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

UTC SEMI-ANNUAL PROGRESS REPORT

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OVERVIEW

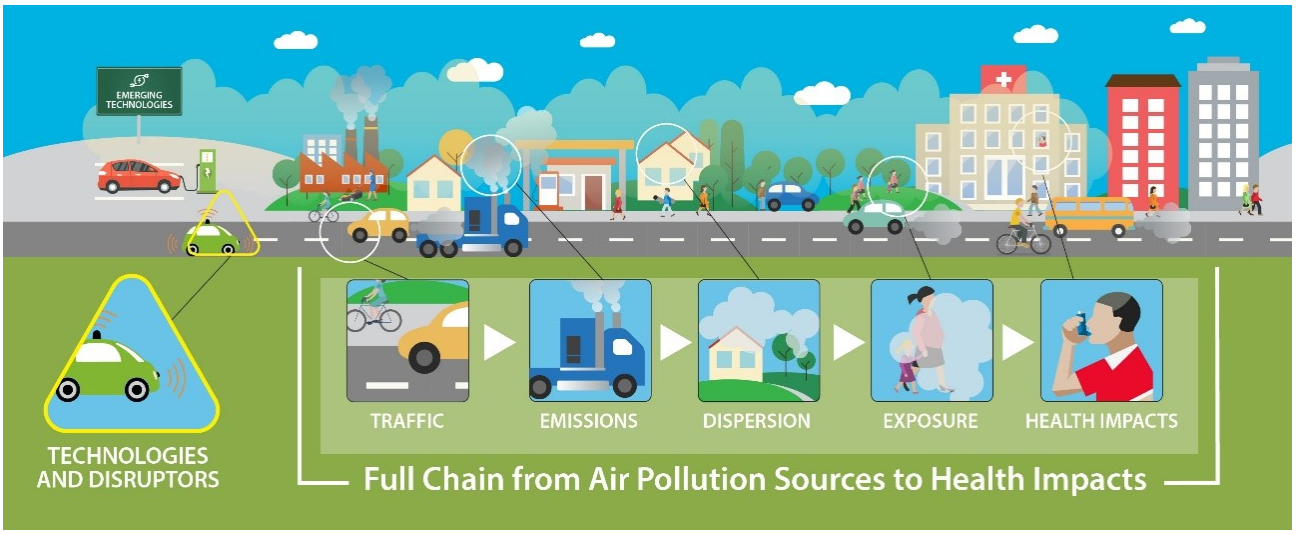
The Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH) has been highly productive during this reporting period. This period was marked by the great success of the CARTEEH Transportation, Air Quality, and Health Symposium, held in February 2019, drawing over 150 participants to Austin, Texas. 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 primary purpose is to advance research on transportation emissions in a more comprehensive manner, mapping the holistic tailpipe-to-lungs spectrum which includes the impacts of transportation emissions on the environment and public health. Figure 1 shows a simplified version of the tailpipe-to-lungs chain.

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 is divided into three areas: cooperative research, the competitive program, and strategic, targeted initiatives.

Work on cooperative projects identified in the first-year project work plan is successfully progressing, and most are scheduled to be completed during the next reporting period. The consortium partners have successfully met the collaboration requirements of these projects, and in the third year, are discussing future collaborative projects.

The competitive research projects awarded in CARTEEH's second year are all underway at each partner institution. Principal Investigators submit quarterly progress reports, which are reviewed by CARTEEH leadership members who follow up with the project PIs with any comments or questions. Most competitive projects began in early 2018, and with the 12 – 18 month required timeline, many are scheduled to be completed during the coming reporting period.

Strategic Initiatives

In addition to cooperative and competitive projects identified above, three strategic initiatives targeting areas identified by CARTEEH leadership as being impactful and relevant to the area of health and transportation were underway during this reporting period.

Technology Landscape and Future Direction for Transportation Emissions, Energy and Health

This project was initiated to facilitate key elements of CARTEEH's technology transfer plan. Its overall goal is to develop a technology roadmap for transportation emissions, energy, and health, by identifying:

- technologies currently available or under development in both software and hardware;
- technologies with high potential to further CARTEEH's mission;
- partners in private and public sectors for technology transfer;
- gaps in research development.

Transportation and Health – Conceptualization and Quantification

As transportation, air quality and health issues are increasingly being tackled in an interdisciplinary manner, there is a need to address the transportation-health nexus beyond air quality and emissions topics. CARTEEH researchers developed a comprehensive conceptual model framing the various linkages between transportation and health, termed as "pathways." Some pathways are associated with beneficial health impacts, while others are associated with detrimental health impacts. Our framework identified the existing literature and evidence on each. We are also working on initiatives to quantify and monetize the impacts of selected pathways for case studies in Texas and beyond. This framework is a first step to promote holistic solutions that enhance the beneficial health impacts of transportation while addressing its detrimental health outcomes.

Urban Policy Interventions and Their Effectiveness in Reducing Traffic Emissions and Traffic-Related Air Pollution

In this study, researchers are conducting a systematic review to identify policy interventions at the urban level that can be implemented by local authorities to effectively reduce traffic emissions and/or traffic-related air pollution (TRAP) from on-road mobile sources. An interactive tool will be developed to allow local authorities to pinpoint policy interventions that may be most effective in their area. It is believed that this will be the first peer-reviewed systematic review exclusively focused on synthesizing international evidence on the effectiveness of urban-level policy interventions in reducing traffic emissions and/or TRAP from on-road mobile sources in the context of human exposure and health effects.

Reporting Requirements and Close-Out Procedures

During this reporting period, the closeout procedures for all research projects were finalized, and a report template and closeout checklist was created and distributed to all researchers. Final research reports are due 60 days after the completion of the project.

Research Results Disseminated

Preliminary findings from CARTEEH projects have been presented at various conferences throughout this reporting period, including TRB and the CARTEEH Transportation, Air Quality, and Health Symposium.

In addition, some of the projects lend themselves to public outreach and involvement, such as with cooperative project #3, "Border Crossing Emissions Impacts Study." As part of the recruiting efforts, project researchers reached out to teachers in the El Paso Independent School District and discussed the impacts of vehicle emissions on their health, along with that of the students.

Community members in Baltimore City, Maryland play a significant role in securing site locations for data collection, on the projected titled "Assessing Regulatory Compliance and Community

Air Pollution Impacts of Crude Oil by Rail Transport, " which is being conducted at Johns Hopkins University.

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.

Table 1 provides a high-level picture of CARTEEH's full research portfolio.

Table 1: CARTEEH Research Portfolio

Project	Lead Institution	Principal Investigator	Project Number
Transportation Emissions and Health Data Hub	TTI	Dr. Andrew Birt	01-TTI
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	02-GT
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	03-TTI
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	04-UTEP
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	05-UCR
Evaluates benefits of batter electric trucks and plug-in hybrid electric trucks over conventional diesel trucks			
Health Risk Characterization for Transportation Users	JHU	Dr. Mary Fox	06-JHU
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	07-JHU
Delivers evidence-based characterization of emissions impacts of CBR within Baltimore City, Maryland			
PM Exposure for Paratransit Transport	GaTech	Dr. Alex Samoylov	01-08-GT
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	01-09-GT
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	01-10-TTI

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	01-11-TTI
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	01-12-TTI
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	01-13-UTEP
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	01-14-UCR
Assesses emissions from gasoline direct injection and multipoint injection vehicles when operated under different driving cycles			
Quantifying Traffic Congestion-Induced Change of Near-Road Air Pollutant Concentration	UCR	Dr. Jill Luo	01-15-UCR
Develops a statistical model to quantify the contribution to the ambient air quality degradation due to traffic congestion			
Truck Driver Wellness Pilot Study	TTI	Dr. Reza Farzaneh	01-16-TTI
Investigates health and wellness needs of long-haul truckers			
Transportation and Health - Conceptualization and Quantification	TTI	Dr. Haneen Khreis	01-17-TTI
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	01-18-TTI
Identifies policy interventions to effectively reduce traffic emissions and traffic-related air pollution from on-road mobile sources			
Technology Landscape and Future Direction for Transportation Emissions, Energy, and Health	TTI	Dr. Yanzhi (Ann) Xu	01-19-TTI
Develops a technology roadmap for transportation emissions, energy, and health			

Plans for Next Reporting Period to Accomplish Research Goal

Due to the delay in receiving our third-year funding, as well as CARTEEH focused efforts on the CARTEEH Symposium in February, the call for the next round of competitive research projects was postponed until May 2019. The RFP is being updated to more carefully target impactful projects closely aligned to CARTEEH's research and technology transfer goals. We are also increasing the response time window, to allow more time for preparation of the problem statements. We will make the awards in early September 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.

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. During the past six months, CARTEEH has expanded its student engagement to include intermediate-school level students, with its participation in the Advancement Via Individual Determination (AVID) program.

Curriculum Course Development

Progress continues on the development of CARTEEH's cross-disciplinary course titled "Traffic-Related Air Pollution, Human Exposures, and Health." The course outline has been revised with the addition of 8 lectures, and a pool of primary and back-up lecturers have been identified for each of the 60 planned sessions.

The course will cover key 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. There will be 60 lectures, which will include a 15 minute pre-recorded video lecture from a subject matter expert for each. Preparation of the templates for each of the 60 planned sessions is ongoing to standardize reporting and delivery of course materials.

CARTEEH Summer Internship Program

During this reporting period, applications were accepted for the CARTEEH internship program to be held this summer at TTI. The number of applicants increased significantly from last year, and of the 18 applications received, four senior students were selected to receive internships. Students chosen are from Texas A&M, as well as two of the CARTEEH partner institutions – Georgia Tech and UC Riverside.

Held in conjunction with the SAFE-D UTC summer internship program, the internship program runs from May 28th through August 2nd, approximately nine weeks. Each student will be paired with a mentor and will spend their summer working on a health and transportation-related project. At the completion of the program, students will participate in a university-wide, undergraduate research poster session. A core group manages CARTEEH and the SAFE-D UTC internship programs from both UTCs.

Figure 2: AVID students learn about the impact of emissions on our health

Advancement Via Individual Determination (AVID) Program

In mid-December 2018, CARTEEH researchers and graduate students spoke to 91 local intermediate school students who visited TTI as participants in the AVID program. AVID encourages underachieving students who have shown an ability to succeed to consider college and introduces them to professions with which they may be unfamiliar.

Students received an introduction to the "World of Transportation and Engineering," observed a crash test, and participated in multiple breakout sessions. CARTEEH staff and students hosted a breakout session designed to educate students on the links between transportation, air pollution, and health.

Student of the Year

Ms. Ayla Moretti from UC Riverside was chosen as CARTEEH's 2018 Student of the Year. Ms. Moretti received her bachelor's degree in Environmental Science at Oregon State University and is currently a third-year Ph.D. student at UCR with a research specialization of air quality, particularly secondary organic aerosols aged from vehicle emissions. Ayla attended TRB where she presented a poster titled "Understanding Air Quality Data, Traffic, and Weather Parameters Collected from Near-Road Stations." She also joined others from TTI and the SAFE-D UTC at the CUTC banquet.

Education Results Disseminated

During this reporting period, one of the 2018 CARTEEH summer interns, Ms. Kristen Sanchez, completed her bachelor's degree in public health from Texas A&M and was hired as a full-time researcher at TTI. Kristen is working on several of CARTEEH's special initiatives, as well as serving as a member of the summer internship program core group. While Kristen hadn't previously considered a career in transportation, her internship exposed her to the linkage between public health and transportation. Kristen's story may be found here, on the CARTEEH website.

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 a further refinement 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, efforts were focused on the CARTEEH inaugural Transportation, Air Quality, and Health Symposium, which was held February 18-20, in Austin, Texas.

Figure 3: L-R, Joe Zietsman, Greg Winfree, Christopher Frey, Bakeyah Nelson, Oliver Gao, and Thomas Burke, following the plenary session

The symposium's objective was to promote 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 included students, researchers and university faculty or staff, as well as transportation professionals.

Keynote speakers for the symposium were Dr. Daniel Greenbaum, President of the Health Effects Institute and Mr. Neil Pedersen, TRB Executive Director. There was a total of 151 participants representing industry, higher education, and the public sector. The symposium attracted participants from the United Arab Emirates, Germany, the UK and from many states across the U.S.

Figure 4: Andrew Glazener, CARTEEH student researcher

The Symposium was a three-day event, beginning with workshops on topics such as "Beyond Air Quality – The Wider Impacts of Transportation on Health" on Monday afternoon. Tuesday provided a number of presentations, as well as on-going poster sessions and opportunities for discussions on collaboration and networking. At the conclusion of the symposium, two students were recognized for their outstanding posters and awarded certificates of recognition and a $250 award, which were donated by TTI.

"Fantastic to have folks with diverse trans-sector expertise gather to refine understanding and consider solutions to complex issues!"

"Glad to see lots of enthusiasm for the transportation and health topic. There is certainly a lot of work yet to do to continue 'connecting the dots' between transportation emissions, air quality and health outcomes."

Comments from the survey conducted at the completion of the symposium were very favorable, with the majority giving it the highest possible rating.

The symposium information is housed here on CARTEEH's website. Slides from most presentations have been uploaded, and videos and slides of the opening remarks and keynote session may also be found at the same location.

Transportation Emissions and Health Data Hub

Work continues the Transportation Emissions and Health Data Hub, one of the initial collaborative projects identified in CARTEEH year 1 workplan. As a key component of CARTEEH's technology transfer vision, the Data Hub will provide a means to reconcile different methods of data collection and analysis in the fields of transportation and public health and will serve as one of the products of our technology transfer goals. While the first phase of the data hub will be completed in late May, plans for the second phase and on-going development are already underway.

CARTEEH Seminars/Webinars

The CARTEEH Seminar/Webinar series continued in this reporting period, with one seminar held at the University of California, Riverside. Dr. Andrea Polidori spoke on the "Use and Applications of Low-Cost Air Quality Sensors." The seminar was well attended, with over 100 participants registered from across the country. Videos or slides from all CARTEEH seminars are posted to the CARTEEH website for future viewing, and information on Dr. Polidori's seminar may be found here.

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. The reference list has grown to over 800 scientific studies addressing the full chain of events between transportation pollution sources and health impacts. This reference list is 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 early 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.

The first CARTEEH Biannual report, covering the Center's first two years, was completed and published during this reporting period. The report was distributed electronically to approximately 1200 members of the CARTEEH mailing list, as well as via TTI's LinkedIn account and Twitter handle. It can be found posted here on the CARTEEH website.

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.

As a result of the success of the inaugural CARTEEH symposium, we will continue the momentum and hold a second symposium in 2020 in southern California. We will co-host this

event with our partners at UC Riverside. Planning has begun, and dates and location are currently being finalized.

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 2: 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
Breathe Easy Dallas	Dallas, Texas	Collaboration
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
Environmental Defense Fund	Austin, Texas	Collaboration
Georgia Ports Authority	Savannah, Georgia	Collaboration
Health Effects Institute	Boston, Massachusetts	Collaboration
Houston-Galveston Area Council	Houston, Texas	Collaboration
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
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 and equipment
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
University of Miami	Miami, FL	Collaborative research
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

Table 3: CARTEEH Significant 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. Andrea Strzelec	Mississippi State University	Collaboration	USA
Dr. Bakeyah Nelson	Air Alliance Houston	Collaboration	USA
Mr. Brandon Feenstra	South Coast Air Quality Management District	In-kind support	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
Mr. Douglass Mann	Maryland Institute College of Art	Data collection access	USA
Dr. Ellen MacKenzie	Dean, JHU Bloomberg School of Public Health	Collaboration	USA
Dr. Eun Sug Park	TTI – Mobility Analysis Program	Collaboration	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
Mr. Hugh Pocock	Maryland Institute College of Art	Data collection access	USA
Dr. Jenny Mindell	University College London	Collaboration	The U.K.
Dr. Joan Reibman	New York University School of Medicine	Collaboration	USA
Mr. John Smart	Advanced Vehicles - Idaho National Lab	Collaboration	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. Mark Benden	TAMU Health Science Center	Collaboration	USA
Dr. Mark Burris	TAMU – Civil Engineering	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
Ms. Niina Kuittinen	Tampere University of Technology	Collaboration	Finland
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 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. Susan Anenberg	Environmental and Occupational Health, George Washington University	Collaboration	USA
Dr. Susan Chrysler	TTI – SAFE-D UTC Assistant Director	Collaboration	USA
Dr. Teresa Qu	Michigan State University	Collaboration	USA
Dr. Tom Durbin	University of California, Riverside	Data	USA
Ms. Victoria DeGuzman	University of Southern California/ METRANS UTC	Collaboration	USA
Dr. Wei Li	TAMU – Landscape Architecture and Urban Planning	Collaboration	USA
Dr. Yunlong Zhang	TAMU – Civil Engineering	Collaboration	USA
Mr. Zhiming Gao	Oak Ridge National Laboratory	In-kind support	USA

OUTPUTS

In CARTEEH's 2018 Technology Transfer Plan, several output performance measures were targeted to be tracked for our center. While the implementation of our Technology Transfer plan is still in its early stages, 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 40 organizations during the first half of this year.

Presentations

Name: Dan Seedah, Andrew Birt, TTI
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Developing a Transportation, Emissions, and Health Data Hub
Location: Austin, Texas

Name: Reza Farzaneh, Joe Zietsman, TTI; Teresa Penbrooke, GreenPlay, LLC
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Truck Driver Wellness Pilot Study
Location: Austin, Texas

Name: Phil Lewis, Sherif El Khouly, Texas A&M University; Andrea Strzelec, Mississippi State University; Jeremy Johnson, Adam Mayer, TTI
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Assessing In-Cab Air Quality for Construction Equipment
Location: Austin, Texas

Name: April Gadsby, Kaitlyn Schaffer, Nic Alton, Kari Watkins, Christopher Le Dantec, Georgia Tech
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Influence of Bike Infrastructure on Cyclist Air Pollution Exposure
Location: Austin, Texas

Name: Ji Luo, Kanok Boriboonsomsin, Matthew Barth, UCR
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Consideration of Exposure to Traffic-Related Air Pollution in Bicycle Route Planning
Location: Austin, Texas

Name: Raed Alotaibi, TTI; Mathew Bechle, Julian Marshall, University of Washington; Tara Ramani, Haneen Khreis, TTI; Mark Nieuwenhuijsen, ISGlobal
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Air Pollution and the Burden of Childhood Asthma in the Contiguous United States in 2000 and 2010
Location: Austin, Texas

Name: Farinoush Sharifi, Reza Farzaneh, Soheil Sohrabi, Haneen Khreis, TTI
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Active Transportation and Self-Impression of Health – Evidence from 2017 National Household Travel Survey Data
Location: Austin, Texas

Name: Soheil Sohrabi, Haneen Khreis, TTI
Event: CARTEEH Transportation, Air Quality, and Health Symposium

Title: Assessing the Health Impact of Transportation Systems: A Burden of Disease Analysis
Location: Austin, Texas

Name: Mary Fox, Joseph Amoah, Andrew Patton, Misty Zamora, Kristen Koehler, Johns Hopkins University
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Exploring Transportation-Related Chemical Mixtures and Cumulative Risks
Location: Austin, Texas

Name: Thomas Gill, Iyasu Eibedingil, Lixin Jin, Marcos Mendez, UTEP; David Dubois, Jaylen Fuentes, New Mexico State University; Junran Li, University of Tulsa; John Tatarko, R. Scott Van Pelt, Nicholas Webb, USDA-ARS
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Assessing the Acute Safety Hazard to Highway Transportation from Blowing Dust at Lordsburg Playa, New Mexico
Location: Austin, Texas

Name: Ji Luo, Ayla Moretti, Guoyuan Wu, Brandon Feenstra, Kanok Boriboonsomsin, Matthew Barth, UCR
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Performance Evaluation of Low-Cost Air Quality Sensors at Near-Road Air Quality Monitoring Stations
Location: Austin, Texas

Name: Wen-Whai Li, Soyoung Jeon, Leah Whigham, UTEP; Amit Raysoni, University of Texas Rio Grande Valley
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: Near-Highway Criteria Pollutant Concentrations are Weakly Associated with Adverse Respiratory Symptoms for Asthmatic Children Attending Roadside Schools
Location: Austin, Texas

Name: Soheil Sohrabi, Farinoush Sharifi, Haneen Khreis, TTI
Event: CARTEEH Transportation, Air Quality, and Health Symposium
Title: The Impact of Connected and Autonomous Vehicles on Public Health: A Conceptual Model
Location: Austin, Texas

Name: Patton, A.
Event: Johns Hopkins Dept. of Environmental Health and Engineering Seminar
Title: Exposure and Risk in Occupational and Non-Occupational Groups from Commercial Gasoline Station Filling Events
Location: Baltimore, Maryland

Name: Ayla Moretti, Ji Luo, Guoyuan Wu, Brandon Feenstra, Kanok Boriboonsomsin, Matthew Barth,
Event: Transportation Research Board Annual Meeting
Title: Understanding Air Quality Data, Traffic, and Weather Parameters Collected from Near-Road Stations
Location: Washington, DC

Name: Amit U. Raysoni, Juan A. Aguilera, Leah D. Whigham, Stephanie Garcia, Moises Garcia, Adan Rangel, Mayra C. Chavez, Ivan M. Ramirez, Wen-Whai Li
Event: American Public Health Association 2018 Annual Meeting and Expo
Title: Airway inflammation and lung function measurements in asthmatic children at two road-side elementary schools in El Paso, TX
Location: San Diego, California

Name: Wen-Whai Li, Soyoung Jeon, Amit U. Raysoni, Juan A. Aguilera, Leah D. Whigham, Adan Rangel, Mayra C. Chavez, Ivan M. Ramirez
Event: Air Sensors International Conference
Title: Associations of respiratory responses with traffic air pollution for asthmatic children attending roadside schools
Location: Oakland, California

Name: Juan Aguilera, Leah Whigham, Wen-Whai Li
Event: 73rd meeting of the Joint Advisory Committee (JAC) for the Improvement of Air Quality in the Ciudad Juarez, Chihuahua, El Paso, Texas, and Dona Ana County New Mexico Air Basin
Title: Physical activity levels and traffic-related air pollutants in children with asthma attending near-road schools
Location: Las Cruces, New Mexico

Conference Abstracts, Conference Papers, and Journal Articles

Zamora, M. L., Pulczinski, J. C., Johnson, N., Garcia-Hernandez, R., Rule, A., Carrillo, G., Zietsman, J., Sandragorsian, B., Vallamsundar, S., Askariyeh, M.H. & Koehler, K. (2018). Maternal exposure to PM 2.5 in south Texas, a pilot study. Science of The Total Environment, 628, 1497-1507. https://www.ncbi.nlm.nih.gov/pubmed/30045568

Juan Aguilera and Leah Whigham, 2018. Using the $^{13}C/^{12}C$ carbon isotope ratio to characterize the emission sources of airborne particulate matter: a review of literature Journal of Isotopes in Environmental and Health Studies, Vol 54 (6): 573-587, 2018

Glazener, Andrew; and Khreis, Haneen (2018). "Transforming Our Cities: Best Practice Towards Clean Air and Active Transportation." Invited for Special Issue on Air Pollution and Health in *Current Environmental Health Reports*, 1-16, doi: 10.1007/s40572-019-0228-1.

Alotaibi, Raed; Bechle, Mathew; Marshall, Julian D.; Ramani, Tara; Zietsman, Josias (Joe); Nieuwenhuijsen, Mark J.; Khreis, Haneen (2018). "Traffic-Related Air Pollution and the Burden of Childhood Asthma in the Contiguous United States in 2000 and 2010". *Environment International*, online: https://doi.org/10.1016/j.envint.2019.03.041, (IF = 7.1).

Sanchez, Kristen; Ramani, Tara; Zietsman, Josias (Joe); Nieuwenhuijsen, Mark J.; Khreis, Haneen (2020). "The State of the Literature on Traffic-Related Emissions, Air Pollution, Human Exposures, and Health." Book Chapter, Traffic-Related Air Pollution: Emissions, Human Exposures, and Health. Editors: Khreis, H., Nieuwenhuijsen, M., Ramani, T., Zietsman, J. Elsevier.

Khreis, Haneen; Glazener, Andrew; Ramani, Tara; Zietsman, Josias; Nieuwenhuijsen, Mark J.; Mindell, Jennifer S.; Foxx, Mary; Winfree, Gregory D.; and Burke, Thomas A. (2019). Transportation and Health: A Conceptual Model and Literature Review. College Station, Texas: Center for Advancing Research in Transportation Emissions, Energy, and Health, May 2019. Available at: http://www.carteeh.org/wp-content/uploads/2019/04/14-Pathways-Project-Brief_Final-version_24April2019.pdf

Kyuhyun Lee[1] and Ipek N. Sener [2,]
Understanding Potential Exposure of Bicyclists on Roadways to Traffic-Related Air Pollution: Findings from El Paso, Texas, Using Strava Metro Data https://www.mdpi.com/1660-4601/16/3/371/htm

Website

The CARTEEH website continues to be the face of our Center and is regularly updated with weekly news articles relevant to the CARTEEH focus areas. It also provides access to the Transportation Emissions and Health Data Hub, as well as the literature library and videos from CARTEEH seminars.

During this reporting period, carteeh.org was reviewed and made compliant with the 508 requirements. CARTEEH staff members who regularly post to the website are receiving training to familiarize them with the 508 compliance requirements.

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

Though the implementation of the Technology Transfer plan is still in its early stages, and was impacted by our funding delay, we 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. As mentioned earlier, there was a high level of interest in the seminar conducted by Dr. Andrea Polidori on the "Use and Applications of Low-Cost Air Quality Sensors," with over 100 participants registered. Plans for the next seminar/webinar to be held in the upcoming reporting period are currently underway.

The Transportation, Air Quality, and Health Symposium had over 150 participants, and we expect an even larger group at the second symposium next year.

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. In the current reporting period, we've had over 460, so we are well on our way to meeting that goal.

Impact

While the initial research projects funded by CARTEEH are being completed, the impacts of this work are being established. We have already seen our contributions impact the body of existing scientific knowledge, with our publications in high-level journals and conference presentations reaching a scientific audience, as well as the local media. Our impact is evidenced by the requests CARTEEH researchers receive to speak to various audiences.

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.

Changes/Problems

None

Special Reporting Requirements

No special reporting requirements.