



National Center
for Sustainable
Transportation

Program Progress Performance Report for University Transportation Centers

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ACCOMPLISHMENTS

What are the major goals of the program?

The National Center for Sustainable Transportation (NCST) is led by the University of California, Davis (UC Davis) and brings together the expertise of its consortium members: Georgia Institute of Technology (Georgia Tech); University of Southern California with California State University, Long Beach (METRANS); University of California, Riverside (UC Riverside); and University of Vermont.

The goal of the NCST is to transform the transportation system to improve environmental sustainability nationwide. We aim to provide leadership that produces meaningful action and outcomes by mobilizing innovative and accomplished research teams and partnering with influential individuals and stakeholder groups. To provide this leadership, we are building upon the well-established and highly influential transportation centers in our consortium to develop a self-supporting center that grows influential research and education programs fully integrated with an aggressive program of engagement.

Specific actions NCST is taking to achieve our goals include:

- mobilizing a network of universities to generate knowledge and tools that address climate change and environmental sustainability in transportation;
- designing and evaluating real-world strategies that contribute to mitigation of greenhouse gas (GHG) emissions and other environmental impacts; and
- delivering knowledge and tools to state departments of transportation, Metropolitan Planning Organization (MPOs), and local governments to support implementation of these real-world strategies.

What was accomplished under these goals?

During this report period (April 1, 2016 to September 30, 2016), the NCST advanced our goals by accomplishing the following administrative, research, engagement, and educational activities:

Administrative Accomplishments

- The NCST Executive Committee conducted one teleconference meeting to discuss and coordinate activities and the NCST Director scheduled one-on-one meetings as needed with partners to discuss and coordinate the selection of Year 3 research projects.
- All of the NCST universities partners coordinated on the Call for Proposals (CFP) for Year 3 research projects. UC Riverside and UC Davis released CFPs for Year 3 research projects for both USDOT and Caltrans funding on March 1, 2016, with proposals due April 1, 2016. METRANS released CFPs for Year 3 research projects for both USDOT and Caltrans funding on March 11, 2016, with proposals due April 15, 2016. Georgia Tech released its CFP for Year 3 USDOT funded research projects on July 12, 2016, with proposals due August 19, 2016. Vermont allocated Year 3 funding to on-going projects

and to one new white paper and two student projects.

- UC Davis completed 3 white papers (one in partnership with Georgia Tech) and 2 research projects, launched one new white paper, and selected 14 research projects as part of Year 3 funding from USDOT and Caltrans. Year 3 projects will launch in the next reporting period.
- UC Riverside completed one research project, launched one new white paper and one new project, and selected 5 research projects as part of Year 3 funding from USDOT and Caltrans. UC Riverside also has a new proposal pending with the California Air Resources Board, in conjunction with UC Davis.
- METRANS completed three white papers and one research project, launched one new white paper, and selected 1 research projects as part of Year 3 funding from USDOT and Caltrans.
- Georgia Tech completed 2 research projects and one white paper (in partnership with UC Davis).
- Vermont completed one research project and launched one new white paper and one new research project.
- The California universities are working together to pursue additional matching funds from the South Coast Air Quality Management District (SCAQMD). Three NCST research proposals are being considered by SCAQMD and it is expected these projects will be officially approved and begin in Winter 2017.

Research Accomplishments

To date, NCST has 17 completed white papers (Table 1), 16 completed research projects (Table 2), 8 white papers in progress (Table 3), and 36 research projects in progress (Table 4). Many research projects involve collaborations across partner institutions, and all projects incorporate technology transfer activities designed to link research to policy and practice. Highlights of NCST research activities include the following:

- **UC Davis and METRANS** researchers served as founding members of the Freight Efficiency Strategies Development Group (FESDG). Caltrans established this group with support from the California Air Resources Board (CARB), California Energy Commission (CEC), and the Governor's Office of Business and Economic Development (GO-Biz) to inform the development of California's Sustainable Freight Action Plan. Members of the group include freight experts from academia, industry, and government who were brought together to produce white papers that identify promising strategies for increasing the efficiency of California's freight system. NCST researchers from UC Davis and METRANS served as lead authors on five of the six white papers produced by the FESDG. All five NCST white papers were used to inform the California Sustainable Freight Action Plan and are prominently displayed on Caltrans's website (listed as the "The Freight Efficiency White Paper Series"). NCST researchers will continue to participate in the FESDG and assist with implementation of California's Sustainable Freight Action Plan.
- **University of Vermont** researchers are using the detailed transportation model of the

Sacramento Area Council of Governments (SACOG) for network criticality research funded by the NCST. In addition, the University of Vermont Transportation Air Quality Lab continues their work examining the composition of biodiesel emissions. University of Vermont also prepared data and drafted the report for the biannual State of Vermont Transportation Energy Profile, an on-going activity of the Vermont Agency of Transportation.

- Georgia Tech** has launched an updated online version of its Fuel and Emissions Calculator (FEC) Version 2.0 that was developed as an update to Version 1.0. It is currently available in the original Excel format as well as a Python code, to support connectivity between the FEC algorithms and other models.

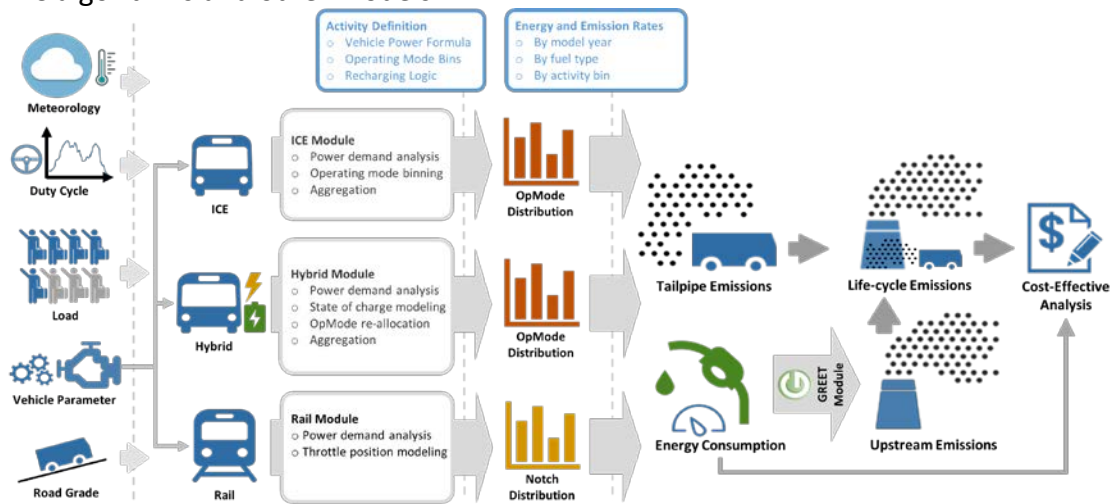


Figure 1: Fuel and Emissions Calculator (FEC) Structure

In Version 2.0, five major FEC modules were updated, including the scenario setting module, energy consumption module, on-road emission rate module, life-cycle assessment module, and cost-effectiveness module. FEC Version 2.0 currently supports four calculators, including the: transit bus calculator, shuttle bus calculator, heavy-duty truck calculator, and rail transit calculator. The calculator makes it easier for transit agencies to assess and compare the performance of alternative vehicle technologies on the basis of purchasing, operating and maintenance costs, including energy/fuel efficiency, and the ability to reduce GHG emissions. The updated version can be reached at <http://fec.ce.gatech.edu/spreadsheetsheetool.html>.

- UC Riverside** started a new project with the goal of evaluating the practical renewable natural gas (RNG) potential in California. The project will identify and examine key production technology components, as well as analyze the benefits, costs, and barriers associated with implementation of this technology. UCR also completed a preliminary study on the viability of dimethyl carbonate as an alternative fuel for the transportation sector. This pilot study included a literature review to address questions related to air emissions, impact on vehicle system durability and parts, and any potential water issues. The pilot study also included some additional emissions testing to evaluate any emissions of toxic species, such as aldehydes, and to look at optimizing the blend level. Another

completed project investigated the cloud forming potential of aerosol from light-duty gasoline direct injection vehicles using a mobile environmental chamber that is designed and constructed to characterize secondary emissions. The cloud condensation nuclei (CCN) ability of aged aerosols was compared to fresh measurements. The fresh and aged emissions were then characterized for CCN properties for a total of six light-duty GDI vehicles. Testing included GDI vehicles with low and high mileage, vehicles operated with ethanol blends, and vehicles retrofitted with prototype gasoline particle filters (GPFs). Projects launched during this time included an evaluation of the potential for renewable natural gas.

Table 1: Completed White Papers

University	Title of White Paper	Funder
GT	Eco-Driving for Transit- Vehicles	USDOT
UCD	Strategies for Transitioning to Low-Carbon Emission Trucks in the United States	USDOT
UCD	A Funding Compromise Can Set Transportation on Path Towards Sustainability	USDOT
UCD	Actual Results May Vary: A Behavioral Review of Eco-Driving for Policy Makers	USDOT
UCD	The Effect of Land Use Policies and Infrastructure Investments on How Much We Drive: A Practitioner’s Guide to the Literature	USDOT
UCD & GT & UVM	What Affects U.S. Passenger Travel? Current Trends and Future Perspectives	Caltrans
UCD	Measuring Land Use Performance: Policy, Plan, and Outcome	Caltrans
UCD	The Role of Life Cycle Assessment in Reducing Greenhouse Gas Emissions from Road Construction and Maintenance	USDOT
UCR	Reducing Carbon Footprint of Freight Movement through Eco--Driving Programs for Heavy-Duty Trucks	USDOT
UCR	Intelligent Transportation Systems for Improving Traffic Energy Efficiency and Reducing GHG Emissions from Roadways	USDOT
UVM	Challenges and Opportunities for Integrating Climate Adaptation Efforts across State, Regional and Local Transportation Agencies	USDOT
UCD & GT	You Can Get There From Here: New Perspectives on Transportation Equity	USDOT
UCD	Freight Efficiency: Maximizing Assets, Off Peak Strategies	Caltrans
UCD	Freight Efficiency: Collaborative Logistics	Caltrans
USC	Freight Efficiency: Information Technology	Caltrans
USC	Freight Efficiency: Hub Modernization	Caltrans
USC	Freight Efficiency: Planning and Policy Harmonization	Caltrans

Table 2: Completed Research Projects

University	Title of Research Project	Funder
UCD	The Application of Permeable Pavement with Emphasis on Successful Design, Water Quality Benefits, and Identification of Knowledge and Data Gaps for Sustainable Transportation	Caltrans
UCD	Understanding Factors that Lead to Electric Bicycles for Bay Area Users with Children	USDOT
UCD	Mandating Green: On the Design of Renewable Fuel Policies and Containment Mechanisms	USDOT
UCD	Do California Highways Act as Barriers to Gene Flow for Ground-Dwelling Mammals?	Caltrans
UCD	Evaluation of the Combined Effect of Recycled Asphalt Pavement (RAP), Recycled Asphalt Shingles (RAS), and Different Virgin Binder Sources on Performance of the Blended Binder for Mixes with Higher Percentages of RAP and RAS	Caltrans
UCD	Exploring Unintended Environmental and Social-Equity Consequences of Transit Oriented Development Using a Spatial Economic Land Use and Activity-Based Microsimulation Model	Caltrans
UCD	The Role of Environmental Concerns, Lifestyles, Mobility-Related Attitudes and Peers' Influence in Affecting Travel Behavior and Aspirations Towards the Purchase of Private Vehicles of Young Adults in California	Caltrans
UCR	Environmentally Friendly Driving Feedback Systems Research and Development for Heavy Duty Trucks	Caltrans
UCR	Using Connected Vehicle Technology for Advanced Signal Control Strategies	USDOT
USC	Spatial Dynamics of the Logistics Industry and Implications for Freight Flows	Caltrans
GT	Improved Emissions Models for Project Evaluation	USDOT
GT	Online Fuel and Emissions Calculator for Heavy-Duty Vehicles	USDOT
UCD	Bicyclist Behavior in San Francisco: A Before-and-After Study of the Impact of Infrastructure Investments	Caltrans
UCD	Equity Impacts of Fee Systems to Support Zero Emission Vehicle Sales in California	USDOT
USC	Urban Spatial Structure and the Potential for VMT Reduction	Caltrans
UVM	Factors Influencing Mode Choice for Intercity Travel from Northern New England to Major Northeastern Cities	USDOT

Table 3: White Papers in Progress

University	Title of White Paper	Funder
UCD	The Environmental Effects of New Mobility Services	Caltrans
USC	The Economic Benefits of Placemaking: Transportation Implications	Caltrans
USC	The Sustainability of Building Affordable Housing in Transit Oriented Developments	Caltrans
CSULB	Introducing Resilience into the State Transportation Network	Caltrans
UCR	Examining the Safety, Mobility and Environmental Sustainability Co-Benefits and Tradeoffs of Intelligent Transportation Systems	Caltrans
UCD & UCR	Environmental Impacts of Autonomous Vehicles	USDOT
UCD	Supporting Sustainable Transportation: Redefining State Practices for Allocating Transportation Funding in California	USDOT
UVM	Long Distance Travel in the United States	USDOT

Table 4: Research Projects in Progress

University	Title of Research Project	Funder
CSULB	Impact of Legislative Mandates on Transportation Workforce Capacity	USDOT
CSULB	Analysis and Optimization Methods for Centralized Processing of Chassis	USDOT
CSULB	Introducing the Resilience into the State Transportation Network	Caltrans
CSULB	Sustainable Mitigation of Stormwater Runoff Through Fully Permeable Pavement	Caltrans
GT	Using Technology to Expand Mobility Options – Innovative Data Collection to Improve Transit Service Assessment	USDOT
UCD	Program for Vehicle Regulatory Reform: Assessing Life Cycle-Based Greenhouse Gas Standards	USDOT
UCD	Accelerating Commercialization of Alternative and Renewable Fuels and Vehicles	CEC
UCD	Assessment of Critical Barriers to Alternative and Renewable Fuel and Vehicle Deployment	CEC
UCD	Electric Vehicle Consumers in China	USDOT
UCD	Deployment of Sustainable Fueling/Charging Systems at California Highway Safety Rest Areas	Caltrans
UCD	Dynamic Ridesharing: Simulation of System-Level Travel Effects Using Agent-Based Demand and Supply Models in the Sacramento Region (Caltrans)	Caltrans
UCD	High Impact Prioritization of Bike Share Program Investment to Improve Underserved Communities' Access to Jobs and Services	USDOT

UCD	Highway and Ecosystem Monitoring and Adaptation to Sea Level Rise	USDOT
UCD	Stochastic Multi-agent Optimization Model for Addressing Risk and Equity Issues in Sustainable Transportation Energy System Planning	USDOT
UCD	The Effect that State and Federal Housing Policies on Vehicle Miles of Travel	Caltrans
UCD	The Impact of Residential Location, Lifestyles and Emerging Technologies on the Travel Behavior and Vehicle Ownership of Young Adults (“Millennials”) in California	Caltrans
UCD	Tracking Land Use Changes that Support Sustainable Mobility	Caltrans
UCD	Using Noninvasive Genetics to Compare How a California Freeway Affects Gene Flow in a Disturbance Averse Versus a Disturbance-Tolerant Species	Caltrans
UCD	Warehousing and Distribution Center Facilities in Southern California: The Use of the Commodity Flow Survey Microdata to Identify Logistics Sprawl and Freight Generation Patterns	Caltrans
UCD	The Dynamics of Plug-In Electric Vehicles in the Secondary Market and Their Implications for Vehicle Demand, Durability, and Emissions	CARB
UCD & UCR	Potential to Build Current Natural Gas Infrastructure to Accommodate the Future Conversion to Near-Zero Transportation Technology	CARB
UCD & UCR	The Development of Lifecycle Data for Hydrogen Fuel Production and Delivery	CARB
UCR	Biking in Fresh Air: Consideration of Exposure to Traffic-Related Air Pollution in Bicycle Route Planning	Caltrans
UCR	Cloud Forming Potential of Aerosol from Light-Duty Gasoline Direct Injection Vehicles	USDOT
UCR	Evaluating the Viability of Dimethyl Carbonate as an Alternative Fuel for the Transportation Sector	USDOT
UCR	Renewable Natural Gas (RNG) Potential Evaluation	USDOT
UCR, USC, & UCD	Eco-Friendly Intelligent Transportation System Technology for Freight Vehicles	CEC
USC	Integrating Management of Truck and Rail Systems in Los Angeles	Volvo
USC	Modeling for Local Impact Analysis	Volvo
USC	Reducing Truck Emissions and Improving Truck Fuel Economy via ITS Technologies	USDOT
USC	Routing Strategies for Efficient Deployment of Alternative Fuel Vehicles for Freight Delivery	USDOT

USC	Congestion Reduction through Efficient Empty Container Movement	Caltrans
USC	Sustainability and Displacement: Assessing the Spatial Pattern of Residential Moves near Rail Transit	USDOT
UVM	Assessing Network Criticality for Climate Adaptation Planning	USDOT
UVM	Advancing Models of Intercity Travel: Overnight Models and Mobile Device Data	USDOT
UVM	Characterizing Biodiesel Tailpipe Emissions (Graduate Student Project)	USDOT

Engagement Accomplishments

In this reporting period, NCST researchers provided 12 presentations on their NCST research, while NCST organized and/or sponsored 38 tech transfer events (including conferences, briefings, and seminars) and held 15 meetings. Engagement highlights during this reporting period are featured below:

UC Riverside hosted a five-week summer lecture series that raised public awareness about topics such as transportation emissions and renewable fuels. This lecture series was partially funded by NCST. Additionally, UC Riverside is actively involved in planning three major engagement events (described in the upcoming engagements events section of this report) that are relevant to sustainable transportation. The 2016 STEP Conference, which encourages local area high school students to pursue STEM careers through hands-on transportation projects and demonstrations hosted by CE-CERT researchers; the 2016 Living the Promise Campaign Launch at which UCR CE-CERT will host a sustainable transportation demonstration; and the Harbor Performance Enhancement Center (HPEC) Workshop, which will focus on sustainable freight and goods movement through our ports.

UC Davis organized a two-part forum in Sacramento on June 20, 2016, that provided an introduction to the Integrated Transport and Health Impact Modeling Tool (ITHIM), which is a family of models being used to explore the health effects of transportation scenarios and policies at varying scales. The forum was planned in partnership with the Sacramento Area Council of Governments, Sacramento County, CARB, Caltrans, California Department of Public Health (CDPH), and Walk Sacramento. The forum engaged over 80 individuals representing state, regional, and local agencies involved in transportation planning and/or public health, public health practitioners, non-governmental organizations, community advocates, and others.



Figure 2: Integrated Transport and Health Impact Modeling Tool (ITHIM) Forum in Sacramento, June 20, 2016

The first part of the forum included a high level introduction to ITHIM including the history, evolution, and current use of ITHIM and featured a panel moderated by Dr. Caroline Rodier (UC Davis) and featuring early users of ITHIM, including practitioners from Fresno Council of Governments and the Metropolitan Transportation Commission as well as Dr. Alex Karner at Georgia Tech. The second part of this two-part event was a technical “under the hood” look at how ITHIM works. This second half featured a more technical presentation by ITHIM’s creator Dr. James Woodcock and Dr. Neil Maizlish who was a former researcher at CDPH and now affiliated with the Public Health Institute.

University of Vermont Associate Director, Professor Lisa Aultman-Hall, will split her time in 2016-2017 between UC Davis and Vermont in order to facilitate growth in the understudied area of sustainability in the long distance travel system of the United States.

The following tables highlight the range of engagement activities completed during this reporting period, including presentations by NCST researchers (Table 5), events sponsored and/or organized by NCST (Table 6), NCST meetings (Table 7), and NCST social media and online engagement activities (Table 8).

Table 5: Presentations by NCST Researchers on NCST-funded Projects

Date	Title	Speaker(s)	Event	Location
4/1/16	<i>The Environmental and Traffic Impacts</i>	Susan Handy, UC Davis	Napa Vision 2050 Economic Forum	Napa, CA

Date	Title	Speaker(s)	Event	Location
4/06/16	<i>Managing Roadway Systems to Reduce Greenhouse Gas Emissions and Improved Energy Efficiency</i>	Matthew Barth, UC Riverside	CARB Meeting	Sacramento, CA
4/6/16	<i>UCLA Lewis Center Goods Movement Lecture</i>	Genevieve Giuliano, USC	Harvey S. Perloff Lecture Series	Los Angeles, CA
4/8/16	<i>The Science Behind Sustainable Communities</i>	Susan Handy, UC Davis	UC Davis Capitol Speaker Series	Sacramento, CA
4/12/16 - 4/14/16	<i>Powering Possibilities</i>	Tom Durbin, UC Riverside	2016 SAE World Congress	Detroit, MI
5/14/16	<i>"Stuck in Traffic: Will More Lanes Help?"</i>	Susan Handy, UC Davis	Sensible Transportation Lecture	Santa Cruz, CA
5/26/16	<i>"Mobility of Millennials"</i>	Giovanni Circella, UC Davis	Caltrans Seminar Series	Sacramento, CA
6/13/16	<i>Potential for Reducing Pedestrian's Exposure to Traffic-Related Air Pollution through Route Choice Decision</i>	Kanok Boriboonsomsin, Matthew Barth, and Jill Luo, UC Riverside	2nd International Conference on Transport & Health	San Jose, CA
6/22/16	<i>Update on NCST Activities and Research</i>	Laura Podolsky, UC Davis	AASHTO Standing Committee on the Environment Meeting	San Antonio, TX
7/11/16	<i>Pathways To Deep Decarbonization In Transportation</i>	Dan Sperling, UC Davis	2016 Sustainable Transportation Summit	Washington D.C
7/19/16- 7/21/16	<i>Energy and Emissions Implications of Connected and Automated Vehicles</i>	Matthew Barth, UCR & Caroline Rodier, UC Davis	Automated Vehicles Symposium 2016	San Francisco, CA
7/20/16	<i>Environmental Impacts of Connected and Automated Vehicles: Research Update</i>	Matthew Barth, UC Riverside	IEEE Intelligent Vehicle Conference	Gothenburg, Sweden
8/10/16	<i>Sustainable Transportation and Sustainable Pavement</i>	Laura Podolsky & John Harvey, UC Davis	Congressman John Garamendi Transportation Forum	Fairfield, CA

Date	Title	Speaker(s)	Event	Location
8/11/16	<i>How Three Transportation Revolutions Are Starting To Disrupt Transportation As We Know It</i>	Dan Sperling, UC Davis	UC Davis Tahoe Science Center Speaker Series	Lake Tahoe, CA
8/18/16	<i>Housing and Transportation</i>	Laura Podolsky, UC Davis	San Joaquin Valley Affordable Housing Summit	Fresno, CA
8/30/16-8/31/16	<i>Alt Fuels & Heavy-Duty Vehicles: Fuel and Emissions Calculator</i>	Yanzhi (Ann) Xu,, Georgia Institute of Technology	Northern Transportation & Air Quality Summit 2016	Baltimore, MD
9/2/16	<i>Innovative Travel Survey Methods in Vermont</i>	Jonathan Dowds, UVM	Vermont Planners Association	Montpelier, VT
9/21/16	<i>Roundtable Discussion: The Future and the Vision for Reaching Air Quality, Climate, and Fuel Savings Goals for California</i>	Dan Sperling, UC Davis	Diesel Technology Forum	Sacramento, CA
9/28/16	<i>What Planners Need to Know About Automated Vehicles</i>	Giovanni Circella, UC Davis	Caltrans Seminar Series	Sacramento, CA

Table 6: NCST Sponsored and/or Organized Events

Date	Event Name	Description	Organizer	Location
4/6/16	New Solutions for Building and Operating Roadways to Achieve GHG Reductions	This briefing provided NCST funders an update on NCST research and discussed implication of research on policy and practice.	UC Davis	Sacramento, CA
5/5/16	Eco-Driving to Reduce Emissions for Buses	This webinar featured a presentation from Yanzhi (Ann) Xu (Georgia Tech) and guest respondents from American Public Transportation Association and Georgia Regional Transportation Authority.	UC Davis	Online

Date	Event Name	Description	Organizer	Location
5/19/16	Do Highways Act As Barriers To Gene Flow For Wildlife Populations?	The webinar featured a presentation from Fraser Shilling and Amanda Coen from UC Davis and featured guest respondents from Caltrans and CA Department of Fish and Wildlife.	UC Davis	Online
6/1/16	Reducing GHG Emissions Through Intelligent Transportation System Solutions	The webinar featured a presentation from Matthew Barth from UC Riverside, and guest respondents from Southern California Association of Governments and Honda R&D Americas, Inc.	UC Davis	Online
6/6/16	Equity Impacts Of Fee Systems To Support Zero-Emission Vehicle Sales In California	This webinar featured a presentation from Lew Fulton, Gil Tal, and Julie Schiffman from UC Davis, and guest respondent from ARB.	UC Davis	Online
6/13/16 – 6/15/16	International Conference on Transport & Health	NCST sponsored this conference, which brought together policymakers, practitioners, and academics to share stories of success and failure, build collaborations, and find inspiration.	Mineta Transportation Institute	San Jose, CA
6/20/16	Advancing Health Through Transportation Planning: An Introduction To The Integrated Transport And Health Impact Model Tool	NCST organized this event in partnership with ARB, Sacramento County, SACOG, Sacramento Walks, and CA Public Health Department. The event brought participants together to gain a better understanding of the history, evolution, and current use of ITHIM.	UC Davis	Sacramento, CA
9/15/16	NCST Undergraduate Research Fellows Presentations	All UC Davis undergraduates that received a summer research fellowship presented their research to UC Davis researchers and students.	UC Davis	Davis, CA

Table 7: NCST Meetings

Date	Purpose and Description	Location
4/1/16	Caroline Rodier provided technical assistance to David Flink of Climate Resolve regarding GHG impacts of LA Metro's transportation funding plan	Phone Meeting
4/20/16	NCST Executive Committee conference call	N/A
5/27/16	John Harvey (UC Davis) met with CA State Association of Counties staff and members to discuss sustainable pavement practices.	Sacramento, CA
6/2/16	Susan Handy, Dan Sperling, and Laura Podolsky met with James Corless with Transportation for America to discuss NCST research and future collaborations on dissemination.	Davis, CA
7/19/16	NCST Executive Committee conference call	N/A

Table 8: Media and Online Engagement Summary

Media Platform	Activity
YouTube	All UC Davis seminars and NCST webinars are recorded and posted on YouTube.
Web Page	The main NCST website (ncst.ucdavis.edu) had 6,187 unique visits or “sessions” within this reporting period. On average, each session included the person visiting three different pages on the NCST site, which translates to approximately 16,709 page views.
Online Engagement	NCST manages two social media accounts (Twitter and LinkedIn) to disseminate research results, news, events, and other updates; and to engage with policymakers and practitioners. Our Twitter account has 345 Followers and LinkedIn has 145 followers. In addition, UVM manages Twitter and Facebook accounts; METTRANS manages Twitter, Facebook, and LinkedIn accounts; and UC Davis manages separate Facebook and Twitter accounts.

UC Davis continues to host a weekly seminar series, available online for UC Davis students and those of other partner institutions. Speakers are invited from government, industry, public interest groups, partner institutions, and other academic institutions. The seminar series is a required course for all first and second year transportation graduate students. UC Davis faculty, staff, and researchers also attend the seminars, as do state and local agency staff and community members. The following are seminars that occurred during the reporting period:

The Potential of Volunteered Geographic Information (VGI) on Future Transport Systems - Maria Attard, Professor, University of Malta, Department of Geography, Faculty of Arts, Director, Institute for Climate Change and Sustainable Development

The Potential of Volunteered Geographic Information (VGI) on Future Transport Systems - Maria Attard, Professor, University of Malta, Department of Geography, Faculty of Arts,

Director, Institute for Climate Change and Sustainable Development

LOS to VMT: A Paradigm Shift in Transportation Planning - Chris Ganson, Senior Planner, Governor's Office of Planning and Research

Efficiency Measurement and the Design of Engineered Systems for Resilience: Themes and Future Research Opportunities - Konstantinos (Kostas) Triantis, John Lawrence Professor of Industrial Engineering and Operations Research, National Capital Region Senior Advisor, Chair, National Capital Region College of Engineering Executive Committee, Grado Department of Industrial and Systems Engineering, Adjunct Professor of Civil and Environmental Engineering, Virginia Tech

Road Ecology and Transformative Change in Sustainable Transportation - Fraser Shilling, Co-Director, Road Ecology Center, Dept. of Environmental Science and Policy, UC Davis

Improving Air Transportation System Performance through Coordinated Speed Control - Michael O. Ball, Robert H Smith School of Business & Institute for Systems Research University of Maryland and Civil & Environmental Engineering, UC Berkeley

Why Don't Teenagers Drive Anymore? Factors Associated With Delayed Driver's License Acquisition Among High School Students - Rodney Brown, Engineer/Planner at Fehr & Peers

Emerging Best Practices to Accelerate Electric Vehicle Deployment - Nic Lutsey, Program Director, The International Council on Clean Transportation (ICCT)

The Rise of Electric Bikes in the US: An Analysis of their Roots, their Early Adopters, and Implications on Urban Transportation - Jonathan Weinert, Sales and Marketing Manager, Robert Bosch LLC, Automotive Electronics, Bosch eBike Systems

Implications of a Peak in Global Oil Demand – Amy Jaffe, Executive Director, Energy and Sustainability, ITS- Davis, UC Davis

Educational Accomplishments

Sustainable Curriculum Development:

The Georgia Tech team is developing online lecture content development that will continue recording this year. We expect to have the online lectures ready for UC Davis, UC Riverside, and University of Vermont next year. The table below summarizes the status of lecture content development that has been recorded up to Oct 15, 2016.

Module	PPT Status	Record Status
Course Introduction	N/A	Completed
Module 1: Course Overview	Completed	Completed
Module 2: Energy and Transport as Complex Systems	Completed	Completed
Module 3: Energy Resources and Energy Consumption	Developing	To Be Recorded
Module 4: The Transportation System	Completed	To Be Recorded
Module 5: Transportation Sectors	Completed	To Be Recorded
Module 6: Petroleum Refining	Completed	Completed
Module 7: IC Engine Operations	Completed	To Be Recorded
Module 8: Ultra-lighting and Efficiency Improvements	Completed	Completed

Module 9: Electric and Hybrid Vehicles	Completed	Completed
Module 10: Managing Transportation Demand	Completed	To Be Recorded
Module 11: Solar and Wind	Completed	Completed
Module 12: Biofuels	Completed	To Be Recorded
Module 13: CNG as a Transportation Fuel	Completed	Completed
Module 14: Electric Utilities - Power Production	Completed	To Be Recorded
Module 15: Nuclear Power	Completed	Completed
Module 16: Electricity Distribution	Completed	Completed
Module 17: Shale Oil Production and Distribution	Completed	Completed
Module 18: Transportation Subsystem Presentations	Completed	N/A
Module 19: Alternative Energy Subsystem Posters	Completed	N/A
Module 20: GREET Overview	Completed	Completed
Module 21: MOVES	Completed	Completed
Module 22: FEC	Completed	Completed
Module 23: Solar Facility Tour	N/A	To Be Recorded
Module 24: CSX Yard Operations Tour	N/A	To Be Recorded
Module 25: MARTA Operations Tour	N/A	To Be Recorded

Educational Courses and Conferences: In Fall 2015 and 2016, the University of Vermont's NCST researcher James Sullivan became a new instructor for the junior-level course Introduction to Transportation Engineering. Dr. Britt Holmen continues to teach UVM's Transportation Air Quality Course, the focus on tailpipe emissions is unique in an undergraduate civil engineering program. In Spring 2016, Dr. Lisa Aultman-Hall adapted a long-standing graduate level course in transportation safety into a senior design course for civil engineering seniors. Students used real world data for technical papers addressing safety as a core piece of the social elements of sustainability. Project topics included bicycle safety in New York City, the relationship between traffic safety and crime in Chicago, diverging double diamond interchange design, use of in-vehicle restraints for children, alcohol involved crashes, socioeconomic status and crash severity, pedestrian safety and urban design.

UC Riverside- CE-CERT hosted a Summer Lecture Series during the month of August that focused on such topics as transportation emissions and renewable fuels. This series was partially funded by NCST. The curriculum included the formation and mitigation of transportation-based air pollution, an examination of the production and economic impacts of renewable fuels, and the future of renewable fuel technology. Students also participated in related site visits to partners such as the Air Quality Management District. The Summer Lecture raises awareness of issues related to the impact of transportation on the environment, and provides a current technical education about how these issues can be addressed. As a hands-on program, the projects that accompanied the lecture allowed students to learn and directly apply their new knowledge, which will enhance their existing careers or assist in preparing them for new ones.

Student Travel: UC Davis provided travel funding for three students to attend the International Conference on Transport & Health in San Jose, CA from June 13 – 15, 2016. In addition, NCST

supported the “Mobility Quest” tour for incoming UC Davis transportation graduate students. The learning and adventure trip takes place in September, the week before the start of Fall Quarter. Students learned firsthand about sustainable transportation and renewable energy efforts across Oregon and Northern California. Meetings with transit agency representatives, municipal transportation planners, and auto/truck maker officials were highlights--including Daimler Trucks North America, where students learned about and inspected the fuel efficient Super Freightliner SuperTruck. In an "epic multi-modal, educational scavenger hunt" students traveled by foot, bike and streetcar in Portland's Downtown and Pearl District--through linear parks, redevelopment projects, and transit-oriented neighborhoods. Fifteen students participated in this year’s “MobQuest” tour.

NCST also supported a student team of six undergraduates to attend the MidPac Institute of Transportation Engineers data/design competition in April 2016. This student competition allowed students to use AutoCAD Civil 3D to design an intersection for a Mega Mall in Reno, NV, and included the road design, signal and pedestrian timing, and cost estimation analysis. The UC Davis team was awarded second place. In their own words, the students said this was a valuable learning experience:

- Freshta Pirzada: *“This transportation design project provided me with the opportunity to build my expertise on AutoCAD and to gain insight to traffic engineering”.*
- Din Hong (Co-President, UC Davis ITE Chapter): *“This project allowed me to apply my knowledge and experience in AutoCAD Civil 3D to solve realistic problem in a contemporary application”.*
- Charuni Kurumbalapatiya: *“The compilation of the design report and the participation in the poster session developed my presentational and technical writing skills, while simultaneously allowing me to build my enthusiasm for transportation engineering”.*

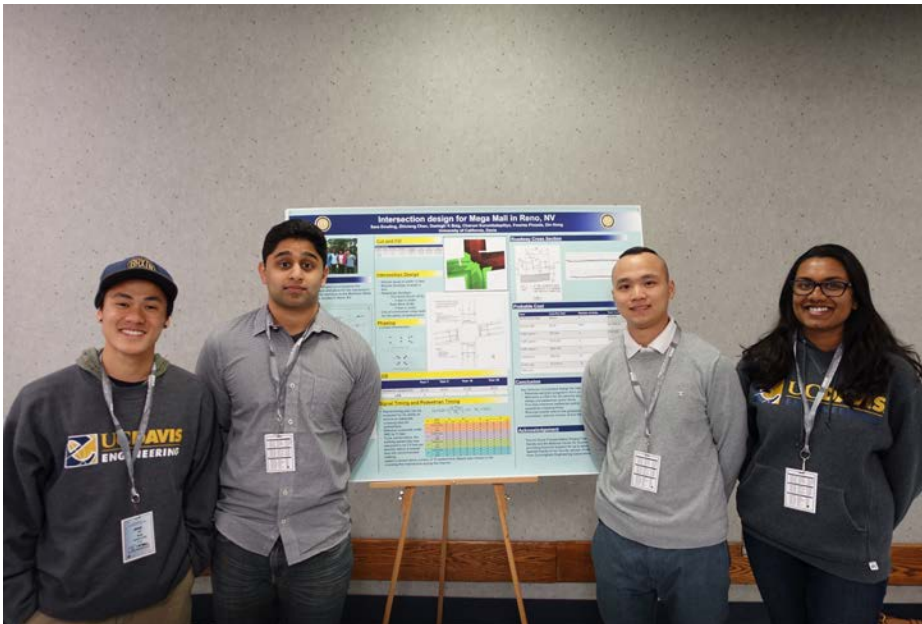


Figure 3: The UC Davis ITE Team at the 2016 MidPac Competition, April, 2016.

Dissertation Fellowships: UC Davis and UC Riverside received and reviewed the spring 2016 dissertation fellowship applications. NCST selected and is funding a total of nine dissertation fellowships for the 2016-2017 academic year. Dissertation proposals fell into one or more of the following focus areas: infrastructure and systems operation, vehicles and fuels, travel demand, and institutional change. The program was open to proposals from any discipline, and multidisciplinary topics were encouraged when appropriate. UC Davis also released a call for Fall 2016 Dissertation proposals, and will review and select those fellows in Fall quarter, 2016. The following are projects currently in progress:

- What Makes Travelers Use Uber? Exploring the Latent Constructs behind the Adoption of On-demand Ride Services – Farzad Alemi, UC Davis
- Traffic signal control with dynamic traffic routing in a VANET environment – Huajun Chai, UC Davis
- The Road Environment and Urban Bicycling: Psychophysiological and Behavioral Responses and their Implications for Transportation Planning – Dillon Fitch, UC Davis
- Estimation of Program Effects from Cross-sectional Observational Surveys – Case Studies of the Effect on Travel Behavior of The Adoption of (i) Future Mobility Options like Car-sharing, and (ii) Telecommuting – Arash Saboori, UC Davis
- Building Stocks of Experience: How Beliefs About How You Can, Ought, and Like To Travel Influence Youths’ Current and Future Travel Behavior – Calvin Thigpen, UC Davis
- Understanding the Role of Transportation in Meeting California’s Greenhouse Gas Emissions Reduction Target: A Focus on Technology Forcing Policies, Interactions with the Electric Sector and Mitigation Costs – Saleh Zakerinia, UC Davis
- Measurement and Estimation of Particulate Matter Concentration on Highways in Southern California; Characterization of Diesel Emissions using In-door Smog Chamber – Liem Pham, UC Riverside
- Understanding and Advancing THF Co-solvent Enhanced Lignocellulosic Fractionation (CELf) Pretreatment when Integrated with Enzymatic Hydrolysis and Fermentation – Abhishek Patri, UC Riverside
- Spatial Accessibility, Perceived Barriers, and Visitation to National Parks – Xiao Xiao, University of Vermont

Graduate Student Research Projects: In fall 2016, Georgia Tech put out a request for proposals to fund three, \$30k, short-term student projects with Year Three funds. Seven proposals were received in August. The peer review panel just completed their evaluations and the top three projects will be funded in October. Each project is supported by a faculty member and includes a 1:1 match.

The University of Vermont also funded a Master’s student, Jack Reed, on a project titled “Characterizing Biodiesel Tailpipe Emissions.” He is expected to complete his Master’s thesis and graduate in Spring 2017.

In addition to the two dissertation fellowships, UC Riverside also awarded four graduate fellowships: Faraz Ahangar, Joshua Buli, Joshua Morales, and Patrick Roth. Research areas addressed by these awardees include emissions and urban air quality, the environmental impacts of fuel after-treatment, and biomass to sustainable fuel conversion.

Undergraduate Summer Research Fellowships: NCST awarded six undergraduate research fellowship awards in 2016 to students interested in continuing their studies over the summer by conducting research in one of the following areas: low-carbon infrastructure and efficient systems operation, low-impact travel and sustainable land use, and zero-emission vehicles and fuel technologies. The following are brief summaries of funded projects:

- **Solar Energy Potential on the Largest Rooftops in the United States** – Praewa (Patty)



Boonlue and Esther Robles De Wence, UC Davis. Patty and Esther worked together to research photovoltaic (PV) solar energy-generating systems. Their goal is to quantify the potential of rooftop-mounted PV systems deployed on 25 of the largest buildings in the United States and compare the amount space on land that rooftop-mounted PV systems save to ground-mounted, utility-scale PV power plants.

- **Investigating the Factors Affecting Millennial Mobility** – Freshta Pirzada, UC Davis.



Freshta worked with a group of graduate students to determine what affects young adults' choices of mobility. She helped analyze responses of over 2,000 young adults to determine how certain factors (e.g., home type, commute distance, travel patterns, city type) influence travel choices. Once patterns and overall preferences were determined, land use and transportation planners can use this information to ensure the mobility needs of young adults are being met.

- **Empirical Analysis of Crowdsourced Google Travel Time Data for Sustainable**



Transportation Applications – Tului Gantulga, UC Davis. Tului researched strategies to improve the efficiency of urban freight deliveries considering delivery times, sequence of stops, costs, and the economic and environmental impact of congestion. He worked on creating a program that takes requests at any time of the day and calculates the most efficient way of picking up/dropping off a package based on previously mentioned considerations. The program also gathers traffic data from Google at different times of the day and different days of the week to be able to work offline.

- **The Expansion and Viability of Dynamic Ridesharing on a Worldwide Scale** – Itsel



Guzman, UC Davis. Itsel researched the social and economic viability of dynamic ride sharing services like Uber and Lyft. The study looks at the growth and efficiency of ride share services, and their impacts on carpooling and car ownership in the future.

How have the results been disseminated?

The engagement activities listed above are the main avenues for NCST research dissemination and engagement with stakeholders. In addition to what is listed above, NCST also produces policy briefs (Figure 2) for all research projects and white papers. The policy briefs distill key research findings into a one-page document that is targeted to a policymaker and practitioner audience. Currently, NCST has 11 policy briefs posted to our website for download.

What do you plan to do during the next reporting period to accomplish the goals?

Planned Administrative Activities

The Center Director and Program Manager will monitor ongoing projects via quarterly reports to ensure projects are progressing on schedule and that final deliverables and products (research reports and policy briefs) are completed and results disseminated effectively. Depending on funding availability, all NCST partner universities will be collecting proposals for Year 4 USDOT-funded research projects and the California universities will be collecting proposals for Year 4 Caltrans-funded research projects. All proposals will be circulated for external review and prioritized for funding. The NCST Executive Committee will continue to have quarterly conference calls.

Planned Research Activities

Researchers at each of the consortium universities will continue work on white papers and research projects that have been initiated and are in progress (see Tables 3 and 4). We expect 20 research projects and 9 white papers to be finalized during the next reporting period. We also expect several projects to begin in the next reporting period (Table 9).

UC Riverside has received funding for two new federal projects. One project will study particle emissions from hybrid-electric vehicle during real world driving under different weather conditions, and the other will examine the development of key-enabling technologies for a variable-blend natural gas vehicle.

Table 9: Research Projects and White Papers that Will Start In Next Reporting Period

University	Project Description	Funder
UCD	The Impact of Shared Mobility on the Use of Other Transportation Modes and Auto Ownership among Millennials and Middle-Age Adults in California	Caltrans
UCD	Truck Choice Modeling: Understanding California's transition to ZEV trucks taking into account truck technologies, costs, and fleet decision behavior	Caltrans
UCD	Development of a Freight System Conceptualization AND Impact Assessment (Fre-SCANDIA) Framework	Caltrans

University	Project Description	Funder
UCD	Life Cycle Assessment for Complete Streets: Framework and Pilot Studies	Caltrans
UCD	Development and Application of an Integrated Health Impacts Assessment Tool For Transportation Plans in Sacramento County	Caltrans
UCD	Understanding the distributional impacts of vehicle policy: Who buys new and used alternative vehicles?	Caltrans
UCD	Automated Vehicle Scenarios: Simulation of System-Level Travel Effects Using Agent-Based Demand and Supply Models in the San Francisco Bay Area	Caltrans
UCD	Evaluating the Need for Policy Interventions: Will On-Demand Ridesharing Services Enhance Sustainability and Mobility?	Caltrans
UCD	Local Government Research, Development and Implementation Organization in Other States	Caltrans
UCD	Framework for Urban Metabolism of Hardscape Including Climate Change Considerations	USDOT
UCD	Are We Hardwiring Gender Differences into the Plug-In Electric Vehicle Market?	USDOT
UCD	A Meta-analysis of Eco-driving Feedback Research	USDOT
UCD	Wildlife-Crossing Mitigation Effectiveness with Traffic Noise and Light	USDOT
UCD	Development of Integrated Vehicle and Fuel Scenarios for Low Carbon US Transportation Futures	USDOT
UCR	Developing an Interactive Machine Learning based Approach for Sidewalk Digitalization	Caltrans
UCR	Evaluating Environmental Impact of Traffic Congestion in Real Time Based on Sparse Mobile Crowd-sourced Data	Caltrans
UCR	Development of Key-Enabling Technologies for a Variable-blend Natural Gas Vehicle	USDOT
UCR	Particle emissions from hybrid-electric vehicle during real world driving under different weather conditions	USDOT
UVM	White Paper on Long Distance Travel in the United States	USDOT
USC	Intelligent Parking Assist for Trucks	USDOT
USC	Market Analysis for ZEVs in Freight Applications (tentative)	Caltrans

Planned Engagement Activities

NCST will continue organizing and participating in a wide range of activities to disseminate research results and engage with relevant stakeholders and policy makers. Activities that have been planned to date are listed in Tables 10, 11, 12, and 13.

Table 10: Upcoming Presentations by NCST Researchers

Date	Title	Speaker(s)	Event	Location
11/5/16	<i>Cars vs. Bikes? Resolving Conflicts Between Different Road Users</i>	Susan Handy, – UC Davis	Association of Collegiate Schools of Planning 56th Annual Conference	Portland, OR
10/9/16-10/12/16	<i>TOD Research: Hot of the Presses – and the Streets</i>	Marlon Boarnet, USC	Rail~Volution 2016 Conference	San Francisco, CA

Table 11: Upcoming NCST Sponsored and/or Organized Events

Date	Event Name	Description	Organizer	Location
10/5/16	2016 STEP Conference	This annual conference hosts students from area high schools that have a strong concentration in STEM subjects for the purpose of inspiring students to pursue education and careers in STEM fields.	UC Riverside	Riverside, CA
10/15/16	Internal UCR Research Highlight Meeting	CE-CERT will sponsor a sustainable transportation themed exhibit as a part of UC Riverside’s Living the Promise campaign. The exhibit will feature a demonstration of the principles of eco-driving using the driving simulator, as well as an information presentation on biomass conversion for sustainable fuels.	UC Riverside	Riverside, CA
10/16/16 – 10/18/16	UCLA Lake Arrowhead Symposium 2016 – Pay It Forward: Investing In Sustainable Mobility	NCST will serve as a sponsor of the UCLA Lake Arrowhead Symposium, which brings together a diverse and intimate group of influential policy-makers, private sector stakeholders, public sector analysts, consultants, advocates, and researchers to take a deep dive into a pressing public policy challenge related to the transportation – land use – environment connection.	UCLA	Lake Arrowhead, CA

Date	Event Name	Description	Organizer	Location
10/28/16	Harbor Performance Enhancement Center (HPEC) Workshop	This workshop will gather experts from a variety of disciplines to discuss and integrate design, financing, and environmental ideas that would achieve the following: (1) significant reductions in port related emissions, (2) increase operational efficiencies, and (3) foster a culture of collaboration, education, continuous improvement, and respect amongst stakeholders. The event will feature speakers from UCR (Kanok Boriboonsomsin), CSULB (Tom O'Brien) and USC (Nick Vyas)	UC Riverside	Riverside, CA
11/15/16 – 11/16/16	<i>Policies for the Three Transportation Revolutions of Shared, Automated, and Electrified Vehicles</i>	This conference will bring together representatives from government, academia, and the private sector to explore the key policies and strategies that will encourage potential synergies between electrification, automation, and vehicle and ride sharing.	UC Davis	Davis, CA

Table 12: Upcoming NCST Meetings

Date	Purpose	Location
10/6/2016	NCST Dinner Meeting	Davis, CA
10/31/16	Briefing for California Assembly Member Jim Frazier and staff from the Assembly Transportation Committee.	Davis, CA
12/13/16	Briefing for California Senate Transportation and Housing Committee.	Davis, CA

Table 13: Planned Media and Online Engagement Activities

Media Platform	Activity
YouTube	All UC Davis seminars and webinars are recorded and posted on YouTube.
Web Page	UC Davis will continue to update the NCST main website. METRANS and UVM will maintain a NCST page on their websites. Georgia Tech will manage an outreach web page for their fuel emissions calculator for transit vehicles.
Online Engagement	UC Davis will continue manage NCST's two social media accounts. UVM will continue to manage its two social media accounts; METRANS will continue to manage its three social media accounts; and UC Davis will continue to

	manage its two separate social media accounts.
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In addition to presentations described above, weekly UC Davis seminars will continue with support from the NCST, including the following seminars:

Dealing with Mega Projects: Big Costs, Big Risks, Big Expectations- Therese McMillan, Chief Planning Officer, Los Angeles County Metropolitan Transportation Authority

Understanding Long-Distance Travel Behavior: Findings from the Longitudinal Survey on Overnight Travel and National Household Travel Surveys- Jeff LaMondia, Associate Professor in Civil Engineering, Auburn University

Congested Development? Rethinking the Causes and Consequences of Metropolitan Traffic Delays- Brian D. Taylor, Professor of Urban Planning; Director, Institute of Transportation Studies; Director, Lewis Center for Regional Policy Studies, Luskin School of Public Affairs, UCLA

Overlapping Environmental Policies and the Impact on Pollution- Kevin Novan, Assistant Professor, Agricultural and Resource Economics, UC Davis

Reduce Bay Area Commuting by 25%, Using: Enterprise Commute Trip Reduction Software, Mobility Aggregation Apps, Gap-Filling Mobility Services, Drive Alone Sticks Fund Green Travel Carrots- Steve Raney, Principal, Cities21

What is Complete Trip and How Do We Achieve It? - Ron Kilcoyne, General Manager, Lane Transit District

High-Speed Rail: Connecting and Transforming California- Dan Richard, Chair, Board of Directors, California High-Speed Rail Authority

Social Networks and Travel Behavior: An Investigation into the Role of Social Influence in the Transportation Mode Choices of Students- Susie Pike, Postdoctoral Researcher, ITS-Davis and Center for Environmental Policy and Behavior, UC Davis

What does a 'Sustainable' Neighborhood Development Pattern look like: Past, Present, Future Fused Grids and Beyond- Gord Lovegrove, Associate Professor, School of Engineering, Sustainable Transport Safety Research Laboratory, The University of British Columbia

Household and Firm Responses to Gasoline Prices and Energy Policy- William Chi Chiao Leung, Postdoctoral Researcher, Economics Department, UC Davis and Economics Fellow, California Air Resources Board

Title to Be Determined- Making Geosense of Transportation, Trade, Environment, and Energy: indicators, impacts, and opportunities for international shipping- James Corbett, Professor, School of Marine Science and Policy, University of Delaware

The Sustainable Urban Mobility Plans (SUMP) in Europe: Planning Walking and Sojourning in Streets and Public Spaces- Thanos Vlastos, Professor of Urban & Transport Planning at National Technical University of Athens, School of Surveying Engineering, Department of Geography and Regional Planning

Incentivize It and They Will Come: How Local Governments Are Leveraging Airline Incentive Programs to Grow Air Service- Megan S. Ryerson, Assistant Professor, Department of City and Regional Planning, Department of Electrical and Systems Engineering, University of Pennsylvania

Planned Educational Activities

Georgia Tech is planning to finish filming of the transportation and energy course, and deliver the course content via HELIX to all partners that are interested.

UC Davis will offer research grants for incoming students for the 2016/17 academic year based on new student applications. UC Davis will review the proposals for 2016/17 Dissertation Grants, due April 29, 2016, and will select and process those fellowships. UC Davis will continue to award travel grants to students who are presenting transportation related research at academic and professional conferences and events.

METRANS will modify the existing on-line training program by developing program code that better tracks user activity on individual pages and increases the test bank. Efforts will also be made to extend the reach of the training by offering it throughout the NCST network of schools and transit partners (including campus bus operators). Exit interviews will be conducted with training participants to gauge the success of the program. This approach leverages METRANS's earlier FTA grant while creating a learning platform that can be used for other training modules.

2016 STEP Conference: On October 5, 2016, UCR CE-CERT will host the Science Technology Education Partnership (STEP) Conference. This conference will include approximately 150 high school students from five different high schools in California's Inland Empire region. The targeted high schools have a strong science and math core with after school programs that help mentor students with hopes to inspire students to further their STEM education. The high school students will be able to experience hands-on demonstrations in laboratory settings. CE-CERT will execute eight different stations covering six different research areas, all with a focus on sustainable transportation.

2017 PEMS Conference: UCR CE-CERT will host its 2017 PEMS Conference on March 30th and 31st, 2016. This annual conference, which is the only worldwide conference dedicated to reviewing the evolving state of research, applications and new regulations on PEMS (Portable emissions measurement systems) for transportation applications, will be attended by approximately 200 people from over 50 different companies, agencies or institutions representing 10 countries from around the world. The presentations will provide a comprehensive discussion on PEMS: regulatory development and trends; approaches for measuring in-use PM from a variety of vehicles; current and future research developments; and development of new instrumentation for vehicle in-use testing.

PRODUCTS

Forty-three of the seventy-six research projects and white papers funded by the NCST to date are on-going, and thus final products have not yet been released. However, the 33 completed projects and many of the on-going projects have deployed and/or developed products in the past six months, including the following examples:

TOOLS/INSTRUMENTS

1. Georgia Tech's Fuel Emissions Calculator (FEC) website and online tool was updated and released March 2016 (fec.ce.gatech.edu). Since its publication, webinars hosted by Georgia Tech have been added that include usage training, technical applications, and non-technical applications of FEC. They can be accessed online at <http://fec.ce.gatech.edu/tutorials.html>.
2. Non-provisional patent application in progress for Online Wobbe Sensor for the Natural Gas by indirect measurement with Chemo-metric Data, UC Case No. 2016-026
3. Provisional patent application in progress for Onboard Ecological Stop-and-Go (Eco-SG) Behavior Learning and Advising System

PEER-REVIEWED PUBLICATIONS

1. Luo, J., Boriboonsomsin, K., and Barth, M. (2016). "Potential for Reducing Pedestrian's Exposure to Traffic-Related Air Pollution through Route Choice Decision." 2nd International Conference on Transport & Health, San Jose, CA, June 13-15.
2. X. Qi, M. Barth, G. Wu, K. Boriboonsomsin, "Intelligent On-Line Energy Management System for Plug-in Hybrid Electric Vehicles based on an Evolutionary Algorithm," Proceedings of the 2016 on Genetic and Evolutionary Computation Conference Companion, pp. 167-168, 2016.
3. W. Li, G. Wu, M. Barth and Y. Zhang, "Safety, Mobility and Environmental Sustainability of Eco-Approach and Departure Application at Signalized Intersections: A Simulation Study," Proceedings of the 2016 IEEE Intelligent Vehicles Symposium (IV), Gothenburg, Sweden, June 19-22, 2016, pp. 1109-1114.
4. Yang, J., Jiang, Y., Karavalakis, G., Johnson, K., Kumar, S., Cocker III, D. and Durbin, T. (2016). "Impacts of dimethyl carbonate blends on gaseous and particulate emissions from a heavy-duty diesel engine," Fuel, 184, 681-688.
5. Aultman-Hall, Lisa and Jonathan Dowds (2016). Role and Position of Local Agencies in Climate Adaptation Planning. 95th Annual Transportation Research Board Meeting Conference, January, Washington, D.C.
6. LaMondia, Jeff, Michael Moore and Lisa Aultman-Hall. (2015) Modeling Inter-Trip Time Intervals Between Individuals' Overnight Long-Distance Trips. *Transportation Research Record* 2495. DOI: <http://dx.doi.org/10.3141/2495-03>
7. Li, H., Haobing Liu, Y. Xu, M.O. Rodgers, R. Guensler (2015). Performance of Multiple Alternatives to Reduce Carbon Emissions for Transit Fleets: A Real-world Operations Perspective (CUE2015-80). CUE2015-Applied Energy Symposium and Summit 2015. Fuzhou, Fujian, China. November 15-17, 2015. In: Energy Procedia (Elsevier).

8. Sullivan, James, Jeffrey LaMondia, Chester Harvey, Carter Garrison** and Lisa Aultman-Hall. An Analysis of the Long Distance and Overnight Travel Tour-Planning Process. Forthcoming *Transportation Research Record*.
9. Xu, Y., F. Gboloh, H. Liu, M.O. Rodgers, and R. Guensler (2015). "Assessment of Alternative Fuel and Powertrain Transit Bus Options using Real-world Operations Data: Life-cycle Fuel and Emissions Modelling." *Applied Energy*. Volume 154, Number 15. pp. 143-159.
10. Xu, Y., H. Li, H. Liu, M.O. Rodgers, R. Guensler (submitted). Eco-driving for Transit: An Effective Strategy to Conserve Fuel and Emissions. *Applied Energy*.
11. Xu, X., Y. Zhao, Y. Xu, M.O. Rodgers and R. Guensler (abstract submitted). "Hybrid Intercity Buses: Fuel Consumption, Emissions, and Life-cycle Cost Analysis." 22nd National Conference on Rural Public and Intercity Bus Transportation. Asheville, NC. October 2-5, 2016.
12. Zhang, Y. and P. Ioannou, ' Combined Variable Speed Limit and Lane Change Control for Highway Traffic' submitted to *IEEE Transactions on ITS*, February 2016.
13. Zhao, Y., X. Xu, R. Guensler and M.O. Rodgers (abstract submitted). "Cost-effectiveness of Alternative Fuel and Powertrain Options for Rural Public Transportation: A Life-Cycle Assessment." 22nd National Conference on Rural Public and Intercity Bus Transportation. Asheville, NC. October 2-5, 2016.

OTHER PUBLICATIONS

1. Master's Thesis from the UVM project "Intercity Travel in Northeastern Non-Metropolitan Regions: What Roles Do Information Access and Technology Services Play in Public and Shared Transport Modes?"

POSTERS and PRESENTATIONS

1. Incorporating Exposure to Traffic-related Air Pollution in Walkability Evaluation (Jill Luo, Kanok Boriboonsomsin, Matthew Barth)
2. Method for Self-Constructing/Updating Vehicle Fuel Consumption Models based on Real-Time Fuel Consumption Data (Nicholas Jarek and Kanok Boriboonsomsin)
3. Vehicle Road Navigation to Minimize Pollutant Exposure (Jill Luo, Matthew Barth, Alexander Vu)
4. Advanced Intersection Management for Connected Vehicles Using Optimal Scheduling Approach (Qiu Jin, Guoyuan Wu, Kanok Boriboonsomsin, Matthew Barth)
5. Aultman-Hall, Lisa, Chester Harvey and Jim Sullivan (2016). "Framing Classes of Long-Distance Travel." Transportation Research Board Annual meeting, Washington D.C. January 2016.
6. Coen, Amanda (2016). "Do California Highways Act as a Barrier to Gene Flow for Ground-Dwelling Mammals?" The Western Section of the Wildlife Society 2016 Annual Meeting Poster Session. Pomona, CA. February 26, 2016.
7. Zhang, Yihang and P. Ioannou (2015). "Combined Variable Speed Limit and Lane Change Control for Highway Traffic." *IEEE Conference on Intelligent Transportation Systems 2015*. Las Palmas, Canary Islands, Spain. September 2015,

8. Zhang, Y. and P. Ioannou (2016). “Environmental Impact of Combined Variable Speed Limit and Lane Change Control: A Comparison of MOVES and CMEM Model”, 2016 IFAC Symposium on Control in Transportation Systems. Istanbul, Turkey. May 2016.

Website(s) or Other Internet Site(s)

UC Davis created and is hosting the NCST website (<http://ncst.ucdavis.edu>) and continues to update it with information on our research, education, and engagement activities. Other NCST partners have also created NCST pages on their websites. Of particular note are the sites hosted by METTRANS (<http://www.mettrans.org/uc-davis-national-center-sustainable-transportation>) and UVM (<http://www.uvm.edu/trc/collaborative-research/>). Georgia Tech has created an online site for its Fuel and Emissions Calculator (<http://fec.ce.gatech.edu/>). Additional information about websites and other internet sites (such as social media accounts) is covered in sections above.

PARTICIPANTS AND OTHER COLLABORATING ORGANIZATIONS

Our key partners are the members of our consortium, which include the University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and the University of Vermont. NCST also makes an effort to stay connected with the regional environmental UTCs. We regularly post research results from the other environmental UTCs on our social media sites, and NCST schedules a meeting among all the environmental UTCs at the annual TRB conference. NCST also facilitates a meeting among all of the Directors of UTC National Centers at the annual TRB conference.

NCST has regular interactions with all of our funders at all stages of our research – selecting projects, providing guidance while research is in progress, and assisting with dissemination once a project is completed. The following entities are providing funding for NCST projects and engagement activities:

- United States Department of Transportation (USDOT)
- California Department of Transportation (Caltrans)
- California Air Resources Board (CARB)
- California Energy Commission (CEC)
- Volvo Research and Educational Foundation (Volvo)
- Georgia Department of Transportation
- Vermont Agency of Transportation
- University support from all partner universities

The NCST’s Leadership Council provides ongoing guidance on the research needs and policy challenges of public agencies in advancing environmental sustainability. A few changes have been made to the Leadership Council in this reporting period. Michael Melaniphy (American

Public Transportation Association) and Sue Minter (Vermont Agency of Transportation) are no longer serving in their positions. The current membership of the NCST Leadership Council is presented in Table 14.

Table 14: Current Membership of NCST Leadership Council

Name	Affiliation
Rick Blasgen	Council of Supply Chain Management Professionals
Phillip Caruso	Institute of Transportation Studies
Emily Castor	Lyft
Steve Cliff	California Air Resources Board
Chris Cole	Vermont Agency of Transportation
James Corless	Transportation for America
Shannon Eggleston	American Association of State Highway and Transportation Officials
John Horsley	American Association of State Highway and Transportation Officials
Hasan Ikhata	Southern California Association of Governments
Brian Kelly	California State Transportation Agency
Joan McDonald	National Infrastructure Advisory Council
Kirk Steudle	Michigan Department of Transportation
Douglas Shinkle	National Conference of State Legislatures
Stephanie Stuckey-Benfield	City of Atlanta
Janea Scott	California Energy Commission
Erich Zimmermann	National Association of Regional Councils

UC Davis collaborates with researchers at the Institute of Transportation Studies, the Plug-In Hybrid & Electric Vehicle Research Center, the Sustainable Transportation Energy Pathways program, the Urban Land Use and Transportation Center, the China Center for Energy and Transportation, and the Policy Institute for Energy, Environment, and the Economy. This collaboration is both interdepartmental and interdisciplinary.

Work under the \$1.1 million award from the California Energy Commission will be completed in a collaborative effort between UC Davis, UC Riverside and the University of Southern California. Two projects funded by the California Air Resources Board will be collaborative efforts by UC Davis and UC Riverside researchers.

All partners are collaborating on the development of the model sustainable transportation curriculum. University of Virginia’s regional UTC, focusing on environmental sustainability, is also collaborating on this work.

NCST is also actively working with leaders from industry, government, professional associations, and non-governmental organizations during all stages of our research to ensure our research is

addressing the most pressing policy and practice related questions, and delivering results that are timely, relevant, and valuable to policymakers and practitioners. We call upon this broader community of practitioners and professionals to provide external reviews of research proposals, serve on project panels where they provide feedback and direction on specific research projects, participate in tech transfer events (e.g., webinars, conference panels) as guest respondents, review and provide comments on draft reports and policy briefs, and identify high value opportunities for sharing research results with the broader community of practitioners and policymakers.

NCST's current working groups include Freight Efficiency Strategies Development Group and the Zero Emission Market Acceleration Partnerships (ZE MAP). These groups provide an open and ongoing forum for generating ideas, sharing research results, identifying future research needs, and developing best-practices and policy strategies that put research findings into action.

IMPACT

What is the impact of the program? How has it contributed to transportation education, research, and technology transfer?

Researchers and staff have met and engaged with key decision makers and practitioners at all levels of government to discuss NCST research and explore opportunities for research to impact policy discussions in a timely way as described in the engagement section above.

NCST researchers have been referenced on several occasions in the media, focusing the attention of a potentially unlimited audience on the importance of working toward sustainable transportation systems. Some examples of media coverage include the following:

- Toyota is Using Sewage Sludge to Power its New Electric Car – Quartz
- A Price on Carbon May Be Coming Soon to the U.S. – The Wall Street Journal
- 10 Powerful Climate Change Insights for Improving the Planet – UC Davis Office of Research Newsletter
- Hydrogen fuel-cell vehicle landscape truly changed, says longtime expert – The Christian Science Monitor
- In deep with a hydrogen vehicle expert: 'There is something different this time' – Autoblog Green
- Why are the world's cap-and-trade markets struggling to keep prices up? – The Sacramento Bee
- California Considers Change to Fuel Rules as Tesla Cries Foul – Bloomberg News
- Here's What Your July 4 Road Trip Means for the Climate - Climate Central
- Predicting the Car (and Fuel) of the Future – NPR's Science Friday
- Why is Saudi Arabia saying it wouldn't flood the market with oil? – CNBC
- America is Hitting the Road Again – New York Times
- How Trump's Energy Plan Stacks Up To The Democrats – NPR
- Utilities Want To Plug In More Electric Drivers - KQED Science

- EVs and An Appeal Beyond Emissions: Tom Turrentine Drives Us Down the Electric Highway – Jefferson Public Radio
- Uber and a Bay Area landlord will pay new tenants \$100 a month to go car-free: A first-of-its-kind partnership – The Verge
- Lost in transit: To succeed in November, \$3.6 billion transportation measure must play to the Sacramento suburbs – Sacramento News & Review
- Can Tesla Build enough Electric Cars? ClimateWire: reprinted in Scientific American
- The Future of Transportation: An Interview with Dan Sperling – Center for Strategic and International Studies
- How to Travel the Earth And Protect It, Too – The New York Times
- ZEV technology splits new car buyers into aficionados and skeptics – ClimateWire
- The research of UC Riverside’s Xuewei Qi on Plug-in hybrid electric vehicles (PHEVs) was featured in the US Automotive Industries magazine. Please see http://www.ai-online.com/Adv/Previous/show_issue.php?id=6895&search=true#sthash.TJy9naah.cuxqWMF5.dpbs

What is the impact on the development of the principal discipline(s) of the program?

The NCST is an interdisciplinary consortium involving faculty from engineering, urban planning, environmental policy, and other disciplines. The activities of the NCST are promoting increased focus in these disciplines on sustainability, greenhouse gas reduction, low-carbon infrastructure, efficient transportation system operation, low-impact travel, sustainable land use, zero-emission vehicles and fuels, and related institutional change across the United States. The NCST is producing educational materials related to these topics that can be used in graduate education in a variety of disciplines and in continuing education and workforce development programs.

What is the impact on other disciplines?

Interdisciplinary collaboration is a core principle of the NCST’s research projects, educational programs, and engagement activities. Involvement of students and researchers from disciplines not traditionally linked to the transportation field will strengthen efforts to advance sustainable transportation and will strengthen these disciplines by adding to the real-world problems to which they apply their theories and methods.

What is the impact on transportation workforce development?

Workshops, training sessions, presentations, and engagement activities organized by NCST engage the transportation workforce at many different levels. Highlights of our impact on workforce development include the following:

- **Georgia Tech:** The Georgia Tech team is proposing a plan of eco-driving training for transit drivers to avoid aggressive driving at uphill and reduce idling. A driving monitoring system has been embedded in the Commute Warrior™ Android™ app for use in a related DOE ARPA-E project. When aggressive driving behavior (e.g., sharp acceleration at median- to high-speed level) is detected, the app can remind drivers to avoid aggressive acceleration. In the next year, we are also proposing a plan to

coordinate with Georgia Tech campus trolley fleet and the local MARTA transit fleet to provide technical and policy support in terms of fuel consumption saving and emission reduction through eco-driving training, route optimization, idle reduction, and smart fleet retrofit/replacement/resale strategy. The team has prepared a proposal for funding support that will be transmitted to MARTA in Year Three.

- **CSU Long Beach** is well connected with the Southern California Regional Transit Training Consortium (SCR TTC), a leading provider of training for the public transit industry, and will be leveraging this relationship to develop and deliver additional training opportunities to these members. Tom O'Brien (CSU Long Beach) serves on the SCR TTC Board and was recently elected Vice Chair.
- **METRANS and the University of Vermont** are designated Surface Transportation Workforce Development Centers of Excellence. NCST research helps to inform activities organized by these centers.
- **UC Davis** conducted an interactive workshops for Caltrans staff exploring how automated vehicle technology might affect and interact with the physical, natural, and social systems. The goal of the training was to present an overview of automated vehicle technology and provide a hands-on experience with the application of automated vehicle systems. To ensure a common baseline of knowledge among workshop participants, Dr. Caroline Rodier (UC Davis) presented an introduction to automated vehicles followed by an expert panel discussion of automated vehicle issues faced by California agencies. Participants then broke into small groups to develop and examine different future scenarios with automated vehicle technology. Following the exercise, Dr. Rodier summarized key issues presented in the scenarios, including those concerned with technology, institutional barriers, travel and land use effects, and planning issues. The agenda and presentation for the workshop are available for download on NCST's website and can be found here: <http://ncst.ucdavis.edu/education/ncst-trainings>.
- **UC Riverside's** Summer Lecture series was designed as hands-on program with projects to accompany the lectures in transportation emissions and renewable fuels that allowed students to learn and directly apply their new knowledge, which will enhance their existing careers or assist in preparing them for new ones. Additionally, one of the primary objectives of the annual PEMS conference (upcoming in March 2017) is to provide the emissions workforce with the latest knowledge and technology to be applied in the field.

What is the impact on physical, institutional, and information resources at the university or other partner institutions?

The NCST is generating increased awareness of and emphasis on the importance and breadth of transportation at all partner institutions, as well as other collaborating institutions in the region and nationwide. All partners are leveraging each other's dissemination infrastructure (e.g., email lists, social media sites, etc.) to increase the awareness and availability of NCST products and reports and to enhance the flow of information. NCST partners are also leveraging existing relationships with outside stakeholders and our funders to help share and disseminate information. UC Davis provides central communication, engagement, and outreach support to

all NCST partners, such as organizing webinars, developing policy briefs, identifying opportunities for NCST researchers to present at professional conferences, and much more.

What is the impact on technology transfer?

NCST is connecting research to policymakers and practitioners through in-person events, training sessions, briefings, seminars, and forums as described in earlier sections. NCST is also creating online opportunities to engage with our research, such as: regularly updating our website; managing several social media accounts where we share research and engage with our followers; and organizing webinars highlighting our research as well as commentary from guest respondents representing industry, public sector, and/or policy perspectives. NCST is also making research more accessible to busy policymakers and practitioners by distilling key findings and policy implications of our research into 2-page policy briefs.

UC Riverside is supporting NCST's goal of technology transfer through the creation of market-ready technologies that will contribute to sustainable transportation. The following items are currently undergoing the patent process:

- Non-provisional patent application in progress for Online Wobbe Sensor for the Natural Gas by indirect measurement with Chemo-metric Data, UC Case No. 2016-026
- Provisional patent application in progress for Onboard Ecological Stop-and-Go (Eco-SG) Behavior Learning and Advising System

What is the impact on society beyond science and technology?

The NCST is fostering greater collaboration between academic institutions, industry, government, and NGOs, which is helping to expedite solutions to some of today's greatest transportation environmental challenges. As an example, the NCST facilitates discussions throughout the year between researchers and those on the frontlines making policy and practice-related decisions. These meetings provide two significant benefits to society: 1) those in decision making positions are aware of and can use the latest research when formulating policies that will in turn impact society; and 2) researchers are more aware of the most pressing issues and decisions facing policy leaders and practitioners and can shape their future and current research to ensure it is timely, relevant, and producing information and/or tools that can be readily applied by policymakers and practitioners.

CHANGES AND/OR PROBLEMS

There is nothing of significance to report in terms of changes or problems.

SPECIAL REPORTING REQUIREMENTS

Website: <http://ncst.ucdavis.edu/>

Directory of Key Personnel: Information available on the NCST website <http://ncst.ucdavis.edu/about/executive-committee/>

Financial and Annual Share Reports: The SF425 requirements will be met by separate report.

Annual Recipient Cost Share Report: Will be met by separate report.

FFATA Sub award and Executive Compensation Report: Will be met by separate submission.

Research Project Descriptions: Available on program website: <http://ncst.ucdavis.edu/research/white-papers/> and <http://ncst.ucdavis.edu/research/current-projects/>