tailpipe emissions, and then they will develop communication strategies to affect behavior related to vehicle emissions.

Partners: Vermont Agency of Natural Resources, Resource Systems Group (RSG), Inc., Udall Foundation, UVM Parking and Transportation

![Students in the Summer Transportation Institute explore the properties of porous pavement materials.](image)

**RESEARCH PROJECT:**
**Designing Sustainable Porous Pavements for Northern Communities**

Stormwater runoff from traditional, non-porous pavement systems—including parking lots—significantly pollutes our rivers, lakes, and estuaries. Alternative porous pavement systems allow polluted water to pass through into the natural sub-base thereby reducing the quantity of stormwater and potentially improving water quality.

This UVM research project, led by CEMS faculty Drs. Dewoolkhar and Pinder and funded by VTrans and US DOT, is characterizing the suitability of porous concrete pavements for northern communities. Research focuses on an instrumented park and ride facility built by VTrans. In addition to the basic mix design, of particular interest are the effects of factors such as freeze-thaw, wear and tear, and winter maintenance on the system properties. These determinations can then lead to development of more appropriate mix design specifications for our region. A numerical model for the overall system (pavement, sub-grade and sub-base) will be developed and will allow results to be transferred to other locations.

**TRC SIGNATURE PROJECT #1:**
**Integrated Land-Use, Transportation and Environmental Modeling**

Travel patterns such as the distances we drive are directly related to the arrangement of land uses and activities where we live. Yet the models traditionally used in transportation planning simply assume a set arrangement of land use, neglecting the interactions between development patterns and travel. For example, building a road facilitates land development, which creates traffic and the congestion, in turn, might cause officials to expand the road or travelers to choose other destinations.

To capture the complex interactions of multiple players within the regional transportation-land use system, UVM researchers are using advanced computing to integrate several models which had typically been used separately (UrbanSIM, TRANSIM, activity models, traffic simulation models and demand forecasting models).

The research team is also developing metrics for the impacts of land use and transportation on stormwater, roadside plants, network robustness, greenhouse gas emissions, air toxics, and airborne ultrafine particles.

Most of the researchers working on metric development are new to transportation and are guided by experienced modelers Drs. Austin Tray (RSEN) and Adel Sadek (CEMS). The project is funded by the US DOT.

Partners: RSG, CCMPD, CCRPC, and McMaster University

**OTHER PROJECTS OF NOTE:**
(Unless otherwise noted, funded by US DOT.)

- **Atmospheric Oxidative Chemistry of Organic Particulate Emissions from Fuel Combustion** - Dr. Giuseppe Petrucci, Department of Chemistry

- **Integrating Ecosystem Service Impact Assessment into an Integrated Land Use/Transportation Modeling Framework** - Ken Bagstad, Ph.D. Candidate, RSEN

- **Implementation and Architecture Development of a Combined Land Use & Transportation Model for Chittenden County, VT** - Brian Voigt, Ph.D. Candidate, RSEN

- **Development of an Architecture for Generating Environmental Outputs from an Integrated Land Use and Transportation Model** - Garen Wilkerson, Master's Degree Candidate, RSEN

- **A Land Use-Based County-Level Carbon Budget for Chittenden County, Vermont** - Erin Quigley, Master's Degree Candidate, RSEN

- **Characterizing Older Driver Behavior for Traffic Simulation and Emissions Modeling** - Dr. Lisa Aultman-Hall, TRC; Funded by NEUTC at MIT
VITAL COMMUNITIES

Transportation and mobility contribute greatly to our quality of life. Through our research, we are looking to define elements that encourage, support, and enable increased vitality in our communities. The efficient movement of people and goods is critical to a vibrant and predictable economy. Our lives can be better if we are physically active and healthy, if we are connected to our neighbors, and if we have safe and convenient options for travel.

TRC SIGNATURE PROJECT #4: Seasonal and Built Environment Impacts of Mobility

The climate and development patterns of rural northern communities make mobility particularly challenging and often cost prohibitive. This project, led by Drs. Jane Kolodinsky (CDAE) and Brian Flynn (COM), focuses on how weather impacts three aspects of mobility: un-served travel demand, bicycle travel and pedestrian transportation.

First, in partnership with the New England Transportation Institute (NETI), using new survey data and existing Center for Rural Studies (CRS) built environment data, team members are measuring and describing the effects of weather on both revealed and un-served travel demand in rural northern communities.

Focus groups and surveys are measuring the seasonal variation in bicycle travel demand as well as the associated causes of this variation in order to recommend policies and programs that might promote year-round use. A continuing analysis of pedestrian volume data has already indicated that weather can account for 30% of volume variation. The Project is funded by US DOT.

Partners: VTrans, NETI and RSG, Inc.

As part of Signature Project #4, VTrans' Amy Bell and TRC's Damon Lane set up a pedestrian counter in Montpelier, Vermont.
OUTREACH PROJECT:
Transportation Workforce Development

A new four-year workforce development project, funded by a grant from the US DOT, will help develop innovative programs to attract and retain skilled workers in the transportation sectors of Vermont, New Hampshire and Maine.

Given northern New England’s demographic changes and the turbulent nature of our 21st century transportation system, the transportation sector will require a comprehensive workforce development plan. The TRC will create four new programs to help transportation leaders attract and maintain workers in this challenging environment.

1. The Transportation Systems Institute will focus on maintaining or recruiting new talent to the DOT workforce in the three northern New England states.

2. The Second Careers in Transportation Program will focus on attracting retirees from other industries to bring their skills to bear on the 21st century challenges in transportation.

3. The Transportation Systems Academy will provide hands-on training for transportation industry jobs to students at technical high schools or within state corrections systems.

4. A National Transportation and Community College Summit will enable facilitated discussions to create an action blueprint for enhancing the role of community colleges in all types of transportation workforce development.

TRC SIGNATURE PROJECT #3:
Sustainable Transportation for Tourism

Transportation engineers often study patterns for routine daily travel: to work, to school, for social activities and errands. In this project, funded by US DOT, an experienced interdisciplinary team, led by Dr. Robert Manning (RSEN), tackles the issue of sustainable transportation in the context of tourism. They propose a model built on a matrix-based approach to define varying levels of sustainability where “indicators” are organized into a three-fold framework of environmental, social, and economic considerations. A range of “standards” for these indicators is arrayed across the matrix. Researchers are focusing on three types of geography where tourism travel is significant: tourist towns, scenic corridors and national parks. By incorporating indicators and standards a Level of Service (LOS) style metric can be extended to tourist travel.

Researchers are also considering marketing aspects of tourist travel behavior. Provision of more sustainable transportation such as a certified Green Coach is hypothesized to not only affect tourist travel decisions but to also provide public education and community/economic development.

OTHER PROJECTS OF NOTE:
(Unless otherwise noted, funded by US DOT)

Application of The Network Robustness Index to Identify Critical Road Network Links - Drs. David Novak and Lisa Aultman-Hall, School of Business Administration and School of Engineering

Pupil Transportation: Travel Behavior, Traffic Impacts and Potentials For Improvement - Dr. Qingbin Wang, CDAE

Measuring the Effect of Passengers on the Safety of Older Drivers - Dr. Lisa Aultman-Hall; Funding Agency: New England UTC at MIT

Using a Regional Microscopic Simulation Model to Evaluate Potential Work Zone Control Strategies - Drs. Sadek, Potil and Watts; Funding Agency: VTrans

Scenario Land Use and Transportation Modeling for Community Engagement and Understanding of Regional and Local Scales of Governance - Alexandra (Lexie) Reiss, Master’s Degree Candidate, RSEN

Staple Foods and Transportation: An Institutional Analysis of Local Versus Conventional Supply Chains on Carbon Emissions - Alec Antczak, Master’s Degree Candidate, RSEN

Access to Health Care: Does Transportation Play a Role? - Jane Roodenburg, Master’s Degree Candidate, School of Nursing

Multiple Model Framework of Extended Kalman Filtering for Predicting Vehicle Location Using Latest Global Positioning System – Cesar Barrios, Master’s Degree Candidate, CEMS

Intelligent Traffic Signals: Extending the Range of Self-Organization in Models - Dan Brown, Master’s Degree Candidate, Dept. of Mathematics and Statistics

Transportation Equity and Communities at Risk: Refusing Populations and Transport - Dr. Pablo Bose, Department of Geography

Summer Transportation Institute – Karen Glitman, TRC; Funding Agency: VTrans & FHWA

Demographics of Transportation in the Two Rivers Area - Dr. Richard Watts; Funding Agency: Two Rivers RPC

Transportation Impacts of Transit-oriented Development in Rural Towns - Dr. Watts; Funding Agency: ME DOT
External Funding by source (FY08)

Expenditures by category (FY08)
Total: $2,650,042
The UVM TRC brings together graduate students from across campus to study and research different aspects of the transportation system and its impacts. In problem-based courses, students consider critical issues for transportation in the 21st century and move away from the engineering-dominated transportation focus of the Interstate era. These new generation professionals are from science, engineering, health and social science backgrounds. The transdisciplinary struggles these students and their faculty face in the classroom reflect those now present in our transitioning transportation agencies and firms.

A new course in transportation air quality has been established and taught twice by Dr. Britt Holmén. In 2008 Dr. Holmén presented the course 100% on-line and will expand this opportunity beyond UVM in future years. The course emphasizes the need to integrate the modeling approaches of traffic engineering and environmental engineering.

The Honors College was established in 2004 at UVM to serve outstanding students in a learning-residency environment. In spring 2008, an interdisciplinary team of faculty offered the first case-based course for Honors students on sustainable transportation. The course focused on students determining if the decision to build a controversial regional freeway was an advance or failure in terms of sustainable transportation.

Find out more! Go to www.uvm.edu/transportationcenter and click on "Graduate Studies"

TRC Associated Graduate Students (L to R): Jennifer Kenyon (Master’s in Public Administration), James Sullivan (CEMS), N. Tucker Stevens (CEMS), Joseph Bartlett (RSENR), Elaine Wang (RSENR), Eleanor Campbell (RSENR), Shan Huang (CEMS), Alexandra Reiss (RSENR)
FACULTY & STAFF

External Board of Advisors

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Paul Toussaint - University of Kentucky
Judith Van Houten - Vermont EPSCoR
Jennifer Wallace-Brodeur - VT-AARP
Mark Zydal - McFarland-Johnson, Inc

TRC Staff (left to right)

Gopal Patil, Postdoctoral Researcher
Kim Mercer, Communications Coordinator
Debra Kobus, Business Manager
Richard Watts, Research Director
Lisa Aultman-Hall, Director and Professor, School of Engineering and CDAE
Karen Gilman, Program Director
Julia Kirby, Office Assistant
Damon Lane, Research Engineer
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Pablo Bose - Dept. of Geography
Roelof Boumans - Gund Institute, RSENR
William Bowden - RSENR
Lisa Chase - UVM Extension, VT Tourism Data Center
Bernard Cole - Dept. of Mathematics & Statistics
Robert Costanza - Gund Institute, RSENR
Chris Danforth - Dept. of Mathematics & Statistics
Mandar Dewoolkar - School of Engineering
Peter Dodds - Dept. of Mathematics & Statistics
Margaret Eppstein - Dept. of Computer Science
Brian Flynn - Office of Health Promotion Research
Jeff Frolik - School of Engineering
Lynn Gregory - CDAE
Paul Hines - School of Engineering
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Thomas Macias - Dept. of Sociology
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David Novak - School of Business Administration
Giuseppe Petrucci - Dept. of Chemistry
George Pinder - School of Engineering
Donna Rizzo - School of Engineering
Adel Sadek - School of Engineering
Frederick Schmidt - CDAE
Richard Sicotte - Dept. of Economics
Julia Smith - Dept. of Animal Science

Laura Solomon - Dept. of Psychology
Thomas Streeter - Dept. of Sociology
Austin Troy - RSENR
Qingbin Wang - CDAE
Mary Watzin - RSENR
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Faculty Advisory Committee

Meghan Cope - Dept. of Geography
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David Novak - School of Business Administration
Adel Sadek - School of Engineering
Austin Troy - RSENR

TRC Associated Faculty (l to r): Mandar Dewoolkar, Chris Danforth, Maggie Eppstein, Lynn Gregory, Britt Holmén and Paul Hines
A LOOK BACK AT 2007-2008

July

7·30 / 7·31·07
Center for Excellence in Rural Safety (CERS)
Conference co-hosted with University of Minnesota.

August

SUMMER
Brown Bag Discussion Series: "Critical Issues in Transportation"

September

9·20·07
Seminars: "The Changing Face of Highway Safety in Vermont" with Kevin Markha, VTrans

October

9·21·07
Roundtable Discussion: "Rural Public Transportation: Challenges and Opportunities"

10·10·07
TRC co-hosts Biofuels Workshop which draws 175 participants

10·18·07
RSG and UVM host TRANSIMS FHWA peer review at TRC

10·9·07
CCMPO hosts Senator Bernie Sanders at TRC

November

11·10·07
TRC awarded first NETC grants

11·26·07
Dr. Lisa Aultman-Hall delivers RSEN seminar

FALL
Call issued for new UTC faculty grant proposals

December

12·6·07
Panel Discussion: "Critical Issues in Transportation" with Neale Lunderville, VT Secretary of Transportation, Cindy Burbank, Parsons Brinkerhoff; and Peter Plumeau, RSG

12·11·07
PHEV Event with Nancy Giora, Ford Motor Company

TRC by the numbers

- Graduate students funded: 27
- Faculty on TRC projects: 40
- Colleges involved in TRC projects: 7
- Attendees at outreach events: 1,691
- New staff hired: 5
- Transportation research papers presented at conferences: 17
**January**

1•31•08
Elaine Wang honored as a UTC Outstanding Student of the Year at the Council of UTCs 11th Anniversary Annual Banquet in Washington, D.C.

2•13•08
Seminar: Dr. Joseph Susman of MIT on "Where is Transportation Going in the 'Complex, Large-Scale, Interconnected, Open, Sociotechnical' Systems Era"

2•21•08
PHEV transfer of title ceremony with CVPS President Young, UVM President Fogel and VT Governor Douglas

**February**

**March**

**April**

4•10•08
Seminar: "Rural Roads & Water" - Charles Luce, USDA Forest Service

4•10•08
VT Clean Cities Coalition Stakeholders annual meeting

**May**

5•12•08
1st Annual Transportation Research Expo

5•16•08
Seminar: "Merging Epidemiologic Methods with Transportation Data: the Example of the Black Women's Health Study" Dr. Patricia Coogan, Boston University

5•30•08
TRC completes first project for VTraNS involving traffic simulation on I-89

**June**

6•15•08
TRC partners with Maine DOT to study rural transit-oriented development

6•16•08
Kick-off of the Summer Transportation Institute

6•24•08
TRC hosts Institute of Transportation Engineers (ITE) meeting

**ANNUAL REPORT 2007 - 2008**
The University of Vermont Transportation Research Center (UVM TRC), located in Farrell Hall, is a hub for research, education and outreach related to sustainable transportation. The TRC, founded in 2006, serves as the host of the National University Transportation Center (UTC), funded by the U.S. Department of Transportation. The UVM Transportation Center is a UVM Matrix Center with a clear mission to involve all colleges in all aspects of Center programs and projects.