



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

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US Department of Transportation

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Energy, and Health (CARTEEH)

Center Director: Josias Zietsman, Ph.D., P.E.,
j-zietsman@tti.tamu.edu
(979) 317-2796

Submitting Official: Tara Ramani, Ph.D., P.E.
CARTEEH Deputy Director
(979) 393-0688

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DUNS & EIN Numbers: 93-848-5539; 74-2270624

Recipient Organization: Texas A&M Transportation Institute
1111 RELLIS Parkway
Bryan, TX 77807

Recipient Identifying Number: 608101; 608102; 165821; 165822; 165823

Grant Period: November 30, 2016 – September 30, 2023

Reporting Period End Date: September 30, 2023

Report Term: Semi-Annual

Signature of Submitting Official:

OVERVIEW

The Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH) had a productive reporting period coinciding with the end of the University Transportation Center (UTC) Grant received under the Fixing America's Surface Transportation (FAST Act). The focus of the center activities was therefore on wrapping up projects and bringing this grant to a conclusion. Some of the activities conducted also were aligned with future activities that could be conducted through the new grant awarded to CARTEEH under the Bipartisan Infrastructure Law (BIL) UTC program.

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 comprehensively, 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. A comprehensive list of these projects are available on CARTEEH's website [Projects \(carteeh.org\)](https://www.carteeh.org), and are no longer included in this report due



to space constraints. Since this was the end of the grant period, no new research projects were initiated, and the focus of the grant activities was on obtaining final reports from project Principal Investigators (PIs) and publishing them on the CARTEEH website, and disseminating them to the required USDOT repositories. Final reports published under CARTEEH are available here: <https://www.carteeh.org/research/final-reports/>. A new webpage was also created under the CARTEEH website to highlight journal articles resulting from CARTEEH funded research, available here: <https://www.carteeh.org/research/journal-articles/>.

Journal Articles

Publications generated for the University Transportation Center Funded by the Fixing America's Surface Transportation (FAST) Act

Exploring the Spatial-temporal dynamics of travel patterns and air pollution exposure of E-scooters
Suriya Vallamsundar, Texas A&M Transportation Institute

Journal of Transport Geography

Urban policy interventions to reduce traffic-related emissions and air pollution: A systematic evidence map
Haneen Khreis, Texas A&M Transportation Institute

Environment International

Burden of disease from transportation noise and motor vehicle crashes: Analysis of data from Houston, Texas
Sohail Sohrabi, Texas A&M Transportation Institute

Environment International

Figure 2. New Webpage Featuring Journal Articles

Research Results Disseminated

CARTEEH researchers continue to disseminate their research results through various venues, including presentations at conferences, paper submittals to journals, and meetings and outreach to stakeholders. Key research findings and final reports are also disseminated through the CARTEEH website. CARTEEH continues to host webinars that feature completed work funded by the grant.

Plans for Next Reporting Period to Accomplish Research Goal

Not applicable - this report represents the end of grant reporting.

CARTEEH Goal #2: Education and Workforce Development

CARTEEH research projects are catalysts for CARTEEH student involvement, with several students involved with CARTEEH as research assistants, student workers, and interns.



Texas A&M University College of Education Collaboration

In the previous reporting period, CARTEEH K-12 classroom lessons were developed and distributed to schools. In this reporting period, the CARTEEH team working with faculty and graduate students in the Department of Teaching, Learning, and Culture continued to refine and disseminate the lesson plans and materials. A webpage on the CARTEEH website was also created to house the lesson plans and related materials, including an introductory video: <https://www.carteeh.org/education/k-12-curriculum/what-is-in-the-air-introducing-air-pollution-to-grades-5-8/>



The screenshot shows a webpage layout. On the left is a large image titled "What is in the air? Science Unit for Grades 5 - 8" featuring photos of students in a classroom. To the right of this image is a "Lesson Plan" section with text explaining the unit's focus on air pollution. Below the lesson plan are "Lesson Objectives" listed as three numbered points. At the bottom left, there is a "Download Curriculum Materials" section with a list of links. On the bottom right, there is a video player titled "Overview of 'What's in the Air' Lessons" showing a woman speaking.

What is in the air?
Science Unit for Grades 5 - 8

Lesson Plan

Many people are unfamiliar with the serious environmental problem of air pollution compared to other issues like anthropogenic climate change. However, in 2016 the World Health Organization attributed 4.2 million premature deaths to unhealthy air quality worldwide. Air quality challenges are likely to become more exacerbated as populations, transportation, and energy demands continue to grow. This sequence of lessons is designed to promote a deep understanding of this critical issue, including the scientific knowledge and societal decision-making facets. Each lesson draws on the extensive science education research base to foster a logical flow, questions, and activities that promote a high-quality and meaningful learning experience for students.

Lesson Objectives

1. Promote a deep and robust knowledge of the air pollution environmental issue.
2. Build an accurate understanding of the airborne particles we breathe, including the types of particles, the sources of various particles, and the health and environmental impacts of different particulates. The focus is on particulate particles.
3. Stimulate civic decision-making using reasoning and scientific evidence to

Download Curriculum Materials

- [Lesson Overview & Plan](#)
- [Teacher Companion Slides](#)
- [Student Handouts Pt 1](#)
- [Student Handouts Pt 2 \(Mystery Town\)](#)
- [Video Overview](#)
- [TTI Career Video](#)
- [Materiales en español próximamente \(Materials in Spanish coming soon\)](#)

Overview of "What's in the Air" Lessons

Start Here! Overview of What's in the Air Lessons

Figure 3. CARTEEH K-12 Curriculum Webpage

CARTEEH Summer Internship Program

CARTEEH's third annual Summer Internship program kicked off on May 30, 2023, and concluded on August 4, 2023. This program was held jointly with the internship program for the National Institute for Congestion Reduction (NICR). Four upper-level undergraduates interested in transportation emissions, energy, and health spent 10 weeks in the CARTEEH offices this summer. They participated in professional development activities, technical tours, and research presentations throughout the summer. Each intern took on a chosen research topic under the guidance of a TTI researcher serving as their mentor and presented their research at TTI's Hall of Honor Conference room.

The CARTEEH interns and their research topics were as follows:

- Shreya Sunkari, University of Texas at Austin - Dallas-Fort Worth Electric Vehicle (EV) Infrastructure Equity
- Alireza Mahdaviarab, Texas A&M University - RITIS Data Analysis for Air Quality Application
- Kristie Ulloa Yoshikawa, Texas A&M University - Impacts of Transportation-Related Air Pollution on Environmental Justice Communities



- Hernán Vega-Camacho, Univ. of Puerto Rico – Mayaguez - Electric versus Diesel: Operational Impacts on Buses' Life Cycles Due to Tropical Climate Conditions

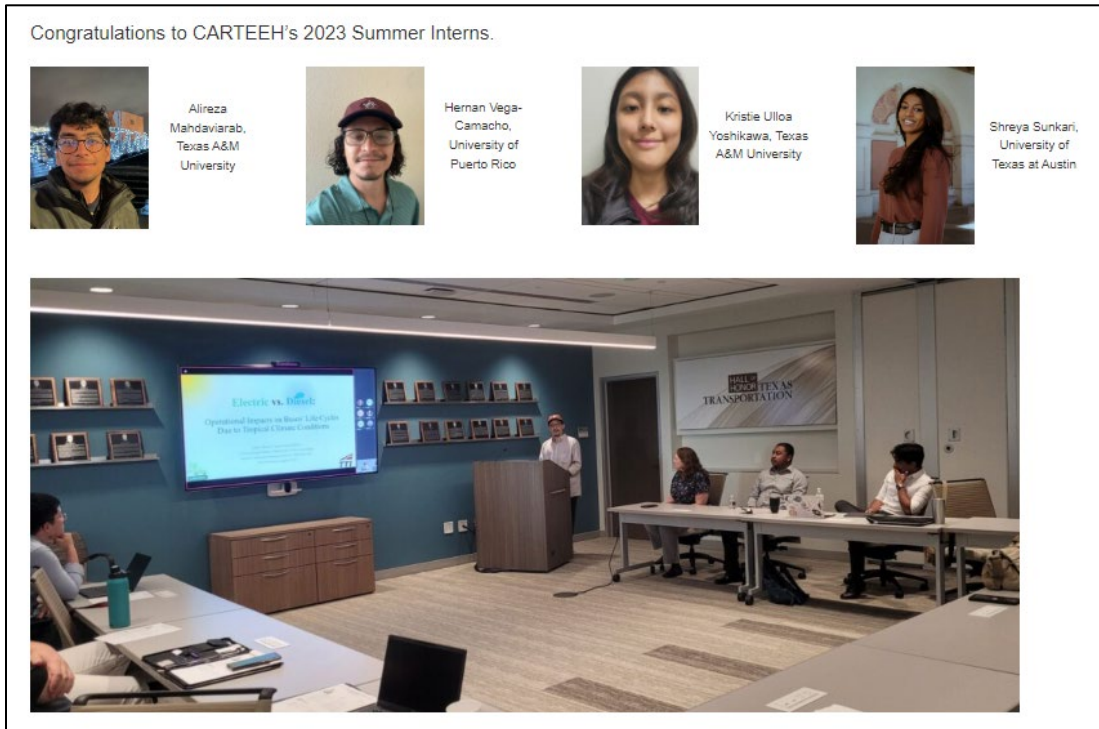


Figure 4. CARTEEH Interns and Picture from their Final Presentation Seminar

Plans for Next Reporting Period to Accomplish Education Goal

Not applicable - this report represents end of grant reporting.

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 activities at all stages and in a cross-cutting manner. We value stakeholder engagement, as well as emphasizing information dissemination and the creation of open-access tools and methods that enable the practical application of cutting-edge research findings.

In this reporting period, coinciding with the wrap-up of our CARTEEH grant under the FAST Act, we continued to maintain and update the following key technology transfer platforms and products, namely:

- The Clean Transportation Collaborative - <https://www.cartteeh.org/ctc/> - a membership collaborative launched in 2022 that engages with topics related to transportation, energy, and emissions in both the private and public sectors. The CTC has developed white papers and facilitated events in the previous reporting period, and activities are expected to continue in the future under the BIL UTC grant.
- The [CARTEEH DataHub](#) currently contains data from completed projects, and will undergo further updates and enhancements in the future.
- The [Infrastructure for Health Equity Toolkit](#), which was released in August 2023, contains an interactive web tool for practitioners to use to identify strategies that can be applied to



- improve health equity across the life cycle of a transportation project.
- The [CARTEEH literature library](#) continues to be maintained on the CARTEEH website. This tool is intended as a resource for students, researchers, and practitioners interested in the area of transportation and health, especially the impact of transportation emissions and air pollution on human health.

CARTEEH Researcher Perspectives Series

A new series on “CARTEEH Researcher Perspectives” (<https://www.carteeh.org/carteeh-researcher-perspectives/>) was initiated to provide a venue for CARTEEH-affiliated researchers to write short, non-technical articles on current topics related to our research program. During the reporting period, two such articles were posted, one on air quality issues that surfaced due to recent wildfires in North America, and another one relating to lithium mining for electric vehicles.

Air Quality in the News with Recent Canadian Wildfires

This is a [new series](#) in which we hear from CARTEEH-affiliated researchers on current topics of interest related to our research program.

By: [Georges Bou Saab, Ph.D.](#)

Air pollution in the United States (U.S.) was increasing at alarming rates in cities after the Great Depression and World War II, which negatively impacted public health and the environment. One significant attributable factor is more reliance on personal vehicles for transportation, leading to an increase in number of cars and trucks, as the economy recovered, population experienced growth, and rapid urbanization in cities¹. On a positive note, there has been successful national efforts to regulate air pollution from vehicles since the passage of the Clean Air Act in 1970¹. The image below shows a comparison of smog levels in New York City from the 1970s and 2010s. As evident, there has been noticeable improvements in air quality and these changes were also observed in other major cities¹.



Source: History of Reducing Air Pollution from Transportation in the United States (EPA, 2023)¹

Unfortunately, new images captured last week in New York City (as shown below)² illustrate a return to significant, visible, air pollution of the past. The recent ravaging wildfires in eastern Canada clogged the air across northeastern U.S. with unhealthy levels of smog. The skies turned orange from the dangerous levels of pollution which are subsequently linked to adverse health impacts including respiratory issues, organ impairment and premature death^{3, 4}.


Figure 5. Example of "CARTEEH Researcher Perspective" Article

Podcast Featuring CARTEEH Leadership

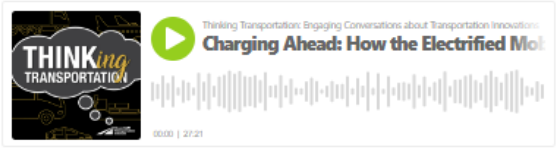
CARTEEH leadership at TTI, including CARTEEH Director Dr. Joe Zietsman and CARTEEH Deputy Director Dr. Tara Ramani worked with members of the Texas A&M University System to establish an “Electrified Mobility Collaborative” workshop which was held on April 12, 2023. While not directly related to CARTEEH, this event allowed for CARTEEH work to be featured as part of an evening poster session. Dr. Ramani also spoke about electrification and related topics in a podcast released in May 2023.



Episode Preview with TTI's Tara Ramani (audio, 41s):



Full Episode (audio):




EPISODE DETAIL

May 25, 2023
Episode 58. Charging Ahead: How the Electrified Mobility Collaborative envisions a radical shift.

FEATURING: Tara Ramani

Nearly 300 million vehicles are on American roads today. Nearly all of them run on gasoline or diesel, so a large-scale shift to electric power would be transformative. A new Texas A&M University System venture is working to figure out how that might work.

ABOUT OUR GUEST



Tara Ramani
 Research Engineer

Tara Ramani leads the Air Quality, Energy and Health Division at TTI. She also is the deputy director of the Center for Advancing Research in Transportation Emissions, Energy, and Health, a US Department of Transportation-funded University Transportation Center. Tara joined TTI in 2008 as a graduate student, and has been active in the transportation research field since, focusing on sustainable transportation and air quality topics.

Figure 6. "Thinking Transportation" Podcast Featuring CARTEEH Deputy Director

Technology Transfer Results Disseminated

All Center activities are posted to the CARTEEH website, and several papers, presentations, and other results have been disseminated, as outlined in later sections of this report. In April 2023, a "Synthesis of Stakeholder Input on Equity in Electric Vehicle Charging Infrastructure" was released in follow up to the March 8th CTC Equity Workshop which was covered in the previous reporting period. This report was disseminated to workshop attendees and is available on the CTC webpage on the CARTEEH website.

Plans for Next Reporting Period to Accomplish Technology Transfer Goal

Not applicable - this report represents end of grant reporting.

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 1: 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
Cherry Hill Neighborhood	South Baltimore, Maryland	Collaboration
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
El Paso Health Department	El Paso, Texas	Data sharing
El Paso Metropolitan Planning Organization	El Paso, Texas	Data sharing
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 Baltimore Go! Pilot Project	South Baltimore, Maryland	Collaboration
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, El Paso Department of Public Health	El Paso, Texas	Data sharing



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
Sun Metro	El Paso, Texas	Project Stakeholder
El Paso County Transit	El Paso, Texas	Project Stakeholder
City of El Paso	El Paso, Texas	Project Stakeholder
Camino Real Regional Mobility	El Paso, Texas	Project Stakeholder
Center for Disease Control and Prevention	Atlanta, Georgia	Next Generation Sequencing
Children's Hospital Los Angeles	California	Collaboration
El Paso Electric Company	El Paso, Texas	Provided sample survey questions
Texas Commission on Environmental Quality	Houston, Texas	Sampling and logistics
LINK Houston	Houston, Texas	Collaboration
City of Riverside	California	In-kind support
Norfolk Southern Railway	Atlanta	Personnel, Collaboration
Ray C. Anderson Foundation	Atlanta	Data, Personnel

Table 2: 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 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
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 Kuitinen	Tampere University of Technology	Collaboration	Finland
Ms. Victoria DeGuzman	University of Southern California/ METTRANS UTC	Collaboration	USA
Mr. Trent Botkin	New Mexico Department of Transportation	Collaboration	USA
Mr. William Hutchinson	New Mexico Department of Transportation	Collaboration	USA
Mr. Michael Baca	New Mexico Environment Department	Collaboration	USA
Dr. Sarah Hayes	U.S. Geological Survey	Facilities, Equipment, Data	USA
Dr. Robert Wunderlich	Center for Transportation Safety, TTI	Data	USA
Dr. Jothikumar Narayanan	Centers for Disease Control and Prevention	Next Generation Sequencing	USA
Stephen Paciotti	Texas Commission on Environmental Quality	Collaboration	USA
Dr. Shankar Chellam	TAMU	Collaborator	USA
Jennifer Dien Bard	Children's Hospital Los Angeles	Collaboration	USA
Kevin Hall	TTI	Data	USA
Jacob Aun	Socio-Environmental and Geospatial Analysis Lab, UTEP	Data collection access	USA
Ernesto Ortiz	El Paso Independent School District	Access	USA



Jacob Burns	Institute for Medical Information Processing, Biometry and Epidemiology	Collaboration	Germany
Anthony D. May	Institute for Transport Studies	Collaboration	The U.K.
Shams Tanvir	California State Polytechnique, San Luis Obispo	Collaboration	USA
Tom Durbin	University of California at Riverside	Data	USA
Cesunica Ivey	University of California at Riverside	Equipment	USA
Akura Ventakram	University of California at Riverside	Equipment	USA
Nanpeng Yu	University of California at Riverside	Data	USA
Ran Wei	University of California at Riverside	Data	USA
Amy Moore	Oak Ridge National Laboratory	Data, In-Kind Support	USA
Mary Katherine Watson	The Citadel	Collaboration	USA
Andrew Danneberg	University of Washington	In-Kind Support, Collaboration	USA
April Willis Rodgers	Samford University	Collaboration, In-Kind Support	USA
Daniel Rochberg	Emory University	In-Kind Support, Collaboration	USA
Dr. Teresa Penbrooke	GP RED and GreenPlay, LLC	Collaboration	USA

OUTPUTS

In this final reporting period for the grant, CARTEEH has continued to meet its metrics and targets for research outputs and products, student engagement, and visitors to our website.

Presentations

Name: Kanok Boriboonsomsin, University Lead, UCR

Event: California Mexico 2030 Summit: Turning Climate Challenges into Opportunities (April 19, 2023)

Title: Sustainable Freight Research for Accelerating Medium Duty & Heavy Duty Zero Emission Vehicle Deployment

Location: Mexico City, Mexico

Name: Kanok Boriboonsomsin, University Lead, UCR

Event: Leonard Transportation Center Dialogue (June 20, 2023)

Title: Reducing Air Pollution Impacts of Goods Movement in the Inland Empire through Truck Electrification

Location: Virtual

Name: Michelle Duren (CARTEEH funded doctoral candidate and Student of the Year Winner)

Event: Defense seminar, May 2023

Title: Understanding Modal Shift during the Pandemic and Quantifying its Public Health Impact

Location: Baltimore, MD

Name: Georges Bou-Saab, Assistant Research Scientist, TTI

Event: Air and Waste Management Association 116th Annual Conference and Exhibition (June 7, 2023)

Title: Evaluating the Effects of Crashes by Severity on Carbon Emissions by Different Roadway Types

Location: Orlando, Florida



Name: Ben Ettelman, Researcher, TTI

Event: ITS America Conference & Expo 2023: Toward Community Centered Transportation—Refocusing on Human Needs in Design (April 27, 2023)

Title: Smart Infrastructure for Health Equity

Location: Grapevine, Texas

Conference Papers, Conference Abstracts, and Journal Articles

Jaikummar R., Bou-Saab G., Xu M., Rhinehart E., Yoshikawa K. U., Ettelman B., 2024. Can Clean Vehicle Technology Reduce Exposure to Traffic-Related Air Pollution in Disadvantaged Communities? presented at the 2024 annual Transportation Research Board (TRB) meeting in Washington, D.C, 2023. TRBAM-24-05060

Un-Noor, F., Vu. A., Tanvir, S., Gao, Z., Barth, M., and Boriboonsomsin, K. (2023). "Application of Wireless Charging at Sea Ports for Range Extension of Drayage Battery Electric Trucks." Submitted to *IEEE Transactions on Vehicular Technology*.

Garrido, J., Hidalgo, E., Barth, M., and Boriboonsomsin, K. (2023) "An Intelligently Controlled Charging Model for Battery Electric Trucks in Drayage Operations." Submitted to *IEEE Transactions on Vehicular Technology*.

Aguilera J, Jeon S, Raysoni AU, Rangel A, Li W-W, Whigham L, 2023. Decreased moderate to vigorous physical activity levels are associated with increased traffic related air pollutants in children with asthma, *J. of Environmental Health*, 85(2): 16-24 <https://utep.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/decreased-moderate-vigorous-physical-activity/docview/2787674027/se-2?accountid=7121>

Aguilera J, Jeon S, Chavez M, Ibarra-Mejia G, Ferreira-Pinto J, Whigham L, Li W-W, 2023. Short-term effects of traffic related air pollution on cardiorespiratory outcomes among low income residents from a US-Mexico border community, *Journal Air Quality, Atmosphere, and Health* (under peer review).

Li, W-W, Chavez M, Williams E, Vazquez L, 2023. Measurements of traffic-related air pollution at a U.S.-Mexico port of entry and its impacts on nearby community, *Discover Environment*, (2023) 1:10. [Measurements of traffic-related air pollution at a U.S.–Mexico port of entry and its impacts on nearby community | Discover Environment \(springer.com\)](https://www.springer.com/journal/43077)

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Website

The CARTEEH website continues to be the face of our Center and is regularly updated with the latest center activities. During this reporting period, updates and enhancements were made to the website to distinguish the FAST Act and BIL UTC grants, including updating center information, key personnel, and other details. From April 1, 2023, through September 30, 2023, the CARTEEH website had a total of 2,370 page views and a total of 810 unique visitors.

Technologies

There is nothing to report for this period.

Inventions

There is nothing to report for this period.

Other Products

There is nothing 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 are continuing to exceed this goal each year.

IMPACT

We are continuing to see the impacts of our work and are pleased to know that the culmination of this grant resulted in our team being awarded a new grant under the BIL UTC program. We will continue to work with stakeholders to expand our research, education, and technology transfer activities under



this new grant.

CHANGES/PROBLEMS

None

SPECIAL REPORTING REQUIREMENTS

No special reporting requirements.

