



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

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Recipient Organization: Texas A&M Transportation Institute  
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Grant Period: November 30, 2016 – September 30, 2023

Reporting Period End Date: March 31, 2023

Report Term: Semi-Annual

Signature of Submitting Official: *Haylee Yung*

## OVERVIEW

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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 five years. As we reach the end of the grant period, we are wrapping up the grant activities with several projects coming to an end, and several education, outreach and technology transfer activities to support this work.

## ACCOMPLISHMENTS

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### Major Goals of the Program

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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

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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 \(cartteeh.org\)](http://Projects.cartteeh.org), and are no longer included in this report due



to space constraints. This section and following sections of the report discuss some of these projects and results in further detail.

In this reporting period, work continued for our remaining projects, which include current projects awarded during the last RFP cycle as well as collaborative projects led by our consortium members aligned with CARTEEH's "Healthy People through SMART Infrastructure" framework that links health and health equity considerations into decision-making. These projects have progressed well over the past quarter, and many are on track for completion in the next few months.

Since we are in the last year of our grant, our focus is to enhance and build upon current or concluded projects to further our goals as a center. During this reporting period, we have continued efforts to update our web-based tools, research electric vehicle impacts on air quality and health, and complete all collaborative projects related to the SMART initiative. Seven projects have submitted their final reports, and we will be adding them to our web site along with submittal to USDOT in the coming weeks.

CARTEEH also initiated selected quick-turnaround projects for the final year of the grant, on timely and impactful topics. For example, TTI recently awarded an initiative to Mr. Ben Ettelman entitled *Impacts of Transportation Related Air Pollution on Environmental Justice Communities*. The goal of this study is to determine disparate impacts of transportation-related air pollution on underserved populations and determine whether adoption of battery electric vehicles for light duty vehicles will have equitable benefits for all segments of the population. The study will apply MOVES and AERMOD to predict the projected emissions, dispersion, and pollutant concentrations based on the different scenario of zero emissions vehicle adoption. This information can help the state and regional decision-makers identify and develop the best policies and strategies to determine whether a mix of BEVs and other alternatively fueled vehicles may have additional benefits for all segments of the population.

UTEP has continued work under Dr. Jayajit Chakraborty's direction to study Children's Exposure to Traffic Pollution in Texas School Districts: Analyzing Social Disparities and Adoption of Mitigation Strategies. During this reporting period, Characteristics of Children and Vehicular Pollution in Texas School Districts Dashboard has continued to develop. Dr. Chakraborty also continues the process of expanding the online geospatial dashboard for exploring and visualizing children's exposure to vehicular pollution in Texas school districts that was initiated in 2021. The draft version of this dashboard is available at <https://tinyurl.com/CCVPTXSD>. This dashboard allows users to browse and examine interactive maps and datasets related to traffic pollution exposure and socio-demographics of children at the school district level (information compiled in Phase 1 of this project) and school level (information compiled in Phase 3 of this project). Additional map layers, tables, and graphs based on data and analyses associated with multiple phases of this project will be added to this dashboard and new interactive capabilities that allow users to select their own variables for mapping and visualization will be included.

### *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*

In the next reporting period, CARTEEH leadership expects to close out all the ongoing projects successfully with impactful results. We expect to leverage 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 several students involved with CARTEEH as research assistants, student workers, and interns.

#### *Texas A&M University College of Education Collaboration*

CARTEEH K-12 classroom lessons were developed to implement in 5th – 8th grade classrooms as a week-long scientific inquiry unit with the objective of measuring particulate matter and identifying sources of air pollution. A link to the lesson materials including teacher's guide, student handouts, and an overview video were distributed to 537 elementary and middle school teachers. From these schools, eleven elementary and middle schools, primarily Title I sites, were selected to receive a supply grant for air quality monitors. Teachers were also requested to complete survey on air pollution knowledge and beliefs, related environmental behaviors, and teaching practices. This data will inform further curriculum development efforts.



**Figure 1. STEM night showing elementary and middle school children about the effects of air quality.**

Researchers are working closely with the selected 11 elementary and middle schools to pilot the “What’s in the air?” lessons to make updates for effective classroom implementation. The classroom teachers are also testing out various air quality monitors to find an optimal balance between cost effectiveness, accuracy, and classroom use. Based on feedback from teachers and piloting with students, the team finalized an article detailing the lesson sequence on air pollution which was submitted to *Science Scope*, a journal for middle school teachers published by the National Science Teaching Association. The journal has published the article and is available [here](#).



## CARTEEH Student of the Year

Michelle Duren was selected as the CARTEEH Student of the Year for 2022. She is a PhD candidate in Health Policy and Management at the Johns Hopkins Bloomberg School of Public Health. Her research focuses on how the environment and policy change influence health behaviors. Her dissertation centers on uncovering reasons for the observed surge in bicycling during the COVID-19 pandemic and providing concrete policy implications for how bicycling changes can be sustained and furthered moving forward.

Following graduation, Michelle will be working as a health policy analyst for the Government Accountability Office. Michelle has a BA in Political Science and Masters of International Public Affairs from the University of Wisconsin. Michelle recently completed her final report for her CARTEEH project, and which will be published soon.



## CARTEEH Summer Internship Program

In conjunction with two other University Transportation Centers (UTCs), CARTEEH is gearing up for its annual summer internship program from May to July of this year. During this reporting period CARTEEH selected four summer interns, who will work remotely and on site with mentors on research projects and deliver a final research paper and presentation. Hernan Vega-Camacho (Civil Engineering, University of Puerto Rico, Mayaguez Campus), Kristie Ulloa Yoshikawa (Structural Engineering, Texas A&M University), Alireza Mahdaviarab (Computer Engineering, Texas A&M University), Shreya Sunkari (Statistics, University of Texas at Austin) were selected out of a considerable candidate pool. Students will participate in weekly virtual events over the course of the internship, which will run from May 24 to July 31, 2023. All interns will travel to College Station to complete their summer internship with each of them being mentored by a member of the CARTEEH team on the area matching their interest and CARTEEH focus area.

## CARTEEH Webinar Series



### America's Transition to A Clean Transportation System: Exploring Data Behind Multimodal Connections to Health **WEBINAR**



Transportation is an important social determinant of health influencing the risk of injury, cardiovascular disease, and myriad other health outcomes. America's transition to a clean transportation system can mitigate many of the risk factors associated with our carbon-intensive transportation system. Unfortunately, air quality, transportation, and health outcomes are typically collected in separate data systems. New tools and data systems such as CDC PLACES and the National Environmental Public Health Tracking Network contain disaggregated estimates of risk factors and health outcomes to facilitate research into the health effects of the transition to a clean transportation system.



**Dr. David J. Ederer, Ph.D., MPH**  
Epidemic Intelligence Service Officer at the Centers for Disease Control and Prevention  
Dr. Ederer will discuss how America's transition to a clean transportation system can mitigate many of the risk factors associated with our carbon-intensive transportation system.

The Center for Advancing Research in Transportation Emissions, Energy and Health (CARTEEH) hosted a webinar on **Thursday, December 8, 2022** to discuss the connections between active transportation and the associated health benefits including clean air. Dr. David Ederer of the Centers for Disease Control covered how infrastructure and walkability data and assessment connect to health benefits, and how inter-agency collaborations can support building environments for healthier living. Transportation is an important social determinant of health influencing the risk of injury, cardiovascular disease, and myriad other health outcomes. America's transition to a clean transportation



system can mitigate many of the risk factors associated with our carbon-intensive transportation system. Unfortunately, air quality, transportation, and health outcomes are typically collected in separate data systems. New tools and data systems such as [CDC PLACES](#) and the [National Environmental Public Health Tracking Network](#) contain disaggregated estimates of risk factors and health outcomes to facilitate research into the health effects of the transition to a clean transportation system.

CARTEEH also hosted a webinar on **Wednesday, February 15, 2023**, on the role that perceived safety has on bicycling behavior. CARTEEH's 2022 Student of the Year, Michelle Duren, discussed the relationship between local transportation policies and bicycle use. Michelle shared the methods and findings from a series of logistic regression models that were run to assess the extent to which changes in perceived safety mediated the impact of those policies on bicycling behavior.

Materials and recordings from the webinars can be accessed and viewed at the [CARTEEH website](#).



Center for Advancing Research in  
**Transportation Emissions, Energy, and Health**  
A USDOT University Transportation Center

Exploring the Intersection of Policy and Health:  
**The Role of Perceived Safety on Bicycling Behavior**

# WEBINAR



The Center for Advancing Research in Transportation Emissions, Energy and Health (CARTEEH) is hosting a webinar on the role that perceived safety has on bicycling behavior. CARTEEH's 2022 Student of the Year, Michelle Duren, will discuss the relationship between local transportation policies and bicycle use. Michelle will share the methods and findings from a series of logistic regression models that were run to assess the extent to which changes in perceived safety mediated the impact of those policies on bicycling behavior.



**Michelle Duren**  
PhD candidate in Health  
Policy and Management at  
the Johns Hopkins Bloomberg  
School of Public Health

*Michelle's research focuses on how the environment and policy change influence health behaviors. Her dissertation centers on uncovering reasons for the observed surge in bicycling during the COVID-19 pandemic, and providing concrete policy implications for how bicycling changes can be sustained and furthered moving forward. Michelle has a BA in Political Science and Masters of International Public Affairs from the University of Wisconsin.*

### *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, especially those that can continue beyond the end of the current grant.

### 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 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.

### *Clean Transportation Collaborative*

The Clean Transportation Collaborative (CTC) was launched in Spring 2022 under CARTEEH. It consists of stakeholders with interests in transportation, energy, and emissions in both the private and public sectors. CTC is a membership collaborative with [members](#) bringing their expertise to the table and engaging with each other.



## CTC Members



The CTC sent quarterly communication to members on November 14, 2023 that included a link to the new [Clean Transportation Lexicon](#), an overview of responses to a survey sent to CTC members, [a synthesis of the Summer 2022 CTC Meeting on Electric Vehicle Charging Infrastructure Policy](#), and information on upcoming events. Of interest from the member survey, respondents indicated the most interest in four research areas of 1) Pollutant Emissions and Air Quality, 2) Greenhouse Gas and Carbon Reduction, 3) Electric Grid Preparedness, and 4) Infrastructure. Most respondents expressed interest in activities that connect thought leaders for critical information exchange and establishing best practices.

Over the winter, a white paper entitled “[Ensuring Equitable Access to Electric Vehicle Supply Equipment in Disadvantaged Communities.](#)” was developed. This paper was distributed to members along with an invitation to the spring event entitled “Considering Equity in Electric Vehicle Infrastructure.” The event, held on March 8, 2023, featured presentations by thought leader Tamika L. Butler of Tamika L. Butler LLC and national leader Richard Ezike of the United States Joint Office of Energy and Transportation on Equity in Transportation, and how to apply equity frameworks and goals to planning for vehicle electrification. Participants then moved into smaller break-out sessions that focused on specific subject material including infrastructure and grid safety and security, community engagement and capacity, and finding and financing priorities. The meeting met its goals of convening experts to discuss how to ensure equitable access to electric vehicle (EV) charging infrastructure and strengthening collaboration among CTC members to build productive relationships. CTC members who participated in this event came from a range of organizations, both in the private and public sectors. These organizations included the Federal Highway Administration (FHWA), Texas Department of Transportation (TxDOT), U.S. Department of Transportation (USDOT), metropolitan planning organizations (MPOs), city councils, universities, research organizations, private companies, and many others.



## Technology Transfer Web Products

We continue to expend and improve our [CARTEEH DataHub](#) with new data from competitive projects and other data repositories. Work commenced in April of 2022 to update and create a more accessible web portal for our current DataHub. Currently CARTEEH is in the final development of the SMART Toolkit. The web-based tool will navigate the SMART Framework and available resources. The tool will target research projects addressing aspects of transportation infrastructure and health equity. *Healthy People Through Smart Infrastructure* is a framework to help navigate these challenging issues in a consistent and comprehensive manner. This framework was developed to guide practitioners and policy makers through the complex intersections between transportation and health to make the most healthful decisions for people and for the planet. Researchers are in the final development stages of creating a Transportation-Health Enhancement Toolkit, which will include a range of strategies, methods, models, and practitioner guidance that can be used by transportation decision makers to determine how to enhance the health benefits of transportation infrastructure projects. The range of strategies, methods, models, and practitioner guidance will connect to one or more of the transportations-health pathways. In the next reporting period, the portal will go live, and Mr. Ben Ettelman will present the toolkit at ITS America Conference and Expo in Grapevine, Texas on April 24<sup>th</sup>, 2023, as well as present a webinar.

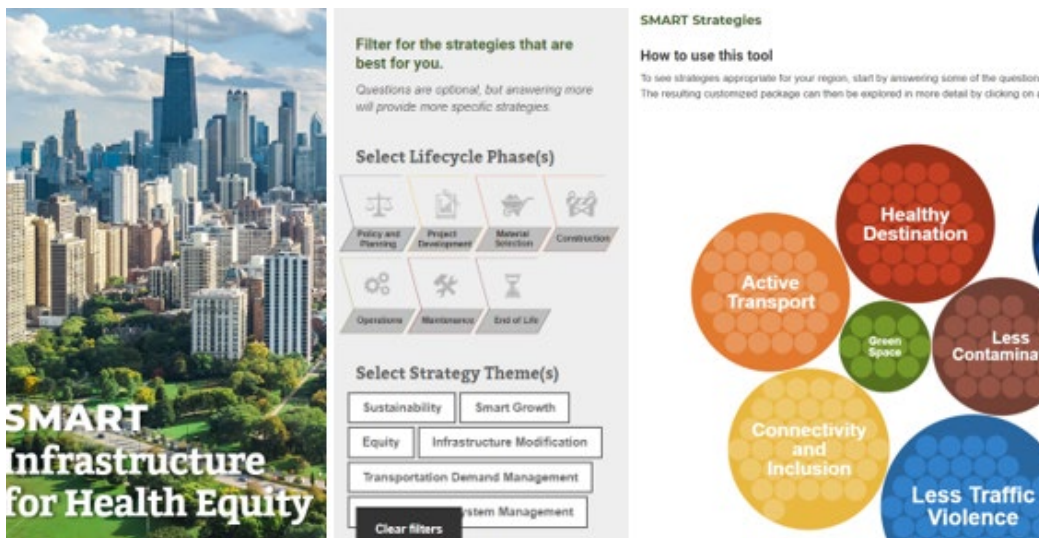


Figure. 3 Example Interactive Visual from Transportation-Health Enhancement Toolkit

This quarter we saw the completion of the Systematic Map initiative. the first peer-reviewed systematic evidence map (SEM) to compile evidence on urban-level policy interventions to reduce traffic emissions and/or traffic-related air pollution (TRAP) in the context of human exposure and health effects. The findings were recently published in *Environment International* and were a collaborative effort between several institutions, led by Dr. Haneen Khreis, a former CARTEEH researcher now with Cambridge University.

The SEM includes 376 unique articles, including 58 unique policy interventions, and 1,139 unique policy scenarios across six policy categories, namely pricing, land-use, infrastructure, behavior, technology, and management, standards, and services. An open-access, query-able Excel database with a complementary interactive visualization tool was created to showcase how users can find more about the effectiveness of the policy scenarios in reducing, increasing, and having mixed or no effect





on traffic emissions or TRAP. This database and interactive visualization tool can be valuable resources for researchers, practitioners, and policymakers to help plan interventions in their own regions and cities. [Click here](#) for open access to the interactive visualization tool.

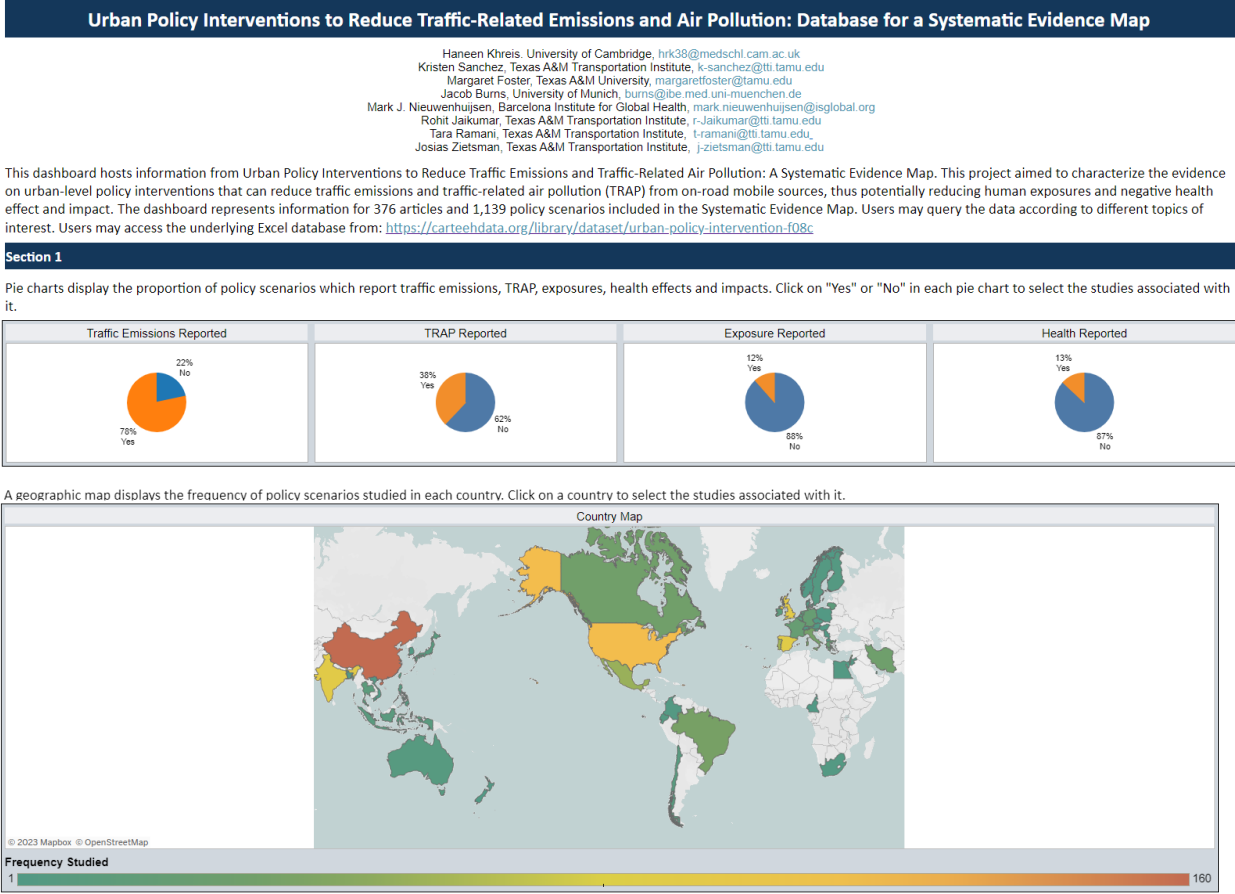


Figure 4. Interactive SEM tool developed as part of the CARTEEH project.

### CARTEEH Literature Library

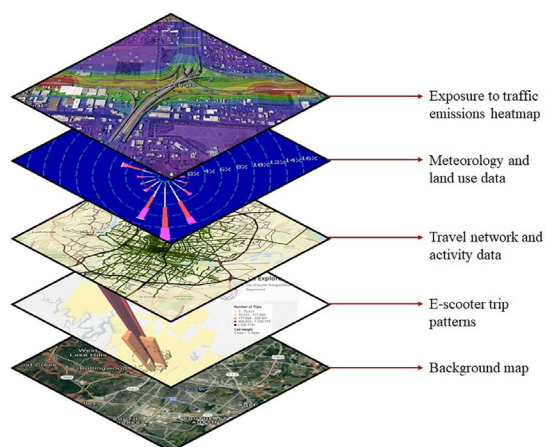
The [CARTEEH literature library](#) continues to be maintained on the CARTEEH website. This tool is intended as a resource for students, researchers and practitioners interested in the area of transportation and health, especially the impact of transportation emissions and air pollution on human health. It currently contains a reference list of over 1,000 scientific studies addressing the full-chain of events between transportation pollution sources and health impacts, in addition to technologies and disruptors. The literature library tabulates several attributes for each study, including the citation details, the publication type, topic area(s), and type(s) of study. This reference list will 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.



Recently a paper based on one of CARTEEH’s projects titled, “Exploring the Spatial-temporal dynamics of travel patterns and air pollution exposure of E-scooters” by Drs. Suriya Vallamsundar, Rohit Jaikumar and Madhusudhan Venugopal was published in the Journal of Transport Geography. This is one of the early studies that focus on the topic of the intersection between transport geography, environment, and health in an emerging mode of shared mobility. The results help in understanding the travel patterns of e-scooters, and their influence on the exposure levels experienced by the users. According to the survey and modeling results, e-scooter trips mostly replace walking for trips connecting to the transit stop, and personal vehicle for trips to and from home and work. By replacing walking, e-scooters could lead to a sedentary lifestyle leading to adverse health impacts including heart diseases, and diabetes. Alternatively, e-scooters reduce personal vehicle and shared ridership, however, the users are exposed to high levels of TRAP considering their peak usage during midday and evening periods due to the nature of the trips that they are replacing. In summary, based on the study findings, it seems like e-scooters may not be a sustainable means of transport because they are not used as a commute or last-mile solution, they replace trips that would otherwise have been made using active modes, and are exposed to direct vehicular exhaust as they are used for home-to-work trips. Local policymakers could develop policies that limit e-scooter usage during certain periods (off-peak periods when traffic volumes are lower) and restrict e-scooter access to roadways away from heavily trafficked roadways. Other incentives could include subsidizing transit costs for people using active modes or e-scooters to get to the transit stations.



**Figure 4.** Modeling framework. (The modeling framework consists of an integration of different layers of data starting with the background map based on which the e-scooter trip trajectories were generated. Next, the travel network and traffic activities layer were combined with meteorology and land use conditions to estimate the dispersion of the pollutant emissions. The e-scooter trajectories were then combined with spatial and temporal distribution of pollutant concentrations to estimate the personal exposure levels to traffic emissions).

### *Plans for Next Reporting Period to Accomplish Technology Transfer Goal*

We plan to continue the implementation of the Technology Transfer Plan, engaging with stakeholders, and developing tools and project outputs that can directly aid practitioners in their work.

### **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 Organizatoin	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

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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. For this six-month reporting period, we had over 300- attendees to our webinar and outreach events and 2,900 visits to our website and are on track to meet our yearly goals for these metrics.

### Presentations

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**Name:** Hamed Tavakoli, Xiujun Li

**Event:** ACS Southwest Regional Meeting SWRM 2022. Baton Rouge, LA, USA, November 6-9, 2022. (Oral)

**Title:** Instrument-free diagnosis of Mycobacterium tuberculosis on a point-of-care polymer/paper hybrid microfluidic biochip

**Name:** Jayajit Chakraborty

**Event:** Webinar on Highway Impacts: Urban Institute: Metropolitan Housing and Communities Policy Center, Washington DC; November 2022.

**Title:** Life Near the Highway: Examining Environmental Justice and Equity in Land Use and Transportation Planning

**Name:** Wen-Whai Li, Evan Williams, Leonardo Vazquez, Mayra Chavez

**Event:** 2022 National Ambient Air Monitoring Conference, Pittsburgh, PA

**Title:** Monitoring of three criteria air pollutants at an international port of entry





**Name:** Liliana Lozada, Isabel Lopez, Ivonne Santiago, and Yuanrui Sang  
**Event:** Transportation Research Board Annual Meeting and Technology Showcase, Washington DC.  
**Title:** Disparities, Perceptions, Opinions, and Knowledge of the Electrified Technology in Underrepresented Communities in the Paso del Norte Region

**Name:** Kent Johnson  
**Event:** Working group meeting, October 10, 2022  
**Title:** On-Board Sensing, Analysis, and Reporting (OSAR) Update

**Name:** Alice Grossman  
**Event:** Transportation Research Board Annual Meeting, Washington DC, January 8<sup>th</sup>, 2023.  
**Title:** Sustainability and Emerging Transportation Technology (SETT): Highlights from the 2022 SETT Conference

**Name:** Kanok Borinoonsomsin  
**Event:** Transportation Research Board Annual Meeting, Washington DC, January 8th, 2023.  
**Title:** Modeling the Impacts of Low Emission Zone on Route Diversion and Emissions of Heavy-Duty Trucks: A Southern California Case Study

**Name:** Wen-Whai Li  
**Event:** Transportation Research Board Annual Meeting, Washington DC, January 8<sup>th</sup>, 2023.  
**Title:** Quantification of Traffic-Related Air Pollution at a U.S.-Mexico Border Crossing

## Conference Papers, Conference Papers, and Journal Articles

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Hu, K.; Ma, L.; Wang, Z.;\* Fernandez-Delgado, O.; Garay, Y.; Lopez, J. A.; Li, X.\* Facile synthesis and integration of polyvinyl alcohol sponge-supported metal nanocatalysts on a microfluidic chip enable a new continuous flow multi-reactor nanocatalysis platform for high efficiency and reusability catalysis, ACS Sustain Chem Eng 2022, 10, 10579-10589. DOI: 10.1021/acssuschemeng.2c02060. (2021 IF 9.2)

Tavakoli, H; Mohammadi, S.; Li, X.C.; Fu, G.;\* Li, X.\* Microfluidic platforms integrated with nano-sensors for point-of-care bioanalysis, TRAC - Trend Anal Chem 2022, 157, 116806. DOI: 10.1016/j.trac.2022.116806. (Invited. 2021 IF 14.9).

Li, H.; Deng, R.; Tavakoli, H.; Li, X.C.;\* Li, X.\* Ultrasensitive detection of acephate based on carbon quantum dots-mediated fluorescence inner filter effects, Analyst 2022, 147, 5462-546. DOI: 10.1039/D2AN01552H.  
Tavakoli, H.;+ Hirth, E.;+ Luo, M.; Sharma, S.; Dou, M.; Dominguez, D. C.; Li, X.\* A microfluidic fully paper-based analytical device integrated with loop-mediated isothermal amplification and nano-biosensors for rapid, sensitive, and specific quantitative detection of infectious diseases, Lab Chip 2022, 22, 4693-4704. DOI: 10.1039/D2LC00834C.

Katla, S. K.;+ Zhou, W.;+ Tavakoli, H.; Mendez, E.; Li, X.\* Portable in-situ temperature-dependent spectroscopy on a low-cost microfluidic platform integrated with a battery-powered thermofoil heater, View 2022, In Press. DOI: 10.1002/VIW.20220053.

Chakraborty J. 2022. Children's Exposure to Vehicular Pollution: Environmental Injustice in Texas, USA. Environmental Research (ISI impact factor = 8.431). Volume 204, Part A, 112008. Available at: <https://doi.org/10.1016/j.envres.2021.112008>. Federal support was acknowledged.

Chakraborty, J and Aun, J J [currently in review]. Social Disparities in Exposure to Traffic-Related Air and Noise Pollution at Public Schools in Texas. Journal of Transport Geography (ISI impact factor = 5.899). Manuscript submitted for publication on December 17, 2022.

Li W-W, Chavez MC, Williams E, Vazquez L. Quantification of Traffic-related Air Pollution at a U.S.-Mexico Border Crossing. To be presented at the Transportation Research Board 102nd Annual Meeting; 2023; Washington, D.C. TRBAM-23-01873



Kenji Santacruz and Yuanrui Sang, Environmentally Aware Allocation of Electric Vehicle Charging Stations by Analyzing Locational Marginal Emissions, 54th North American Power Symposium, Salt Lake City, UT, October 9-11, 2022.

Vallamsundar, S., Jaikumar, R., & Venugopal, M. (2022). Exploring the Spatial-temporal dynamics of travel patterns and air pollution exposure of E-scooters. *Journal of Transport Geography*, 105, 103477. <https://doi.org/10.1016/j.jtrangeo.2022.103477>

Khreis, H., Sanchez, K. A., Foster, M., Burns, J., Nieuwenhuijsen, M. J., Jaikumar, R., Ramani, T., & Zietsman, J. (2023). Urban policy interventions to reduce traffic-related emissions and air pollution: A systematic evidence map. *Environment International*, 172, 107805. <https://doi.org/10.1016/j.envint.2023.107805>

### Media References

None

### Website

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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, 2022, through March 31, 2023, the CARTEEH website had a total of 6,148 page views and a total of 2,900 unique visitors.

### Technologies

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None to report for this period.

### Inventions

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None to report for this period

### Other Products

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None to report for this period

### OUTCOMES

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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

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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, including the establishment of a successful spin-off venture that builds on CARTEEH research. 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

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None

#### SPECIAL REPORTING REQUIREMENTS

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No special reporting requirements.

