CENTER FOR ADVANCING RESEARCH IN
Transportation Emissions, Energy, and Health
A USDOT University Transportation Center

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Report Term:	Semi-Annual
Signature of Submitting Official:	Marcia Walker

OVERVIEW

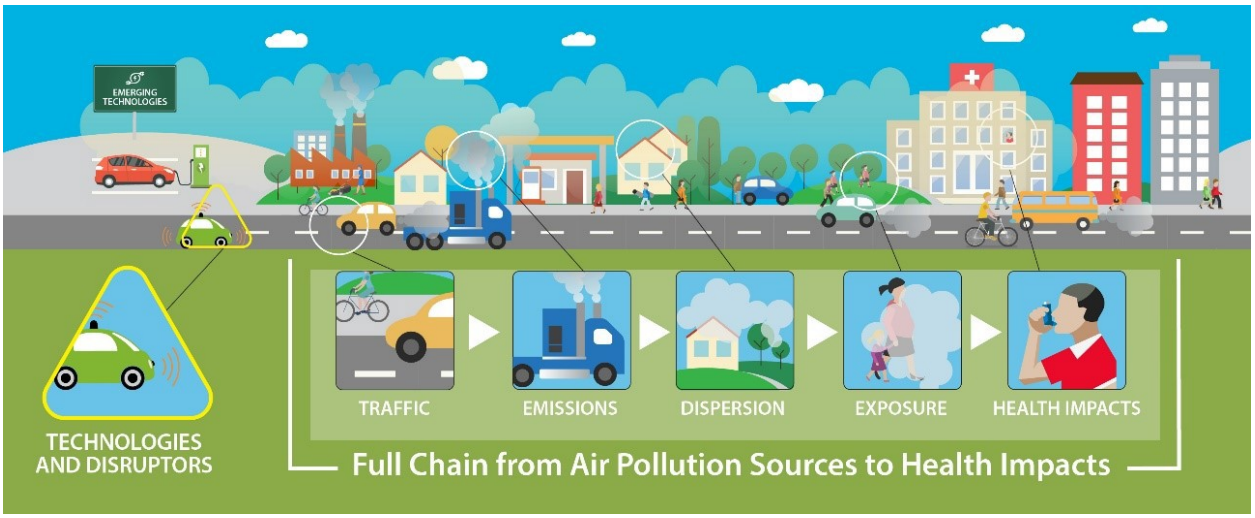
The Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH) has been highly productive during this reporting period as we continue to build on our successes of the last three years. Both the cooperative and competitive research projects are progressing, all involving a talented group of students. We have initiated several technology transfer activities, which have received extremely positive feedback. At the end of this reporting period, we are proud of our progress and excited about upcoming activities in all our goal areas.

ACCOMPLISHMENTS

Major Goals of the Program

CARTEEH brings together experts from transportation and public health, two disciplines that have not traditionally worked together. CARTEEH's focus is to advance research on transportation emissions in a comprehensive manner, mapping the holistic tailpipe-to-lungs spectrum, as shown in Figure 1.

Figure 1: Tailpipe to Lungs Spectrum



CARTEEH's research focus areas were defined to cover this spectrum and are as follows:

- Transportation System
- Emissions and Energy Estimation
- Exposure and Health Impacts
- Data Integration
- Policy and Decision-Making

Progress in each CARTEEH goal area is detailed in the following sections:

CARTEEH Goal #1: Research Program

CARTEEH's research program includes collaborative research projects conducted jointly among consortium members, competitive program awards, and other initiatives that support our strategic research, education, and technology transfer goals. These are all included as part of our project portfolio in Table 1 below, though some initiatives are discussed further under the education and technology transfer sections of this report.

Work on the cooperative projects identified in the first-year project work plan is completed or drawing to a close. Those projects not yet completed, will be finalized during the next reporting period. The consortium partners have successfully met the collaboration requirements of these projects, and at the close of in the third year, are discussing future collaborative projects.

The majority of the competitive research projects awarded in CARTEEH's second year are also ending at each partner institution. CARTEEH staff members are working with researchers to finalize their reports.

Table 1: CARTEEH Project Portfolio

Project	Lead Institution	Principal Investigator
Transportation Emissions and Health Data Hub	TTI	Dr. Andrew Birt
Reconciles differences in characteristics of transportation and health data; develops a platform to house datasets		
Truck Emissions Exposure Study in Ports	GaTech	Dr. Michael Rodgers
Assesses pollutant emissions at selected major ports; evaluates the potential reduction of exposure using multiple methodologies		
Border Crossing Emissions Impact Study	TTI	Dr. Tara Ramani
Characterizes the emissions impact of border crossings and identifies population groups most affected by the emissions		
Healthy Living and Traffic-Related Air Pollution in an Underserved Community	UTEP	Dr. Wen-Whai Li
Quantifies traffic-related air pollution and the associated respiratory health for vulnerable school children in El Paso, Texas		
Development and Evaluation of Connected Vehicle Application for Alternative Fuel Trucks	UCR	Dr. Peng Hao
Evaluates benefits of battery-electric trucks and plug-in hybrid electric trucks over conventional diesel trucks		
Health Risk Characterization for Transportation Users	JHU	Dr. Mary Fox
Develops a cumulative exposure and risk profile for transportation workers and/or system users considering chemical and other stressors		
Assessing Regulatory Compliance and Community Air Pollution Impacts of Crude Oil by Rail (CBR) Transport in Baltimore City, Maryland	JHU	Dr. Genee Smith
Delivers evidence-based characterization of emissions impacts of CBR within Baltimore City, Maryland		

PM Exposure for Paratransit Transport	GaTech	Dr. Alex Samoylov
Characterizes exposure to PM faced by sensitive populations using paratransit transport		
Measuring Temporal and Spatial Exposure of Urban Cyclists to Air Pollutants Using an Instrumented Bicycle	GaTech	Dr. Kari Watkins
Develops an understanding of local cyclists' exposure to PM2.5 air pollutants in an urban environment		
Traffic-Related Air Pollution and Childhood Asthma in the United States: A Burden of Disease Assessment	TTI	Dr. Haneen Khreis
Conducts a burden of disease estimate of childhood asthma attributable to traffic-related air pollution within the US		
Characterizing In-Cab Air Quality in Heavy-Duty Diesel Construction Equipment	TTI	Dr. Phil Lewis
Analyzes air quality and driver exposure inside the cabs of heavy-duty diesel construction equipment		
Dockless Mobility: Addressing Safety, Emissions, and Gaps in Policy Making	TTI	Dr. Suriya Vallamsundar
Examines emissions exposure on dockless mobility users in Dallas, Texas		
Quantifying Bioavailable Metals and Potential Dust Emissions from Highway-Related and Desert Sediments at Lordsburg Playa, New Mexico	UTEP	Dr. Thomas Gill
Scopes the presence of bioavailable metals and potential dust emissions from highway-related and desert sediments in New Mexico		
Secondary Particulate Matter Exceed Primary Emissions from Current Gasoline Vehicles: Air Quality and Public Health Implications	UCR	Dr. Georgios Karavalakis
Assesses emissions from gasoline direct injection and multipoint injection vehicles when operated under different driving		
Quantifying Traffic Congestion-Induced Change of Near-Road Air Pollutant Concentration	UCR	Dr. Jill Luo
Develops a statistical model to quantify the contribution to the ambient air quality degradation due to traffic congestion		
Transportation and Health - Conceptualization and Quantification	TTI	Dr. Haneen Khreis
Addresses the transportation-health nexus beyond air quality and emissions; develops a comprehensive conceptual "pathways" model		
Urban Policy Interventions and Their Effectiveness in Reducing Traffic Emissions and Traffic-Related Air Pollution	TTI	Dr. Haneen Khreis
Identifies policy interventions to effectively reduce traffic emissions and traffic-related air pollution from on-road mobile		
Technology Landscape and Future Direction for Transportation Emissions, Energy, and Health	TTI	Dr. Yanzhi (Ann) Xu
Develops a technology roadmap for transportation emissions, energy, and health		
Curriculum for Transportation Emissions and Health	TTI	Dr. Haneen Khreis
Development of a unique, cross-disciplinary course titled "Traffic-Related Air Pollution: Emissions, Human Exposures, and Health.", which can be used for undergraduate, graduate, and practitioner education.		
Transportation Emissions and Health Literature Library	TTI	Dr. Haneen Khreis
Downloadable spreadsheet resource tabulating and categorizing literature on transportation emissions, energy, and health.		
Innovative Data Applications using CARTEEH's Data Hub	TTI	Dr. Yanzhi (Ann) Xu
Use of CARTEEH's data hub infrastructure for data integration applications, including the development of a national emissions map		

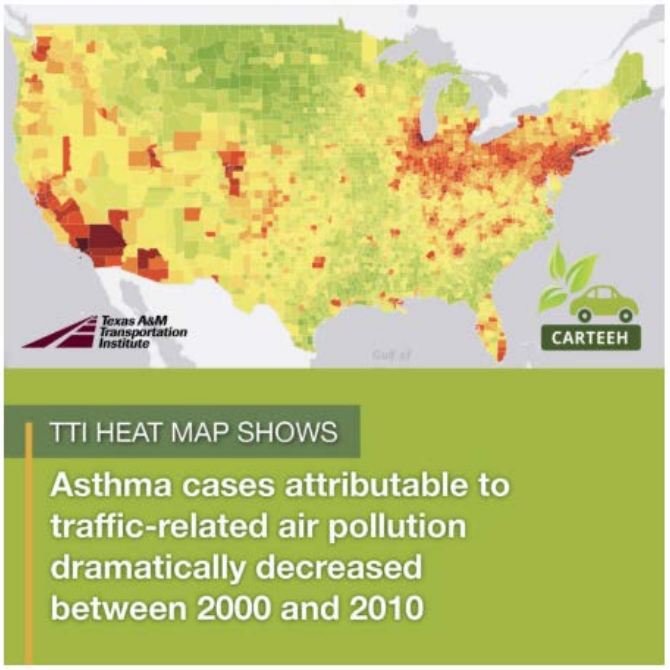
The year three competitive research program was kicked off in May with a request for problem statements. Earlier, the RFP was updated to more carefully target impactful projects closely aligned to CARTEEH's research and technology transfer goals. As planned, we increased the response time window, to allow more time for problem statement development.

Each institution made awards in late August to coincide with the start of the fall semester. CARTEEH leadership will continue to provide support, guidance, and assistance to project principal investigators to aid in achieving individual project objectives. Table 2 below summarizes projects awarded in the year three competition.

Table 2: Year Three Competitive Projects

Project	Lead Institution	Principal Investigator
Development of an Emission-Based Selection Algorithm to Optimize Variable Message Signs Location *(student project)*	TTI	Ms. Farinoush Sharifi
Develops an algorithm to identify locations of variable message signs to maximize emissions savings in situations of nonrecurring congestion		
Real-World Data Measurement of Factors Affecting Air Quality for Nonroad Diesel Equipment Operators	TTI	Dr. Phil Lewis
Characterizes the various factors affecting equipment operators' exposure to poor air quality, using real-world data and measurements.		
Trace Metals in Airborne Particulate Matter and Genomic Characterization of Associated Microorganisms: Insights into Health Effects from an Industrialized, Near-Roadway Site in Houston	TTI	Dr. Shankar Chellam
Investigates vehicular contributions of PM10, and its elemental components and microorganisms, to understand health effects and implications.		
Making New Mobility a "Win" for Public Health	JHU	Dr. Johnathon Ehsani
Investigates the use of new mobility options as a public health intervention, through simulation of scenarios and validation with real-world data.		
Improved Vehicle Emissions and Near-Road Dispersion Modeling Tool for Project Evaluation: Integrating MOVES-Matric, the FEC, and AERMOD	GaTech	Dr. Haobing Liu
Developing a tool to streamline and integrate transportation emissions modeling and dispersion modeling for a more straightforward assessment of air quality impacts.		
Modeling Air Quality Impacts of Pollution Mitigation Scenarios at a Multimodal Inland Port	GaTech	Dr. Franklin Gbologah
Assessment of Nox and PM emissions and dispersion for various pollution control scenarios in an inland port.		
Association of Traffic and Related Air Pollutants on Cardiorespiratory Risk Factors from Low-Income Populations in El Paso, TX.	UTEP	Dr. Jsoyoung Jeon
Studies linkages between cardiorespiratory risk factors and levels of traffic-related air pollutants.		
Onboard Sensing, Analysis, and Reporting (OSAR): Expanded Field Demonstrations and Development of Associated Visual Aids	UCR	Dr. Kent Johnson
Develops the capability for spatial and temporal visualization of emissions from the OSAR on-board emissions measurement system.		

Research Results Disseminated



Results from the project titled "Traffic-Related Air Pollution and Childhood Asthma in the United States: A *B*urden of Disease Assessment" received widespread media attention and generated significant media and public interest. Dr. Haneen Khreis and her team created an interactive heat map showing the impact NO2 had on childhood asthma across the country during the years 2000 and 2010. Every county in the U.S. is represented, allowing users to hover over a specific county for its findings.

The study had more than 75 million media reach/impressions and approximately $695,000 in earned media value, according to Texas A&M Transportation Institute Communications Team.

Further, our robust dissemination of research results is seen in the extensive list of presentations, conference papers, conference abstracts, and journal manuscripts that are detailed in the technology transfer section.

Plans for Next Reporting Period to Accomplish Research Goal

During the next reporting period, CARTEEH leadership will be working closely with the new principal investigators of the year three projects to ensure projects are successfully launched, as well as to explain the reporting requirements and expectations. Individual meetings are currently scheduled with the Director, Assistant Director for Research, and each of the CARTEEH partners to discuss future collaborative projects, as well as the coming year's work plans.

In the upcoming competitive process, we are considering focusing on student-led grants or mini-grants. This was discussed during the year three competition; however, the timing of the call for proposals made implementation impractical since the response time was during the summer semester. In the year three competition, TTI funded one project led by a Ph.D. student researcher, Ms. Farinoush Sharifi, which leverages work conducted under contract from Exxon Mobil.

Finally, we anticipate leveraging our research results for further education and technology transfer activities, with an emphasis on stakeholder engagement and in line with our technology transfer plan.

CARTEEH Goal #2: Education and Workforce Development

CARTEEH research projects are catalysts for CARTEEH student involvement, with the number of students involved with CARTEEH increasing each semester.

Texas A&M University College of Education Collaboration

In September, partnering opportunity discussions got underway with Dr. Michael de Miranda, Head of the Department of Teaching, Learning, and Culture in the Texas A&M College of Education. Dr. de Miranda focuses on engineering and technology teacher preparation and engineering education, and the development of STEM educators. An initiative currently under discussion is the potential establishment of a network of citizen and school-based scientists to measure and monitor environmental particulates in the air through the deployment of low-cost particulate matter (PM) sensors. Students in the schools would collect and report PM data, in addition to building their PM sensor. This work would then engage students in science and data science activities to mathematically model the data they collect and that of the network.

Curriculum Course Development

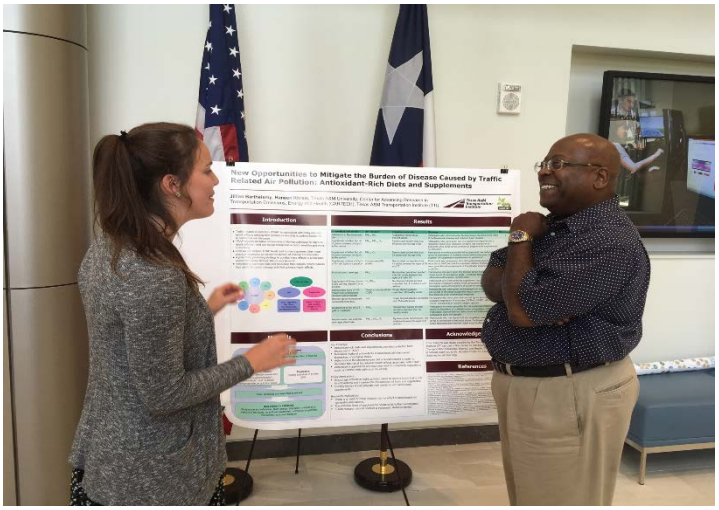
Progress continues with the development of CARTEEH's cross-disciplinary course titled *"Traffic-Related Air Pollution, Human Exposures, and Health*." The course's outline has been finalized and copyrighted and can be found posted on the CARTEEH website. A pool of primary and back-up lecturers has been identified for each of the 60 planned sessions. Currently, members of the consortium are discussing the best way forward to reach out to lecturers and securing the content of each session. This will be a collective effort led by TTI with active involvement from all partners.

The course will cover critical topics from transportation, urban planning, exposure assessment, and public health and policy domains. It is intended to set the foundation for a three-credit-hour graduate-level course offered by consortium member institutions. The course targets students and practitioners in the areas of urban planning, transportation planning, transportation engineering, geography sciences, environmental epidemiology, and public health.

This spring, a modified version of the course was piloted to 34 Georgia Tech undergraduate students as a special topics course. Dr. Michael Rodgers served as the primary instructor and was aided by four other instructors. Based on their experiences, a modified version of the course will be taught in the 2020 Spring Semester, co-taught by Dr. Rodgers and Dr. Liz York of the Center for Disease Control (CDC). After the spring, Dr. Rodgers will petition to make the course a part of the regular curriculum.

CARTEEH Summer Internship Program

CARTEEH again hosted an undergraduate summer internship program, selecting four students from a pool of 20 applicants. Selected students came from Georgia Tech, University of California, Riverside, and Texas A&M. Each student was matched to a mentor working on a CARTEEH-funded project. They completed an independent project related to the CARTEEH project and presented their results at a University-wide research symposium for undergraduate research. Professional development seminars were held throughout the summer on technical topics as well as career options.



CARTEEH Summer Intern Jillian Barthelemy and TTI Agency Director, Greg Winfree

"Hi Dr. Zietsman,

This internship has been an amazing experience. I felt challenged but not overwhelmed, and I am proud of the work I accomplished. I found my communication with Ann to be clear and encouraging…. I felt like TTI provided a welcoming and productive work environment where I could always ask for help if I needed it. Kristen Sanchez was especially helpful and kind by offering advice and encouragement. Thank you again for the opportunity to work at TTI and for such a wonderful summer!"

Best,
Kathleen Weil
Georgia Tech
(Summer Intern)

Education Results Disseminated

In addition to the student posters that were presented at the CARTEEH symposium, papers developed as part of the summer internship program are being considered for potential expansion into journal submissions or other dissemination activities. Intern Jillian Barthelemy is currently completing an article for publication, based on her summer internship project with Dr. Haneen Khreis.

Plans for Next Reporting Period to Accomplish Education Goal

During the next reporting period, the current education initiatives will continue, and CARTEEH will look for additional opportunities for education and workforce development growth. We anticipate further progress on the curriculum course development, as well as initiating another round of the summer internship program.

CARTEEH Goal #3: Technology Transfer

CARTEEH views technology transfer as a vital part of the research process, and one that must be integrated with our R&D activities and not treated as an afterthought. We place a high value on stakeholder identification and engagement, as well as emphasizing information dissemination and the creation of open-access tools and methods that enable practical application of cutting-edge research findings.

Several technology transfer activities are underway and progressing. The CARTEEH technology transfer activities aim to make research results and knowledge available to the research community and beyond.

Transportation, Air Quality, and Health Symposium

During this reporting period, work began on the next CARTEEH Transportation, Air Quality, and Health Symposium, which will be held on May 18-20, 2020, in Riverside, California. TTI and UC Riverside are co-sponsoring the event. Other partners will serve as moderators.

The symposium's objective will continue to be promoting healthy transportation planning and policy by bringing together different disciplines working in the distinct areas of transportation systems, emissions, energy, air pollution, exposures, and public health. The targeted audience includes students, researchers, and university faculty or staff, as well as transportation professionals.

Transportation Emissions and Health Data Hub

Work on the initial Transportation Emissions and Health Data Hub has been completed. With the successful data hub platform, we have initiated a project titled "Innovative Data Applications Using CARTEEH's Data Hub" to leverage its infrastructure for innovative data applications.

The goal of this project is to provide value to end-users in such a way that the data hub can sustain and expand its growth beyond the initial development funds. To the public and policymakers, the project aims to demonstrate use cases and provide value to a large body of diverse end-users. The proposed project output is a national vehicle emissions map with linkages to the existing asthma map. The map will enable the public to look up the most polluted major roadways across the US, differentiated by pollutants.

CARTEEH Literature Library

The CARTEEH literature library continues to develop on the CARTEEH website. This tool is intended as a resource for students, researchers, and practitioners interested in transportation and health, especially the impact of transportation emissions and air pollution on human health. During this period, approximately 140 additional studies were added to the library, bringing the total to 940, addressing the full chain of events between transportation pollution sources and health impacts. This reference list will continue to be periodically updated to include new studies as they become available.

Technology Transfer Results Disseminated

All Center activities are posted to the CARTEEH website, with several updates made to the site following this reporting period. While earlier research projects are just coming to completion, a significant number of abstracts have been submitted, as well as presentations made.

The CARTEEH Transportation, Air Quality, and Health Symposium site remains active, and the detailed program has been supplemented with slides from each presentation, as well as videos in some instances.

Plans for Next Reporting Period to Accomplish Technology Transfer Goal

Work continues on the implementation of the Technology Transfer Plan, including incorporating revised reporting requirements. Further discussion of the implementation of the T2 plan is found in our "outcomes" section.

PARTICIPANTS AND COLLABORATING ORGANIZATIONS

CARTEEH is made up of a consortium of five institutions: TTI is a member of the Texas A&M University System and home to the Center. Faculty and students from other colleges, such as the Texas A&M Health Science Center, are also involved. Johns Hopkins University, Georgia Tech, University of Texas-El Paso, and the University of California, Riverside complete the partnership.

Partner Organizations and Other Significant Collaborators

CARTEEH's focus areas cross multiple disciplines, bringing opportunities for a unique collaborative effort with institutions and individuals. These partners are essential to the success of the Center. Organizations and individuals in the following tables have directly supported or collaborated on Center activities.

Table 3: CARTEEH Partner Organizations

Organization Name	Location	Contribution
Air Alliance Houston	Houston, Texas	Collaboration
American Thoracic Society	New York	Collaboration
Atlanta Bicycle Council	Atlanta, Georgia	Collaboration, In-kind support
Atlanta Bike Coalition	Atlanta, Georgia	In-kind support
Atlanta Regional Commission	Atlanta, Georgia	Data, Collaboration
Breathe Easy Dallas	Dallas, Texas	Collaboration
Broadway Services	Baltimore, Maryland	Access to facilities and data
California Air Resources Board	Sacramento, California	In-kind support
California Energy Commission	Sacramento, California	In-kind support
Chesapeake Climate Action Network	Takoma Park, Maryland	Collaboration

City of Austin Department of Transportation	Austin, Texas	Collaboration
City of Carson	Carson, California	Personnel
City of Dallas	Dallas, Texas	Collaboration
City of Los Angeles	Los Angeles, California	Data
Clean Water Action	Washington, D.C.	Collaboration
Dallas Independent School District	Dallas, Texas	Access to facilities
El Paso Independent School District	El Paso, Texas	Facility and student access
Emory University	Atlanta, Georgia	Personnel, Collaboration
Environmental Defense Fund	Austin, Texas	Collaboration
George Mason University	Fairfax, Virginia	Collaboration, data
Georgia Department of Transportation	Atlanta, Georgia	Data
Georgia Ports Authority	Savannah, Georgia	Data, access to facilities, in-kind support
Georgia Tech Research Institute	Atlanta, Georgia	Data, personnel, access to facilities
Health Effects Institute	Boston, Massachusetts	Collaboration
Houston-Galveston Area Council	Houston, Texas	Collaboration
Institute for Healthy Living at the University of Texas at El Paso	El Paso, Texas	Collaboration, facility and student access
Kelly Burt Dozer	College Station, Texas	In-kind support
Larry Young Paving	College Station, Texas	In-kind support
Los Angeles County Metropolitan Transportation Authority	Los Angeles, California	In-kind support
Maryland Institute College of Art	Baltimore, Maryland	In-kind support
Metropolitan Atlanta Rapid Transit Authority	Atlanta, Georgia	Collaboration, in-kind support
Mississippi State University	Starkville, Mississippi	Collaboration
Mount Winans Community Association	Baltimore, Maryland	Collaboration, facility access
Nashville Metropolitan Transit Authority	Nashville, Tennessee	Collaboration, in-kind support
National Weather Service	Santa Teresa, New Mexico	Information/data sharing, collaboration
New Mexico Department of Environment	Santa Fe, New Mexico	Data, collaboration
New Mexico Department of Health	Santa Fe, New Mexico	Data, collaboration
New Mexico Department of Transportation	Santa Fe, New Mexico	Data, collaboration, access to facilities (field site)
North Central Texas Council of Governments	Arlington, Texas	Collaboration
Oak Ridge National Laboratory	Oak Ridge, Tennessee	Computer models
Port of Galveston	Galveston, Texas	Facilities
Port of Houston	Houston, Texas	Facilities
Port of Long Beach	Long Beach, California	Facilities
Port of Los Angeles	Los Angeles, California	Personnel
South Coast Air Quality Mgmt. District	Diamond Bar, California	Data, equipment, and facilities

Tampere University of Technology	Tampere, Finland	Collaboration, personnel exchange, in-kind support
TAMU Department of Construction Science	College Station, Texas	Facilities
Texas Department of Transportation	Austin, Texas	In-kind support, collaboration
The City of Dallas	Dallas, Texas	Collaboration
The Nature Conservancy	Austin, Texas	Collaboration
U.S. Department of Agriculture	Big Spring, TX and Fort Collins, CO	Collaboration, in-kind support, data, equipment, student access
U.S. Geological Survey	Reston, Virginia	Data, in-kind support, access to equipment
University of Delaware	Newark, Delaware	Collaboration
University of Miami	Miami, Florida	Collaborative research
University of Southern California	Los Angeles, California	Collaboration
University of Texas Houston School of Public Health	Houston, Texas	Collaboration and student access
University of Washington	Seattle, Washington	Collaboration
USDA Agricultural Research Service	Big Spring, Texas	In-kind support, equipment, collaboration
USDA Agricultural Research Service	Fort Collins, Colorado	In-kind support, equipment, collaboration
USDA Agricultural Research Service	Las Cruces, New Mexico	Equipment, collaboration
WeGo Public Transit	Nashville, Tennessee	In-kind support, access to facilities

Table 4: CARTEEH Collaborators

Name	Affiliation	Contribution	Country
Dr. Ananya Roy	Environmental Defense Fund	Collaboration	USA
Dr. Andrea Polidori	University of California - Riverside	In-kind contributions	USA
Dr. Bakeyah Nelson	Air Alliance Houston	Collaboration	USA
Dr. Cassandra Gaston	University of Miami, Miami, FL	Contact/Collaboration/data sharing/leveraging	USA
Dr. Chanam Lee	Texas A&M University	Collaboration	USA
Dr. Daniel Tong	NOAA, Washington DC	Contact/leveraging	USA
Dr. David Cocker	UCR, Department of Chemical and Environmental Engineering	Experimental Design and Data Analysis	USA
Dr. David Dubois	Office of the State Climatologist, Las Cruces, NM	Collaboration	USA
Dr. Dongjoo Park	University of Seoul	Collaboration	Korea
Dr. Ellen MacKenzie	Dean, JHU Bloomberg School of Public Health	Collaboration	USA
Dr. Eun Sug Park	TTI – Mobility Analysis Program	Collaboration	USA
Dr. Gabriel Ibarra-Mejia	The University of Texas at El Paso, Department of Public Health	Collaboration, Data, Faculty	USA

Dr. George Delclos	University of Texas Health Science Center at Houston	Collaboration	USA
Dr. George Thrushton	New York University School of Medicine	Collaboration	USA
Dr. Jennifer Horney	University of Delaware	In-kind support	USA
Dr. Jenny Mindell	University College London	Collaboration	The U.K.
Dr. Jeremy Sarnat	Emory University	Collaboration, Faculty	USA
Dr. Joan Reibman	New York University School of Medicine	Collaboration	USA
Dr. Joao Ferreira-Pinto	The University of Texas at El Paso, Department of Public Health	Collaboration, Data, Equipment, In-kind, Faculty	USA
Dr. John Tatarko	USDA Agricultural Research Service, Fort Collins, CO	Collaboration	USA
Dr. John Wright	Bradford Institute for Health Research	Collaboration	The U.K.
Dr. Jorma Keskinen	Tampere University of Technology	In-kind contributions	Finland
Dr. Julian Marshall	University of Washington	Collaboration	USA
Dr. Kai Zhang	University of Texas Health Science Center	Collaboration	USA
Dr. Karen Lucas	University of Leeds	Collaboration	The U.K.
Dr. Kees de Hoogh	Swiss Tropical and Public Health Institute	Collaboration	Switzerland
Dr. Kent Johnson	University of California, Riverside	Data	USA
Dr. Kyuok Kim	Korea Transport Institute	Collaboration	Korea
Dr. Leah Whigham	University of Texas Houston Health Center	Collaboration, Data, Equipment, In-kind, Faculty	USA
Dr. Lixin Jin	The University of Texas at El Paso	Collaboration, Data, Equipment, In-kind, Faculty	USA
Dr. Liz York	Centers for Disease Control and Prevention	Collaboration	USA
Dr. Mark Benden	TAMU Health Science Center	Collaboration	USA
Dr. Mark Burris	TAMU – Civil Engineering	Collaboration	USA
Dr. Michael de Miranda	TAMU - College of Education	Collaboration	USA
Dr. Mark Nieuwenhuijsen	Barcelona Institute for Global Health	Collaboration	Spain
Dr. Martina Klose	Barcelona Supercomputing Center, Barcelona, Spain	Contact/ data sharing	Spain
Dr. Michael Jerett	University of California, Los Angeles	Collaboration	USA
Dr. Nicholas Webb	USDA Agricultural Research Service, Las Cruces, NM	Collaboration	USA
Dr. Nick Duffield	Texas A&M Institute of Data Science	Collaboration	USA
Dr. Qi Ying	TAMU – Civil Engineering	Collaboration	USA
Dr. R. Scott Van Pelt	USDA Agricultural Research Service, El Paso, TX	Collaboration	USA
Dr. Rashid Shaikh	Health Effects Institute	Collaboration	USA
Dr. Rob McConnell	University of Southern California	In-kind support	USA
Dr. Rob Scott McConnell	The University of Southern California, Keck School of Medicine	Collaboration	USA

Dr. Robin Autenreith	TAMU – Civil Engineering	Collaboration	USA
Dr. Roya Bahreini	UCR, Environmental Sciences	In-kind contributions	USA
Dr. Shams Tanvir	University of California, Riverside	Personnel	USA
Dr. Susan Anenberg	Environmental and Occupational Health, George Washington University	Collaboration	USA
Dr. Susan Chrysler	TTI – SAFE-D UTC Assistant Director	Collaboration	USA
Dr. Tom Durbin	University of California, Riverside	Data	USA
Dr. Wei Li	TAMU – Landscape Architecture and Urban Planning	Collaboration	USA
Dr. Yunlong Zhang	TAMU – Civil Engineering	Collaboration	USA
`	Oak Ridge National Laboratory	Collaboration	USA
Mr. Brandon Feenstra	South Coast Air Quality Management District	Data, In-kind support	USA
Mr. David Ederer	Centers for Disease Control and Prevention	Collaboration	USA
Mr. Douglass Mann	Maryland Institute College of Art	Data collection access	USA
Mr. Hugh Pocock	Maryland Institute College of Art	Data collection access	USA
Mr. Iyasu Eibedingil	The University of Texas at El Paso	Collaboration, Data, Equipment, Student	USA
Mr. John Smart	Advanced Vehicles - Idaho National Lab	Collaboration	USA
Mr. Juan Aguilera	Institute for Healthy Living at the University of Texas at El Paso	Collaboration, Data, Equipment, Student	USA
Mr. Marcos Mendez	The University of Texas at El Paso	Collaboration, Data, Equipment, Student	USA
Mr. Mathew Bechle	University of Washington	Data	USA
Mr. Michael Garber	Emory University	Collaboration	USA
Mr. Zhiming Gao	Oak Ridge National Laboratory	In-kind support	USA
Ms. Niina Kuittinen	Tampere University of Technology	Collaboration	Finland
Ms. Victoria DeGuzman	University of Southern California/ METRANS UTC	Collaboration	USA

OUTPUTS

In CARTEEH's 2018 Technology Transfer Plan, several output performance measures were targeted to be tracked for our center. We have already successfully met several of our output target metrics, such as the number of conference presentations and papers based on CARTEEH research, as well as the number of public, industry, and nonprofit organizations engaged by CARTEEH researchers.

Our target metric for conference presentations and papers based on CARTEEH research is seven per year, and we have already exceeded this number in the current reporting period. Also, the number of public, industry, and nonprofit organizations engaged by CARTEEH researchers is on

target to exceed our identified goal. As shown in the previous list, we have partnered with over 60 organizations over the past year.

Presentations

Name Michael Rodgers, Georgia Tech
Event: Georgia Transportation Institute Lecture Series, April 4, 2019
Title: Transportation and Health
Location: Atlanta, GA

Name Haneen Khreis, Associate Research Scientist, TTI
Event: Health Effects Institute 2019 Annual Conference (May 5-7, 2019) **– invited presentation**
Title: Potential Health Implications of New Mobility
Location: Seattle, Washington

Name Josias Zietsman on behalf of Haneen Khreis, Center Director, TTI
Event: Southern Transportation Air Quality Summit (STAQS) 2019 meeting **– invited presentation**
Title: Traffic-Related Air Pollution and the Burden of Childhood Asthma in the Contiguous United States in 2000 and 2010
Location: Louisville, Kentucky

Name Haneen Khreis, Associate Research Scientist, TTI
Event: World Health Organization Climate, Environment, and Health symposium (June 20-21, 2019) **– invited presentation**
Title: Health and the Urban Environment
Location: Seoul, South Korea

Name Juan Aguilera
Event: Graduate Student Assembly at UTEP (October 21, 2019)
Title: Moderate to Vigorous Physical Activity Levels Negatively Correlate with Traffic-Related Air Pollutants in Children with Asthma Attending a School Near a Freeway
Location: El Paso, TX

Name Juan Aguilera
Event: Stanford PRISM Seminar (October 9, 2019)
Title: Moderate to Vigorous Physical Activity Levels Negatively Correlate with Traffic-Related Air Pollutants in Children with Asthma Attending a School Near a Freeway
Location: Stanford, CA

Name Juan Aguilera
Event: Research Proposal at the Institute for Healthy Living (October 2, 2019)
Title: Associations of Traffic-Related Air Pollution with Physical Activity and Cardiorespiratory Health Outcomes in at-risk Populations from El Paso, TX
Location: El Paso, TX

Name Juan Aguilera
Event: Border Solutions Alliance at UTEP (June 10, 2019)
Title: Moderate to Vigorous Physical Activity Levels Negatively Correlate with Traffic-Related Air Pollutants in Children with Asthma Attending a School Near a Freeway
Location: El Paso, TX

Name Amit Raysoni
Event: Guest speaker at International Museum of Art and Science (IMAS), Edinburg, Texas (Spring, 2019)
Title: Air Pollution and Transportation
Location: Edinburg, TX

Name Amit Raysoni
Event: Guest speaker at UTRGV Coastal Studies Lab, South Padre Island, Spring 2019
Title: Air Pollution for Winter Texans
Location: South Padre Island, TX

Name Amit Raysoni
Event: Career Awareness at 2019 Science, Technology, Engineering and Mathematics (STEM) Industry Forum, Los Fresnos High School, Spring 2019
Title: Panel member
Location: Edinburg, TX

Name Thomas Gill
Event: New Mexico Dust Conference, New Mexico Farm, and Ranch Museum, April 17, 2019
Title: Characteristics and Implications of Windblown Dust and Sand in the El Paso/Las Cruces Area (Invited presentation)
Location: Las Cruces, NM

Name Iyasu Eibedingil
Event: New Mexico Dust Conference, New Mexico Farm, and Ranch Museum, April 17, 2019
Title: Identification of Land Surface Endmembers of Lordsburg Playa Using Spectral Unmixing in Google Earth Engine
Location: Las Cruces, NM

Name Thomas Gill
Event: Workshop on satellite-aided regional dust forecasting for valley fever surveillance, highway accident prevention, and air quality management: New Mexico Department of Health, August 12, 2019
Title: Panel member
Location: Santa Fe, NM

Name Andrew Patton, Doctoral candidate, JHU
Event: Pre-doctoral seminar, Department of Environmental Health and Engineering (June 27, 2019)
Title: Exposure and Health Risk Characterization for Transport Workers and Users
Location: Baltimore, Maryland

Conference Abstracts, Conference Papers, and Journal Articles

Name: Tanvir, S., Un-Noor, F., Boriboonsomsin, K., and Gao, Z.
Event: Submitted for presentation at 99th Annual Meeting of the Transportation Research Board and publication in Transportation Research Record
Title: Feasibility of Operating Heavy-Duty Battery Electric Truck Fleet in Drayage Application

Name: Atmospheric Environment
Event: Submitted for publication
Title: Dust Emission Source Characterization for Visibility Hazard Assessment on Lordsburg Playa in Southwestern New Mexico USA, by R. Scott Van Pelt, John Tatarko, Thomas E. Gill, Chunping Chang, Junran Li, Iyasu G. Eibedingil, and Marcos Mendez

Name: Mary Fox, Assistant Professor, JHU
Event: 2018 Society for Risk Analysis Annual Conference, New Orleans, December 2-6, 2018
Title: Developments in Cumulative Risk Assessment: Approaches for Occupational Health and Beyond

Sohrabi, Soheil; Khreis, Haneen (2019). "Transportation and Public Health: Burden of Disease Analysis of Traffic Noise and Vehicle Crashes in Houston, Texas." Environment International, under review, (IF = 7.1).

Sanchez, Kristen; Foster, Margaret; Nieuwenhuijsen, Mark J.; May, Anthony D.; Ramani, Tara; Zietsman, Josias (Joe); Khreis, Haneen (2019). "Urban policy interventions to reduce traffic emissions and traffic-related air pollution: protocol for a systematic evidence map." Environment International, under review, (IF = 7.1).

Khreis, Haneen; Alotaibi, Raed; Horney, Jennifer; McConnell, Rob (2019). "The Impact of Baseline Incidence Rates on Burden of Disease Assessment of Air Pollution and Onset Childhood Asthma: Analysis of Data from the Contiguous United States." Environment International, under review, (IF = 7.1).

Schaffer, K., Gadsby, A., Lowentritt, S., Le Dantec, C., Rodgers, M. and Watkins, K. "Measuring Temporal and Spatial Exposure of Urban Cyclists to Air Pollutants Using an Instrumented Bike"

Media References

1. Cleveland19 News, **Story: "Research shows connection between Cleveland traffic pollution and asthma in kids"** https://www.cleveland19.com/2019/09/09/research-shows-connection-between-cleveland-traffic-pollution-asthma-kids/
2. The Rivard Report, **Story: "Study Estimates San Antonio Traffic Pollution Causes Nearly 600 Child Asthma Cases Per Year"** https://therivardreport.com/study-estimates-sa-traffic-pollution-causes-nearly-600-child-asthma-cases-per-year/
3. Inverse, **Story: "Air Pollution Map Shows Which Hot Spots in the US Affect Children's Health"** https://www.inverse.com/article/54998-air-pollution-in-the-us-map-children-asthma-cases-health

4. Axios, **Story: "Study shows decrease in children's asthma from traffic-related air pollution"** https://www.axios.com/asthma-children-air-pollution-traffic-study-30d0237f-0d3d-4c66-94ee-e8f5a8295568.html

5. Business Insider, **Story: "These counties are where US traffic pollution hurts children the most"** https://www.businessinsider.com/here-are-the-counties-where-us-traffic-pollution-hurts-children-most-2019-4

6. U.S. News, **Story: "Where Traffic Pollution Hurts Children the Most"** https://www.usnews.com/news/healthiest-communities/articles/2019-04-15/counties-where-traffic-air-pollution-hurts-children-most

7. My San Antonio, **Story: "Mapping the US counties where traffic air pollution hurts children the most"** https://www.mysanantonio.com/news/article/Mapping-the-US-counties-where-traffic-air-13767706.php

8. Houston Chronicle, **Story: "Mapping the US counties where traffic air pollution hurts children the most"** https://www.houstonchronicle.com/news/article/Mapping-the-US-counties-where-traffic-air-13767706.php

9. The Conversation, **Story: "Mapping the US counties where traffic air pollution hurts children the most"** https://theconversation.com/amp/mapping-the-us-counties-where-traffic-air-pollution-hurts-children-the-most-115202

10. City Lab, **Story: "Mapping Where Traffic Pollution Hurts Children Most"** https://www.citylab.com/environment/2019/04/mapping-where-traffic-air-pollution-hurts-children-most/587170/

11. Laredo Morning Times, **Story: "Mapping the US counties where traffic air pollution hurts children the most"** https://www.lmtonline.com/news/article/Mapping-the-US-counties-where-traffic-air-13767706.php

12. San Francisco Gate, **Story: "Mapping the US counties where traffic air pollution hurts children the most"** https://www.sfgate.com/news/article/Mapping-the-US-counties-where-traffic-air-13767706.php

13. Futurity, **Story: "Check the map for your county's traffic-asthma link"** https://www.futurity.org/childhood-asthma-traffic-related-air-pollution-2029422-2/

14. MD Magazine, **Story: "Pediatric Pollution Asthma Rates Drop by One-Third Over Decade"** https://www.mdmag.com/medical-news/pediatric-pollution-asthma-rates-drop-by-onethird-over-decade

15. News Medical, **Story: "Interactive heat map shows childhood asthma burden caused by air pollution"** https://www.news-medical.net/news/20190405/Interactive-heat-map-shows-childhood-asthma-burden-due-to-traffic-related-air-pollution-across-the-US.aspx

16. Texas A&M Transportation Institute, **Story: "Asthma cases attributable to traffic-related air pollution dramatically decreased between 2000 and 2010"** https://tti.tamu.edu/news/tti-creates-new-heat-map-showing-relationship-between-traffic-related-air-pollution-and-childhood-asthma-across-the-united-states/

17. KTSM El Paso News: "Increase in air pollution puts health at risk for those who cross-bridge daily" https://www.ktsm.com/local/el-paso-news/increase-in-air-pollution-puts-health-at-risk-for-those-who-cross-bridge-daily/

18. KFOXTV El Paso: "El Paso MPO says pollutants released by vehicles in bridge lines are increasing" https://kfoxtv.com/news/local/el-paso-mpo-says-pollutants-released-by-vehicles-in-bridge-lines-are-increasing

Website

The CARTEEH website continues to be the face of our Center and is regularly updated with the latest center activities. It also provides access to the Transportation Emissions and Health Data Hub, as well as the literature library and videos from CARTEEH seminars. From October 1, 2018, through September 30, 2019, the CARTEEH website had a total of 5,726 visitors and 14,905 page views with an average time on a page of 2 minutes and 1 second. The site saw a 57.41% increase in page views and a 29.01% increase in time on a page over the previous year.

In the coming months, we will make significant updates to more prominently feature the Data Hub as well as expanding on CARTEEH tech transfer and education activities. In conjunction with TTI Communications, we are working to improve our graphics and strengthen our branding.

Technologies

None to report for this period

Inventions

None to report for this period

Other Products

None to report for this period

OUTCOMES

We have successfully met several of our outcome performance measures, such as the number of attendees at seminar and outreach events, and the number of visitors to the website, literature library, and Data Hub. Our target measure for the number of attendees to the seminar, webinar, and outreach events is 150 per year; we are meeting that goal.

A second performance measure is the number of visitors to the CARTEEH website, literature library, and Data Hub. Our target number is 700 per year. We have well exceeded this goal for this year.

IMPACT

We are continuing to see the impacts of our work, ranging from the successes of our students and interns to the dissemination of our research results and technology transfer activities. We continue to engage several transportation agencies and work with them collaboratively on solutions that can maintain and enhance the functioning of the transportation system while also promoting health. Our outputs continue to impact the body of existing scientific knowledge, with publications and conference presentations reaching a scientific audience, as well as the local media. We hope to continue outreach to stakeholders with a view of increasing our impact in the coming reporting period.

CHANGES/PROBLEMS

None

SPECIAL REPORTING REQUIREMENTS

No special reporting requirements.