

Director's Message

Over this past year, ISSE has made a quantum leap forward in all its research areas as a record number of proposals were submitted and funded.

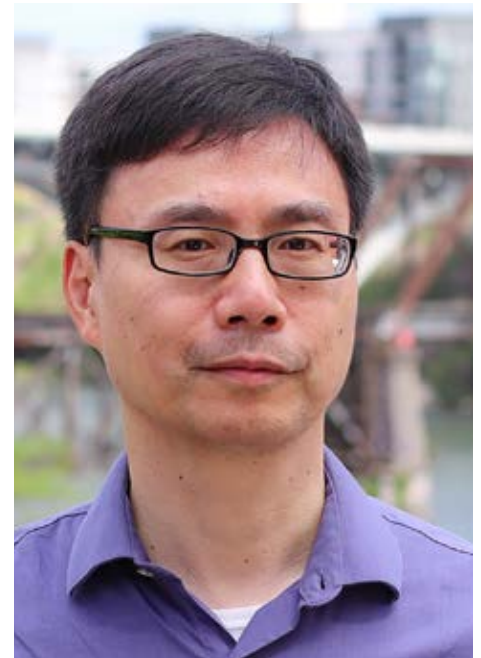
Our research portfolio has expanded to include Energy and Environmental Justice, an initiative directed by Dr. Chien-fei Chen, and a Net-Zero and Decarbonization initiative, built on the DOE-funded work of Drs. Baoshan Huang and Nick Zhou, that should create opportunities to replace coal with low-cost, electrically conductive, and mechanically strong coal-derived solid carbon materials for infrastructural components.

ISSE principal investigators are currently leading 38 active, sponsored projects with funding from 21 individual agencies, and ISSE was awarded 10 new sponsored projects this year. ISSE research projects have engaged more than 50 UT faculty members, several post-doctoral associates, and many graduate and undergraduate students. We are increasing our global reach through work related to food loss and waste, acting as an observer in worldwide climate policy discussions, and developing faculty exchanges with universities in Japan.

ISSE is funding 12 seed grant projects: six that are in progress and six that were completed this year. Topics addressed by these new projects include: assessing the levels of forever chemicals (PFAS) in surface water in Tennessee aquatic ecosystems; identification of novel pathways for bacterial degradation of polycyclic aromatic hydrocarbons; utilization of waste plastics; assessing the implications of large-scale hydrogen production on power transmission systems; couple mass transfer processes during underground hydrogen storage; and transformational production of sustainable aviation fuel and biofertilizer from black soldier flies.

ISSE has a robust internal operation with 10 support staff, 15 research staff, seven of whom are faculty members, and a fluid number of visiting scholars from around the world. Our 20 affiliated faculty members represent Haslam College of Business, the departments of Ecology & Evolutionary Biology, Biosystems Engineering & Soil Science, Electrical Engineering & Computer Science, Sociology, Economics, the Baker Center for Public Policy, Civil & Environmental Engineering, and Industrial & Systems Engineering. Our advisory board members come from UTK, UTIA, ORNL, TVA, TDEC, and the City of Knoxville.

ISSE is equipped and eager to work with all researchers and stakeholders on campus, in Tennessee, and globally to achieve a secure and sustainable environment for this and all future generations.



ISSE Director Dr. Mingzhou Jin

UT and Two Japanese Universities Host First EXCET Workshop in Tokyo

The partnership between Japan and the United States is longstanding and significant. It allows the best of both country's higher education institutions to develop strategies and solutions to promote interdisciplinary problem-solving for global grand challenges. The University of Tennessee leads the collaboration between Japan and the USA in an academic, interdisciplinary platform called EXCET (U.S-Japan Exchange Program for Green Growth Collaboration through Clean Energy Technologies). The purpose of EXCET is to encourage communication and collaboration with researchers on issues of renewable energy, green energy, and environmental and energy justice. As a first step in this groundbreaking partnership, a delegation from the University of Tennessee led by Drs. **Mingzhou Jin** and **Chien-fei Chen** at the Institute for a Secure & Sustainable Environment (ISSE), went to Tokyo and co-hosted EXCET's inaugural workshop with Waseda University.

Supported by the US Department of State and the US Embassy in Tokyo, EXCET is a high-level collaboration with the University of Tennessee (UT), Waseda University, and Osaka University. The key Japanese partners are Professors **Yasuhiro Hayashi** and **Hideo Ishii** at Waseda University and Professors **Shinya Yoshizawa** and **Yohei Yamaguchi** at Osaka University. Professor Hayashi is the Director of Waseda Center for a Carbon Neutral Society and a national leader for the clean energy transition and carbon neutrality.

The workshop kicked off after a welcome by Professors Hayashi and Ishii and opening remarks by Professor Jin. Keynote speakers were Professor **Shin-ichi Tanabe**, Waseda University and Professor **Tony Reames**, University of Michigan.

Six panels were presented with discussions sessions wrapping up each day. The panels were:

- Green Technology and Power Systems
- Decarbonization, NetZero Strategies, and Policy
- Energy Demand & Building Energy Efficiency
- Energy Justice & Social-Technological Integration,
- Decarbonization Technology, Manufacture, and Agriculture,
- Electric Vehicles & Charging Infrastructure

Besides the three hosting universities, panelists represented University of Tokyo, University of Pennsylvania, University of Michigan, University of Buffalo, Oak Ridge National Lab, Lawrence Berkeley National Laboratory, Energy Transition Finance, National Institute of Advanced Industrial Science and Technology, Tokyo Electric Power, Kyoto University, Research Institute of Innovative Technology for the Earth, Gifu University, Nikken Sekkei, Kyushu University, National Institute for Environmental Studies (Japan), and Central Research Institute of Electric Power Industry.

Dr. **Brad Day**, Associate Vice Chancellor for Research and Innovation at University of Tennessee, gave the conference wrap-up and announced the next EXCET workshop in September 2024 in Knoxville, Tennessee.



ISSE Welcomes New Staff



*Darcy Ayers, East Tennessee Clean Fuels
Project Coordinator*

Darcy is a Colorado native who has spent the better part of the last 20 years in East Tennessee. She graduated from UT Knoxville with a Bachelor's in Anthropology, a minor in Geography, and a Master's in Applied Sociology. Before joining the ETCleanFuels team in June 2023, she was Program Director at SEED leading the Career Readiness Program and other workforce development bootcamps for young adults. Darcy is excited about the opportunity to continue serving her community through the pursuit of a just energy transition.



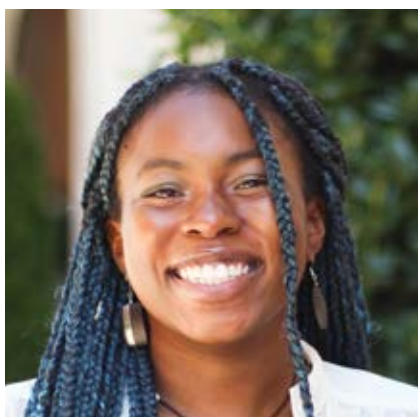
*Chris Black, East Tennessee Clean Fuels
Membership and Fundraising Coordinator*

Born and raised in East Tennessee, Chris is an optimist who believes in transformative change. A graduate of UT Knoxville and Liberty University, he is a lifelong scholar well-versed in political science, public policy, and international law. He is dedicated to doing everything possible to ensure that future generations are afforded every opportunity to thrive in life. Chris holds this commitment the highest, and it is one of his primary reasons for working as Tennessee Clean Fuels's Development Officer.



*Lily Lovingood, East Tennessee Clean Fuels
Project Coordinator*

Lily's experience as an environmental scientist sparked a passion in environmental justice. Her interest and dedication to environmental justice led her to the University of Tennessee, Knoxville. She received her MA in Sociology with a concentration in environmental sociology in 2022. Lily is eager to bring her environmental and social science expertise to the ETCleanFuels team. She looks forward to fortifying the efforts of the EMPOWER project.



*Wesleigh Wright, East Tennessee Clean Fuels
Community Engagement Liaison*

Wesleigh is a Tennessean by way of California and a graduate of the University of Tennessee, Knoxville with a major in Geography and a minor in Philosophy. She joined the ETCleanFuels team as part of the Clean Cities Energy and Environmental Justice Initiative and is passionate about the essentialism of equity in a green future.

California Transportation Secretary visits UT Campus



At the invitation of ISSE and the Department of Industrial & Systems Engineering, California's Secretary of Transportation, Dr. **Taks Omishakin**, visited campus on March 1, 2024, to give a talk titled "Supply Chain California—The Next Frontier." He discussed how California is addressing its supply chain issues and the impact that has on supply chains in Tennessee. Dr. Omishakin presented California's Transportation "Core 4"—Safety, Equity, Economic Prosperity, and Climate Action. The Core 4 guides all investment decisions from the state's transportation agencies.

The talk was sponsored by three programs housed within Tickle College of Engineering: Center for Freight Transportation for Efficient & Resilient Supply Chain (FERSC), Center for Transportation Research (CTR), and Institute for a Secure & Sustainable Environment (ISSE).

Dr. Omishakin is a Knoxville native and earned his PhD here in Industrial Engineering. He will be inducted into the Department of Industrial & Systems Engineering Hall of Fame in April.

below: Students and faculty gathered in 500 Tickle and over zoom to attend Dr. Omishakin's presentation.



Active Research Projects

CONTINUING SPONSORED PROJECTS

<i>PI</i>	<i>Sponsor</i>	<i>Title</i>
Alshibli, Khalid	NSF	3D Dynamic Evolution of Pore Water-Air Interaction Within Saturated Sheared Sand
Alshibli, Khalid	REU: 3D dynamic evolution	REU Supplement for 3D dynamic evolution of pore water-air interaction within saturated sheared sand
Chen, Chien-fei	NSF-SCC University of Michigan	SCC-IRG Track 1: Advancing Human-Centered Sociotechnical Research for Enabling Independent Mobility in People with Physical Disabilities
Chen, Chien-fei	Iowa State University	SAI-R: Community-centered Decision-making Framework for Microgrid Deployment to Enhance Energy Justice and Power System Resilience
Chen, Chien-fei	NSF-SECURE	Planning: Southeast Center for Just, Resilient, and Sustainable Ecosystems (SECURE)
Chen, Chien-fei	University of Alabama	SAI: Integrating human cognition, behavioral mechanisms and societal impacts for large-scale deployment of public charging infrastructure
Ezzell, Timothy	ARC	Appalachian Leadership Institute
Ezzell, Timothy	ETSU	Closing the Regional Tourism Gap: Promoting Multi-jurisdictional tourism in Cumberland Gap Communities
Fu, Joshua	US DOT - FAA	Estimating Soil Organic Carbon Changes from SAF Feedstock Production in the US with Integrative Satellite Data and Machine Learning
Hathaway, Jon	EPA	Wetland Restorations with RSCs
Hathaway, Jon	NSF	REU Site: Green Infrastructure for Sustainable Urban Environments (GI4SUrE)
Hathaway, Jon	NSF-Participant Costs	REU Site: Green Infrastructure for Sustainable Urban Environments (GI4SUrE)
Hathaway, Jon	NSF	REU Site: Green Infrastructure for Sustainable Urban Environments (GI4SUrE)
Hathaway, Jon	NSF-Participant Costs	REU Site: Green Infrastructure for Sustainable Urban Environments (GI4SUrE)
Hathaway, Jon	NSF-CBET	Collaborative Research: Reimagining Urban Watershed Management: A Systems Approach to Stormwater Control and Ecological Rehabilitation
He, Qiang	Aramco Services Company	AOP for wastewater treatment from the oil/gas industry
Jin , Mingzhou	East TN Clean Fuels Coalition	Administrative Support for East Tennessee Clean Fuels
Jin, Mingzhou	NSF EAR	INFEWS: U.S.-China: Coupled FEWS Modeling for Sustainability of the Global Crop Supply Chain with a Focus on China - US Interactions
Jin, Mingzhou	DOE- ORNL	Smart Manufacturing
Jin, Mingzhou	NSF SRS RN: PIAMRS	SRS RN: People-Centric Integrated Assessment Model for Regional Sustainability (PIAMRS): Focusing on the Central Appalachian Region
Jin, Mingzhou	DOE- ORNL	US Food Loss Waste
Jin, Mingzhou	DOE-EERE ETISE	East Tennessee Initiative of Smart Energy Management (ETISE)
Jin, Mingzhou	US Dept of State	U.S.-Japan Exchange Program for Green Growth Collaboration through Clean Energy Technologies (EXCET)
Jin, Mingzhou	US Dept of State-Participants	U.S.-Japan Exchange Program for Green Growth Collaboration through Clean Energy Technologies (EXCET)
Jin, Mingzhou	Eastman - Literature Review	Literature Review of Mass Flow Analysis for Enhancing Sustainability
Schwartz, John	TDEC TN Stream Mitigation	Tennessee Stream Mitigation Guidelines/Debit Tool Course Training
Schwartz, John	USDI-NPS-GRSM-CESU	Southern Appalachian Cooperative Ecosystems Studies Units, Vital Signs Water Quality Monitoring
Schwartz, John	Metro Gov Nashville-Urban Water Report Card	Development of the Tennessee Urban Waters Report Card - Nashville
Schwartz, John	West VA Univ	Appalachian Community Technical Assistance and Training - Tennessee

CONTINUING SPONSORED PROJECTS

<i>PI</i>	<i>Sponsor</i>	<i>Title</i>
Schwartz, John	USDI USGS Alabama	Increasing water treatment resiliency by using natural flood records to reduce the uncertainty of water hazard predictions under changing climate
Schwartz, John	Hamilton County-Urban Water Report Card	Development of Urban Water Report Card - Hamilton County
Schwartz, John	Chattanooga-Urban Water Report Card	Development of the Tennessee Urban Waters Report Card - Chattanooga
Schwartz, John	Knox Cty-Urban Water Report Card	Development of Urban Waters Report Card - Knox County
Schwartz, John	USGS	Tennessee Water Resources Research Center Program
Schwartz, John	EPA	Statewide University-Utility Partnership for Technical, Managerial, and Financial Assistance to Wastewater Systems in Rural Tennessee
Webster , Sheila	Nat'l Partnership	National PETE DOE Worker Training
Zhou, Hongyu	DOE-NETL	Utilizing coal-derived solid carbon materials towards next-generation smart and multifunction pavements

NEW AWARDS

<i>PI</i>	<i>Sponsor</i>	<i>Title</i>
Chen, Chien-fei	Wellcome Trust	A Community Co-design-based Weatherization and Micro-grid Plan for an Equitable Energy Security and Environmental Health
Hathaway, Jon	USDA	Gravel Tree Stormwater Systems: Bringing Ecosystem Services, Education, and Workforce Development to East Knoxville
Hathaway, Jon	Old Castle	Identifying Clogging in Bioretention Using the Internet of Things
Jin, Mingzhou	DOE- ORNL	Ecosystem Vulnerabilities
Jin, Mingzhou	Volkswagon	Support for the Life Cycle Analysis of Automotive Composite Material
Schwartz, John	West VA Univ	Appalachian Community Technical Assistance and Training - Tennessee
Schwartz, John	West VA Univ - DOL	Preparing New Entrants to the Workforce for Sustainable Careers in the Water Sector in Central Appalachia
Schwartz, John	TDEC	Erosion and Sediment Control Handbook Update Project
Schwartz, John	Foundation for Food and Agricultural Research	A multi-source remote sensing-based framework and decision-support tool for flash droughts and floods under climate change
Wu, Jie	USGS	Developing a sensor platform for rapid on-site detection of field-relevant levels of PFAS in the environment

Continuing Research

CLEAN ENERGY & ENERGY EFFICIENCY

East Tennessee Initiative for Smart Energy Management (ETISE): Smart Manufacturing for Energy Efficiency and Carbon Emission Reduction

Supported by the Industrial Efficiency & Decarbonization Office at Department of Energy (DOE), an ISSE team, together with UT Center for Industrial Service and Oak Ridge National, launched the East Tennessee Initiative for Smart Energy Management (ETISE) in April 2023. The goal of ETISE is to create a regional model for technical assistance and workforce training to effectively integrate smart manufacturing in energy management systems into energy-related business practices. Using East Tennessee as a test bed, ETISE will aim to three objectives: 1) understand the SM implementation for energy management by industries and sizes in the region, 2) develop a technical assistance and workforce training model at the regional level through ground service to manufacturers in East Tennessee, and 3) provide DOE strategic suggestions and materials to promote the adoption of SM for energy management. Based on the previous research on the smart manufacturing maturity models, ETISE is conducting a survey among small and medium enterprise (SME) manufacturers in the East Tennessee region to understand their smart manufacturing implementation for energy management and emission reduction. Over two years, ETISE will provide more than 12 technical assistances to some of the 2,200 manufacturers with fewer than 500 employees in East Tennessee. In November 2023, ETISE will have a workshop and training session to create awareness and provide knowledge and skills for SMEs related to smart energy management and ISO 50001.

IMPROVING MOBILITY OF PEOPLE AND GOODS

Center for Freight Transportation for Efficient & Resilient Supply Chain (FERSC)

FERSC is a Tier 1 University Transportation Center consortium led by the University of Tennessee, Knoxville. Its focus is the Infrastructure Investment and Jobs Act (IIJA)'s research priority, Improving Mobility of People and Goods as its primary area. The consortium supports the DOT Strategic Goals of Economic Strength and Global Competitiveness as the primary focus and Equity and Transformation as the secondaries. FERSC Partners are University of Tennessee, University of Illinois Chicago, Oregon State University, California State University Long Beach, North Carolina A&T, and Texas A&M University.

FERSC has three research thrusts: Freight System of Systems (RT1), Stakeholder Behavior Research (RT2), and Freight Innovations for Supply Chain (RT3). RT1 addresses freight as a system and treats freight as part of the larger supply chain system by developing system-level methodologies for optimal performance in the short, medium, and long runs. RT2 recognizes that shipper behavior is critical to freight movement, and it studies behavioral interactions between freight and the supply chain through shipper behavior, considering the best interests of shippers, carriers, and other stakeholders and how the behavioral interactions can be guided and shaped from the system perspective. RT3 aims to exploit the maximum potential technological innovations can achieve in helping freight and supply chains, particularly for under-represented populations and under-served regions.

Our goal is to produce results that will be transformative and long lasting. The research aligns freight research with supply chain efficiency and resiliency to better support the economy and serve stakeholders. It treats the system as inherently multimodal, seeking new and better methodologies to design, operate,

and assess the multimodal transportation system. Third, recognizing that transformative changes in transportation history almost always started with new, innovative technologies, FERSC proposes to examine, promote, and operate new technologies such as drones in freight for improved mobility and better societal benefits.

Our education and workforce development plan builds on accumulated educational resources within the consortium. It covers an array of elements ranging from early career outreach—mainly through K-12 outreach, professional development, and education programs—to regular workshops and seminars. The driving goal of FERSC’s technology transfer and commercialization (T2C) program is to encourage and facilitate the implementation of results from FERSC-funded research. FERSC universities have moved research results into practice through partnerships with state DOTs, local governments, private enterprise, and non-profits.

WATER RESEARCH

Reimagining Urban Watershed Management: A Systems Approach to Stormwater Control and Ecological Rehabilitation

Static and decentralized replacement of grey stormwater infrastructure with green alternatives (e.g., bioswales, wet ponds) has not provided corrective remedies for Urban Stream Syndrome. This has led to increasing advocacy for operational shifts towards basin-scale coordination of stormwater interventions and conceptual shifts towards viewing urban stormwater management through the lens of environmental flows. Recent advances in sensors and controls now allow stormwater infrastructure to be operated as a “smart” system for managing how and when runoff is discharged into a receiving stream, affording unprecedented opportunities to (re)establish desired flow regimes based on a set of multiple objectives. In this project, the target is to determine and demonstrate how stormwater systems can be tuned to achieve environmental flows as an objective function to meet ecological and regulatory goals. This project, funded by National Science Foundation, is led by **Jon Hathaway**, TNWRRC Associate Director.

below: Grad student Abby Knauer collects a TSS sample. The white PVC pipe holds a stream gauge that uses an ultrasonic distance sensor to measure the creek’s water elevation.



Understanding the Long-term Effects of Stream Acidification in the Great Smoky Mountains National Park

Research on stream water quality from long-term effects of acid depositions continues in the Great Smoky Mountains National Park (GRSM). Water quality among GRSM streams is showing slight improvements in some watersheds, however many remain acidified from soils that have been depleted from calcium and other base cations. Our data observed shifts in biogeochemical processes causing continued acidification associated with soil carbon dynamics. **Jason Brown** at the TNWRRC manages the water quality monitoring program and has produced a manuscript on a park-wide survey of stream dissolved organic carbon and the continuation of organic acids to continued stream acidification.

US Geological Survey 104b Program

This fiscal year three research projects have been funded through the USGS 104b funds that come to the TNWRRC. The three awardees are:

- Drs. **Stephanie DeVries** and **Ashley Manning-Berg**; University of Tennessee, Chattanooga, Department of Geography. Title: *Optimizing sampling and processing techniques for improved microplastic source determination in Tennessee waterways.*
- Drs. **Emine Finan**, **Hao Gan**, and **Shawn Hawkins**; UT Institute of Agriculture, Department of Biosystems Engineering & Soil Science. Title: *Quantifying Agricultural Water Use in Tennessee and Assessing Areas of Potential Water Availability Concern.*
- Dr. **Haochen Li**; University of Tennessee, Knoxville, Department of Civil & Environmental Engineering. Title: *Reconstruct Missing Data in Water Systems with Machine Learning.*

Urban Waters Report Card for Tennessee Stormwater Programs

TNWRRC continues to work with the stormwater (MS4) programs in Nashville Metro, the cities of Chattanooga and Memphis, and counties of Knox, Hamilton, and Shelby, and TDEC staff to develop an Urban Waters Report Card (UWRC). The working group has finalized the parameters that will go into the UWRC with four categories related to water quality, watershed hydrology, stream corridor, and community values. During the 2023 summer, a team at the TNWRRC completed stream surveys and desktop data summaries to beta-test the UWRC. Results of this effort were presented to the working group on September 20th in Murfreesboro to discuss any changes to the grading scales proposed for each parameter in the UWRC.



right: Ian Simpson and Matthew Tolson conduct a stream survey to beta-test the UWRC on Turkey Creek in Farragut, Tennessee.



ENERGY & ENVIRONMENTAL JUSTICE

Advancing Human-Centered Sociotechnical Research for Enabling Independent Mobility in People with Physical Disabilities

This Smart and Connected Communities (S&CC) project, funded by NSF, will advance methods to improve end-to-end mobility for people with physical disabilities who rely on wheelchairs in their daily activities and encounter several barriers to their movement in the built environment. A typical mobility scenario involves navigation (finding accessible routes) and maneuvering (parking wheelchair in confined spaces). These scenarios demand substantial effort and pose safety and anxiety risks for people with physical disabilities. This project engages stakeholders with converging disability perspectives (such as veterans with disabilities), patient care expertise, and experience in public service to create a user-centered autonomy that will enable people with physical disabilities to control their own travel. The project scope focuses on individuals without any significant impairment in upper extremity function or sensory and cognitive domains, paving the way for translational research that will extend outcomes to other groups with diverse abilities.

This project addresses critical knowledge gaps and leverages a participatory design process to: 1) Discover determinants for successful end-to-end mobility system performance from the perspective of people with physical disabilities; 2) Integrate new navigation and maneuvering algorithms to support end-to-end personal mobility of people with physical disabilities;

3) Investigate mechanisms to enhance a symbiotic relationship between users and the end-to-end mobility system; and 4) Explore psychological, social, and economic factors conducive to promoting widespread adoption in communities. A cohort of people with physical disabilities embedded within the research team will continually inform the project activities for its entire duration. In addition, two study groups recruited in coordination with the project stakeholders will participate in human factors studies conducted in both laboratory and naturalistic field environments to test and evaluate the implementation of the end-to-end mobility system in the Ann Arbor-Ypsilanti area of southeast Michigan. The evaluation plan includes assessment of economic and social-psychological factors affecting adoption of the system in the community of people with physical disabilities. The project outcomes have no limitation in terms of population size or travel distances and can be applied in mobility scenarios that include transportation modes such as shuttle bus, rail, on-demand vehicles, or soon, shared driverless vehicles, as well as scale across a broad range of constructed facilities and urban communities. Cities aspiring to become smart, connected, and inclusive urban communities will benefit from the results of this research by informing the integration of mobility needs of people with physical disabilities into their master plans.

Project Lead is **Professor Carol Menassa** at the University of Michigan. Co-PIs are **Chien-fei Chen** (UTK ISSE), **Vineet Kamat** (University of Michigan), and **Clive D'Souza** (University of Pittsburgh).

REGIONAL SUSTAINABILITY

Closing the Regional Tourism Gap: Promoting Multi-jurisdictional tourism in Cumberland Gap Communities

This year's Appalachian Collegiate Research Initiative (ACRI) class worked with the town of Cumberland Gap, Tennessee to help with the development of a proposal for the Warrior's Path Trail, a multistate effort to create a hiking trail that would extend from North Georgia to the Ohio River. The trail would recreate a historic Native American trade route and promote outdoor recreation and business development in rural Appalachian communities, Cumberland Gap would be located at the central crossroads of the proposed trail and would serve as a major trailhead for visitors. The students helped residents explore topics such as hospitality training, branding, and workforce development. They also developed plans for a local information center to be placed at the center of Cumberland Gap.

below: UT students Madison Lackey and Carsen Blake present this year's ACRI project at the annual ACRI conference in Washington, DC.



Second Annual ISSE Research Conference

Building on the success of ISSE's first annual research conference, the second symposium was held on Monday, September 18, 2023, at UT Conference Center. Dr. Jin opened the event with an overview of ISSE research activities of the past academic year. Internal researchers presented their current work with a view to the future of sustainability across many disciplines, and Seed Grant recipients reported on their projects' progress. Leaders from TDEC Office of Policy & Planning, Eastman Chemical, and Oak Ridge Innovation Institute discussed updates to their ongoing sustainability projects.

ISSE Projects

Brad Day, UTK Associate Vice Chancellor for Research, gave an overview of Global Energy Ecosystems (GE2), and **John Schwartz**, Director, Tennessee Water Resources Research Center, presented updates on TNWRRC's education and training programs. **Jonathan Overly**, East TN Clean Fuels Coalitions Director, discussed East Tennessee Clean Fuels progress in Alternative-Fuel and Electric Vehicle Adoption. **Chien-fei Chen**, Director of Energy and Environmental Justice, summarized activities in one of ISSE's more recent research initiatives addressing energy and environmental justice.

Seed Projects Presentations

ISSE makes annual funding available for multi-disciplinary, multi-investigator research and support. Each year, ISSE awards three or four seed grants to support research projects that are related to environmental sustainability. The aim is to support project teams as they develop interdisciplinary collaboration and build the capability to secure external funding. These projects were presented at this year's conference:

- Underground Hydrogen Storage, PI **Anna Herring**, Dep't of Civil and Environmental Engineering
- Aviation Fuels from Black Soldier Fly, PI **Toni Wang**, Dep't of Food Science, UTIA
- Integration of Hydrogen and Grids, PI **Kai Sun**, Dep't of Electrical Engineering and Computer Science
- Micromobility Vehicle Second-Life Battery Applications, PI **Chris Cherry**, Dep't of Civil and Environmental Engineering
- Assessing levels of PFAS in surface water in Tennessee aquatic ecosystems, PI **Jiangang Chen**, Dep't of Public Health
- Identification of novel pathways for bacterial degradation of PAHs, PI **Alison Buchan**, Dep't of Microbiology

- Utilization of waste plastics for sustainable and durable asphalt pavements, PI **Baoshan Huang**, Dep't of Civil and Environmental Engineering

Reports from ISSE Partners

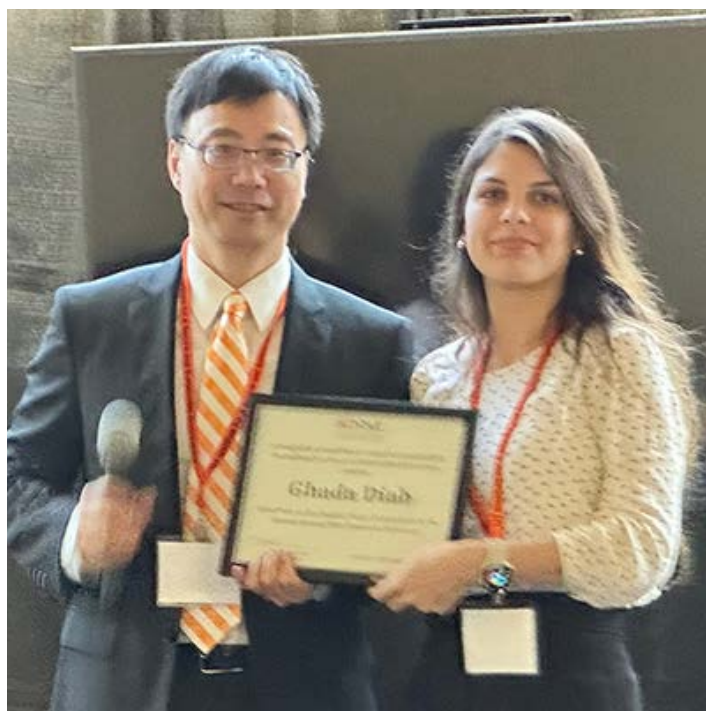
Three of ISSE's industry partners presented their work that is relevant to the ISSE mission:

- Tennessee Volunteer Emission Reduction Strategy, Rachael Maitland, Senior Policy Analyst, TDEC Office of Policy & Planning
- Eastman's Sustainability Platform and Goals, Becky Horton, Eastman Chemical Company
- UT-ORII Convergence Research Initiatives, David Sholl, Interim Executive Director, UT-ORII

Student Poster Contest

Repeating a popular element of last year's conference, students involved in ISSE research competed in a poster presentation, and awards were given during the wrap-up luncheon.

- 1st Prize, **Ghada Diab**, *Enhancing Site Scale Bioretention Modeling to Investigate Watershed Scale Restoration*
- 2nd Prize, **Anirban Roy**, *Understanding Efficient Hydrogen Production via Water Electrolysis*
- 3rd Prize, **Weitian Wang**, *3D Structured Liquid/Gas Diffusion Layers with Flow Enhanced Microchannels for Proton Exchange Membrane Electrolyzers*



New Research Awards

ISSE Partners with Industry Giants Eastman and VW of America

ISSE is helping Tennessee businesses achieve their net zero goals through mass balance and life cycle assessments for pulp and paper, plastics, lighter metals, and other materials. The scope of this work has been published in Nature: “Country-specific net-zero strategies of the pulp and paper industry,” Nature, pp.1-3. 2023.

The project with Eastman is titled **Literature Review of Mass Balance for Enhancing Sustainability**. The goal is to understand and evaluate the efficacy of the mass balance approach to improve sustainable practices across industries. Mass balance, a chain-of-custody method that tracks the net sustainable materials as they move through a system or supply chain, ensures the effective use of these sustainable materials in final products. Investigators want to know how the mass balance approach can be applied and expanded to cover more aspects of industrial processes by understanding relevant standards, certifications, policies, and regulations. The project aims to devise new strategies to integrate sustainable practices

more broadly and effectively that will advance green industrial ecology. By doing so, it seeks to pave the way for industries to adopt more eco-friendly methods, thus aligning with global efforts towards achieving Net Zero emissions and fostering a more sustainable future.

The project with Volkswagen of America (VWoA) is **Life Cycle Analysis of Automotive Composite Materials**. ISSE and VWoA are embarking on a detailed study of the life cycle assessment (LCA) of automotive materials. This includes an in-depth analysis of paper composites and sheet molding compounds. The project will develop a VW-specific LCA framework to conduct cradle-to-gate LCAs for these materials, examining their end-of-life scenarios and impact on carbon footprint. Additionally, the study will compare sheet molding compounds with traditional metallic automotive materials to assess their environmental benefits.

The expanded objective of this initiative is to design a bespoke LCA framework for VWoA and investigate ways to significantly reduce emissions by increasing the use of fiber-based composites and optimizing the sizing characteristics of sheet



molding compounds. The project aims to uncover innovative ways to integrate these materials into VWoA's manufacturing processes, improve the environmental efficiency of their vehicles, and contribute to a more sustainable automotive industry.

Both projects are a result of ISSE's robust commitment to forging productive relations with businesses and industries relevant to sustainability through decarbonization, resilient supply chains, cleaner fuels, climate change, water resources, and smart manufacturing.

Empower Equality in Resilience: Kickstarting a Southeastern Climate Solutions Venture

This project, the Southeast Center for Just, Resilient, and Sustainable Ecosystems (**SECURE**) is funded by National Science Foundation and poised to confront the urgent challenges stemming from the climate crisis in the southeastern United States. The mission is to establish a collaborative hub that brings together academia, industry, and local communities to devise solutions for a just, resilient, and sustainable ecosystem capable of mitigating the impacts of the climate crisis. The Southeast region, which harbors a high concentration of disadvantaged communities, faces escalating risks due to climate-driven hazards, encompassing power outages, extreme weather, and limited access to resources. These challenges necessitate a comprehensive approach to disaster preparedness and mitigation, particularly as the region encounters unique events such as cool-season tornadoes and nocturnal convective weather.

The Principal Investigator, Dr. **Chien-fei Chen**, an environmental sociologist and research associate professor at ISSE and CURENT's diversity and inclusion director, leads the SECURE team of 11 interdisciplinary researchers. With a focus on energy and environmental justice, the team will develop a socio-technological integration framework.

Co-PIs are **Jennifer First**, Assistant Professor of Social Work, who will examine the impacts of heat and disasters, and **Kelsey Ellis**, Associate Professor of Geography and Sustainability, who will investigate the intersections of climatological patterns with vulnerabilities. Co-PI **Hiba Baroud**, an Associate Professor at Vanderbilt University, specializes in resilient infrastructure, while Co-PI **Amir Jafari** from Louisiana State University will lead efforts in building energy efficiency. Other

senior personnel include Dr. **Fran Li** (CURENT) and Dr. **Mingzhou Jin** (ISSE) who will focus on power grid resilience and climate modeling. Dr. **Xinwu Qian** from the University of Alabama will work on transportation resilience, and Dr. **Sanya Carley**, Professor at the University of Pennsylvania, will focus on energy justice and policy. Dr. **Kristina Kintziger** of the University of Nebraska will study the impacts of climate disasters on health. All team members bring diverse expertise and community engagement experiences to the project.

The project will delve into the intricate interdependence of social-environmental-technological systems, aiming to provide effective solutions for the region's disadvantaged communities. The research will explore factors influencing community preparedness, methods for enhancing resilience across interconnected systems, the development of climate-resilient infrastructure, and pathways toward adopting clean energy. Community engagement is integral to the project, ensuring that the voices and needs of marginalized groups, including Indigenous communities, people of color, and those with disabilities, are central to the research.

Through a comprehensive approach that integrates their interdisciplinary expertise and community engagement experiences, the SECURE team envisions establishing a research center that addresses energy supply systems, the built environment, transportation networks, and health infrastructure. Ultimately, the SECURE project seeks to empower underserved communities in the Southeast with effective strategies for resilience, adaptation, and mitigation, thereby assisting them in navigating the challenges posed by the climate crisis.

A Multisource Remote Sensing-based Framework and Decision-support Tool for Climate Change-induced Flash Droughts and Floods

The Foundation for Food & Agriculture Research (FFAR) has funded a project proposed by a UTK and UTIA research team of **John Schwartz** (CEE, TNWRR), **Brian Lieb** (UTIA), **Shawn Hawkins** (UTIA), **Mingzhou Jin** (ISE, ISSE), and **Yuefeng Hao** (ISSE). The funding is for \$532,082 over three years.

Ninety percent of crop losses in the U.S. are related to extreme weather, with drought (44%) and excess moisture (27%) being the top two causes. These environmental effects

are sensitive to both long-term climatic change and short-term weather 'shocks' or flash droughts and floods. Climate change is causing these short-term events to become more frequent and intense in certain regions, which adversely impacts agricultural production during the growing season. Understanding how different crop species respond to both short-term and long-term nature hazards can inform irrigation strategies and agricultural water management practices.

The project PIs will tackle these questions: (1) What is the frequency, duration, intensity, and trend of drought and flood in targeted watersheds? (2) How do different crop species respond to both short-term and long-term nature hazards in terms of irrigation and water use efficiency? (3) What is the potential increase in crop yield under different irrigation application rates? (4) What models can address the uncertainty associated with flash droughts and flash floods under climate change and balance the tradeoff among agriculture production, economic values, environmental impacts, resilience, and justice (especially in underserved communities)? They will test the hypothesis that a multi-source remote sensing-based framework can optimize irrigation plans and improve irrigation and water use efficiency. This hypothesis will be tested with historical data from 2002 to 2017 and validated based on ground measurements in farmland in East Tennessee.

ETFC Works with Clean Cities Georgia and Triangle Clean Cities to Expand Coalition Reach and Public EV Charging Infrastructure



Expanding Coalition Reach in the Southeast

US Department of Energy has funded **Clean Cities Georgia's SE-CCC Expansion** project, according to a recent DOE Vehicle Technologies Office Funding Opportunity Announcement. East TN Clean Fuels Coalition (ETCF) will

participate as a super sub-awardee and contract directly with other participating Coalitions for their roles in this project. ETCF expects to see ~\$230,000 in income that will stay with the Coalition over the next two years.

Clean Cities Georgia will lead the Southeast Clean Cities Network Expansion of partner coalitions. The Southeast Network consists of Clean Cities coalitions representing everyone in Georgia, Tennessee, Alabama, Florida, South Carolina, and North Carolina. As a "super-sub," ETCF will contract directly with these participating Coalitions to help them assume administrative roles and prepare them to become fully functioning Coalition member via these aims:

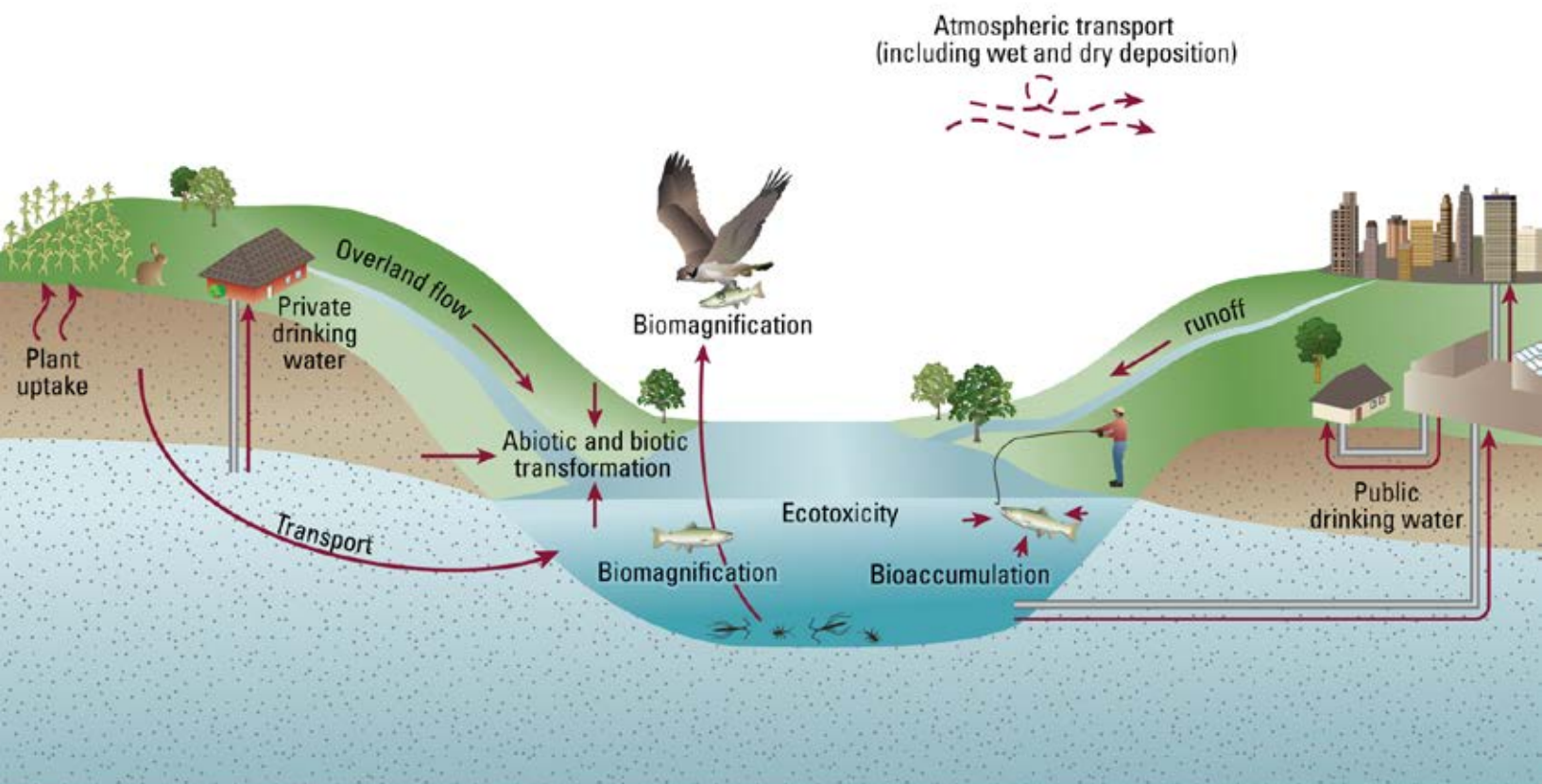
- Expand existing Clean Cities Coalition capacity.
- Grow into new and hard-to-reach areas.
- Provide training to coalitions to be more effective by offering sessions on grant management, financial management, indirect cost rate, scaling team growth, membership recruitment, time tracking for project management, performance measurement and reporting.

TEST Real-World Charging

Funded by the Joint Office of Energy and Transportation, the goal of this project with Triangle Clean Cities is to assess the performance, reliability, usability, and safety conditions of AC Level 2 and DC Fast Charging (DCFC) stations across the United States from Coast to Coast. The Team-based Evaluation, Surveying & Training (TEST) for Real-World Charging project, or TEST Real-World Charging, will use Clean Cities Coalition networks of community-based organizations including EV Chapters/Clubs, community colleges, trade schools and Workforce Development Partners, State Departments of Energy and Departments of Transportation to execute a scalable, in-field methodology to assess AC Level 2 and DCFC performance, reliability, and customer experience.

TEST Real-World Charging Teams will assist in developing a training program to teach state Department of Transportation and state officials how to conduct their own field assessments of charging performance and reliability, using a single, nationally consistent methodology for all 50 states and Puerto Rico.

ETCF will serve as the super sub-awardee responsible for handling the contracting and administrative needs with the Clean Cities coalitions under a single contract with TJCOG/TCC. ETCF, led by 22-year Clean Cities Director **Jonathan Overly**, has substantial experience working with collaborative project teams across the country.



Developing a Sensor Platform for Rapid On-Site Detection of Field-Relevant Levels of PFAS in the Environment

PIs: Jayne Wu (EECS) and Qiang He (CEE)

Purpose: Per- and poly-fluoroalkyl substances (pfas) have been found in various environmental media, including water, soil, sediment, and air, in both urban and rural areas. Pfas can have detrimental effects on the environment, particularly wildlife, and can also impact human health through the food chain. On-site testing for pfas in environmental media is crucial for understanding the distribution and fate of these chemicals in the environment. This understanding is critical to human health, environmental protection, regulatory compliance, and remediation strategies. Unfortunately, conventional pfas detection methods are laboratory based, time-consuming, and expensive. The researchers propose to develop a point-of-use detection system for on-site sensitive and specific detection of several kinds of pfas in water, plasma, and sediments, which are environmental matrices critical for evaluating pfas exposure and impact. The proposed system builds upon previous successes, i.e., a rapid, sensitive, and specific capacitive sensing platform using nanomaterial molecular capture probes for specific pfas species. The researchers plan to develop and incorporate sample extraction protocols for various environ-

mental matrices, and further validate the developed sensor platform and protocols with established detection methods.

Activities: The proposed on-site pfas sensor will use a unique electroanalytical sensing platform technology developed at the University of Tennessee, Knoxville known as alternating current electrokinetic capacitive (aicap) sensing. The proposed work includes (1) laboratory development and characterization of aicap sensors for pfo, pfoa, and total pfas in spiked water and plasma samples, (2) optimization of sensor protocols for pfas detection in sediment samples, and (3) benchmarking the aicap sensing of field samples against established methods and validating its effectiveness in field use.

Outcomes: The project outcome is expected to be a significant advancement in environmental monitoring and surveying. The proposed pfas detection system is designed to be user-friendly, cost-effective, energy-efficient, and compact, making it ideal for field use. The system targets pfoa, pfo, and total pfas, which are known to be harmful to public health. It is anticipated to detect pfo, pfoa, and total pfas at part-per-trillion levels with high specificity when applied to various types of field samples. Field testing of the system is expected to demonstrate a rapid turnaround time of a few minutes, operated by a lay person. Additionally, the platform

can be easily reconfigured for the detection of other pfas targets not yet tested in this project by simply changing the sensor probes. Successful implementation of the proposed system will have a significant impact on protecting public health from pfas exposure.

Beneficiaries: The proposed portable pfas sensing system can provide numerous benefits to the environmental research community, regulators, and the public. A rapid, sensitive, and affordable pfas detection platform can significantly improve the surveillance and monitoring of pfas in the environment, with high temporal and spatial resolutions required for precise mapping, modeling, sourcing, predicting, and subsequent mitigation of pfas pollution and exposure. The system can aid in the characterization and remediation of contaminated sites, which is crucial for protecting human health and the environment. The system's portability and ease-of-use can enable prompt response to pfas contamination incidents, facilitating timely intervention. Overall, such a portable pfas sensing system can have wide-ranging benefits for environmental monitoring and management, contributing to a more sustainable and healthier future.

Tennessee Water Resources Research Center Secures \$1 Million EPA Grant for Statewide Wastewater System Enhancement Project

TNWRRC has been awarded a \$1 million grant from the Environmental Protection Agency for its collaborative initiative, Statewide University-Utility Partnership for Technical, Managerial, and Financial Assistance to Wastewater Systems in Rural Tennessee. The project, planned to span approximately three years, aims to provide aid and support to small and economically disadvantaged communities across the state in obtaining low-interest wastewater infrastructure loans through specialized training and technical assistance programs.

In collaboration with the University of Tennessee Institute of Agriculture (UTIA), Tennessee Tech University (TTU), and the University of Memphis (UofM), the project targets all 95 counties of Tennessee, organized into west, middle, and east regions, to ensure equitable delivery of technical assistance and training.

The project's primary goal is to enhance wastewater system infrastructure in small communities by facilitating their access to loans and funding. To achieve this, the endeavor proposes a comprehensive set of training and technical assistance activities, organized into six essential tasks. These tasks include communication with the project team and partners, identification of community needs, provision of technical assistance, delivery of training, enhancement and creation of training materials, and the establishment of a monitoring and reporting framework.

Heading the initiative is Dr. **John Schwartz**, the Director of TNWRRC and UTK Professor of Civil and Environmental Engineering. Supporting Dr. Schwartz are **Steven Hoagland** from TNWRRC, Dr. **Qiang He** from UTK's Department of Civil and Environmental Engineering, Dr. **Larry Moore** (UofM), Dr. **Tania Datta** (TTU), and Dr. **Sreedhar Upendram** (UTIA). This collaborative team actively engages with small systems, identifies community needs, and provides training and technical assistance across all three regions in Tennessee. Their collective efforts are geared towards empowering communities to secure funding for critical wastewater system enhancements, ultimately contributing to the long-term sustainability of rural Tennessee.

The project aligns with the Clean Water State Revolving Fund (CWSRF) program's annual prioritization requirement, using the Ability to Pay Index (ATPI) developed by the Tennessee Department of Environment and Conservation (TDEC) and UTIA. The ATPI prioritizes projects based on the socioeconomic characteristics of project communities, assigning scores reflecting their ability to fund wastewater system upgrades.

Notably, the proposed work addresses three of EPA's five long-term performance goals: reducing water systems in non-compliance by 33%, leveraging an additional \$45 billion in non-federal funds through EPA's water infrastructure finance programs, and aiding small, rural, or underserved communities to improve the operations of their drinking water or wastewater systems (U.S. EPA, 2022).

This collaborative effort signifies a significant step towards enhancing the resilience and sustainability of wastewater systems in rural Tennessee communities. The project's impact is anticipated to extend beyond the three-year timeline, contributing to the long-term well-being of all the state's populations.

right: Secondary clarifier at Cookeville's wastewater treatment plant.



Seed Grants

ISSE makes annual funding available for multi-disciplinary, multi-investigator research and support. Each year, ISSE awards three or four seed grants to support research projects that are related to environmental sustainability. The aim is to support project teams as they develop interdisciplinary collaboration and build the capability to secure external funding. ISSE expects the funded teams to submit at least one external grant proposal and one article to a peer-reviewed publication acknowledging ISSE's support. Among the topics of interest are

- Modeling sustainability and resilience for regional systems under climate changes and other social and environmental stressors;
- Systems or engineering solutions to reduce nutrient and pollution (e.g., microplastics) in water;
- Technologies and analyses for carbon sequestration; and
- Solutions or modeling to enhance environmental health.

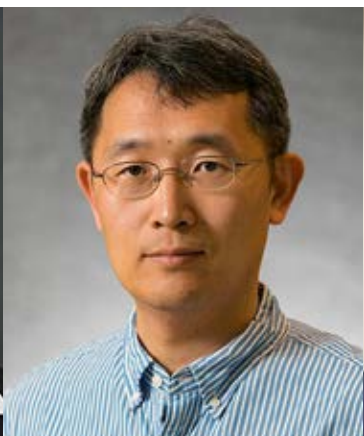
For FY2024, a panel of independent reviewers scored all submissions and selected the following projects.

ACTIVE SEED GRANTS 2024

<i>Investigators</i>	<i>Project Title</i>	<i>CoPI</i>
Anna Herring	Coupled Mass Transfer Processes During Underground Hydrogen Storage	Haochen Li
Kai Sun	Assessing the Implications of Large-Scale Hydrogen Production on Power Transmission Systems	Feng Yuan Zhang
Toni Wang	Transformational Production of Sustainable Aviation Fuel and Biofertilizer from Black Solider Fly	Sindhu Jagadamma
Alison Buchan	Identification of novel pathways for bacterial degradation of polycyclic aromatic hydrocarbons	Qiang He



Anna Herring



Kai Sun



Toni Wang



Alison Buchan

COMPLETED SEED GRANTS 2023-24

<i>Investigators</i>	<i>Project Title</i>	<i>CoPI</i>
Jiangang Chen	Assessing the levels of forever chemicals (PFAS) in surface water in Tennessee aquatic ecosystems	Jie Wu, Qiang He
Baoshan Huang	Utilization of Waste Plastics	Qiang He, Brian Long, Pawel Polaczyk
Chris Cherry	Micromobility Vehicle Second-Life Battery Applications: Market Inventory and End Use Feasibility Analysis	Daniel Costinett

Seed Grant Spotlight: Herring Tackles Climate Change with Multiphase Research

As humanity tries to reduce the global impact of greenhouse gases like carbon dioxide (CO₂), we are encountering some fundamental problems.

First, while our energy demands are consistent, many low-carbon energy sources like solar panels only provide power intermittently. The excess power they generate can be used to create other fuels, like hydrogen gas, for use during low production periods, but we lack large storage facilities with the capacity to hold seasonal quantities of energy. Second, mitigating the most severe effects of climate change will involve reducing the tremendous amounts of CO₂ already in our atmosphere. Herring believes that both problems can be resolved with underground gas storage.

Herring researches the complex multiphase interactions between gases, solids, and fluids, like saline water that occurs in pockets of porous rock deep underground. Such formations are common across the US, but the convoluted stone networks, high temperatures, extreme pressures, and unknown microbial interactions make successful gas storage hard to guarantee.

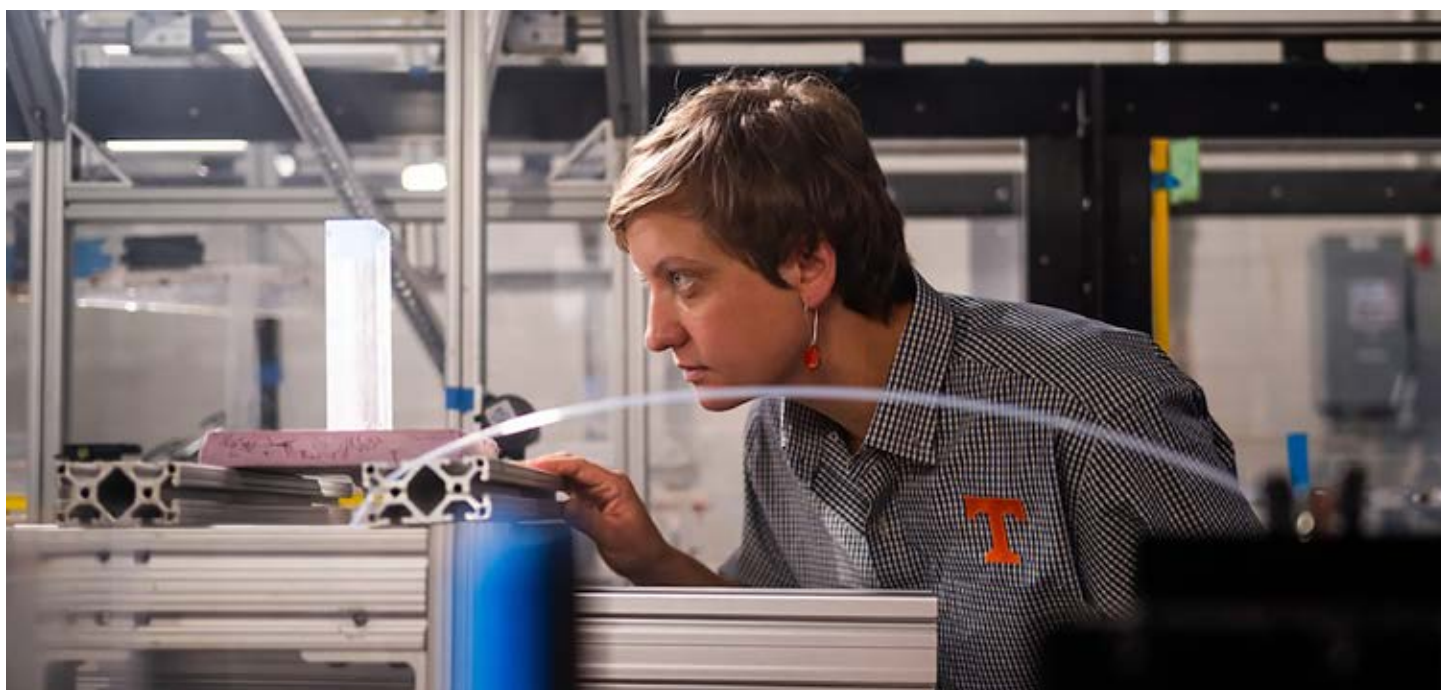
Herring uses multiple experimental systems to understand the mass flow of gases in underground reservoirs. X-ray tomography and similar visualization tools help her observe the ki-

netics of gas bubble dissolution and movements through solid rocks. One of her doctoral students studies how the surface chemistry of porous rocks changes when exposed to saline water and CO₂ at high pressures and variable temperatures found in subsurface environments. Two of her undergraduate researchers are working to simulate how multiple immiscible fluids flow together through complex, porous rock systems.

Thanks to a recent \$50,000 seed grant, Herring will soon approach the problem from another perspective. The funding from UT's Global Energy Ecosystems (GE2) strategic initiative and ISSE will help Herring view multiphase reactions in unprecedented clarity—and safely bring hydrogen to the lab bench.

Once the safety protocols are in place, Herring plans to expand her work on underground hydrogen storage into a research group at UT. The group will be co-led by Assistant Professor Haochen Li and use the high-performance computing capabilities of his water infrastructure laboratory, the Psi Lab.

Though underground hydrogen storage may still be a few decades from widespread implementation, Herring is excited to investigate its potential while simultaneously continuing to develop storage solutions for CO₂.



Training & Education

Tennessee Water Resources Research Center Training, Tim Gangaware

Since October 1, 2021, **TNWRRC** has offered eight different courses: Levels 1 and 2 of Tennessee Erosion Prevention and Sediment Control (TNEPSC) Training Program for Construction Sites plus a Level 1 and Level 2 TNEPSC Recertification courses; Tennessee Hydrologic Determination Training and its corresponding Recertification course; and the Storm Water Control Measure Inspection and Maintenance Workshop and Recertification Course. TNWRRC has offered a total of 30 course sessions and trained 2,000 professionals in these workshops. The courses were a combination of virtual, online, and in person training.

TNEPSC offers three training workshops for developers, contractors, engineers, and other professionals, inspection personnel, and enforcement officials responsible for all aspects of preparation and implementation of Storm Water Pollution Prevention Plans for preventing erosion and controlling sediment at construction sites one acre or more in size.

Tennessee Hydrologic Determination Training is a course for conducting hydrologic determinations. Successful completion of the training course is one of the requirements for certification as a Qualified Hydrologic Professional.

Storm Water Control Measure Inspection and Maintenance Workshops are available to design engineers and architects as well as plan reviewers and other local municipal program personnel. They provide insights on avoidance and minimization approaches to site layout, design guidance on specific permanent stormwater control measures, and experience using tools developed to assist designers and plan reviewers with implementation of runoff reduction and pollutant removal requirements.

Tennessee Stream Quantification Tool, Tool Revision, and Development of a Training Course

The first version of the Tennessee Stream Quantitation Tool has been revised based on a two-year effort from a working group consisting of Tennessee Department of Environment and Conservation (TDEC), the US Army Corps of Engineers (USACE), and consultants. A pilot training was given between July 31st and August 3rd with staff from TDEC, USACOE Nashville and Memphis District Offices, and the Tennessee Department of Transportation.

USDA Appalachian Community Technical Assistance and Training Program (ACTAT)

The purpose of the ACTAT Program is to improve drinking water and wastewater systems that are essential to public health and economic development. Many rural Appalachian communities are deeply entrenched in poverty and suffer from declining populations due to the downturn in the coal industry and the closure of major employers. They lack employment opportunities, resources, and enough capital to provide and sustain compliant water and wastewater services for their citizens and to support economic development activities.

In response, ACTAT builds on over 30 years of service originally established by the National Environmental Services Center (NESC) at West Virginia University (WVU). Work is completed by faculty and staff at the University of Kentucky (UKY), the University of Tennessee-Knoxville (UTK) TNWRRC, and WVU matching appropriate experts in engineering, business and management, law,

public health, communications, education, and stakeholder engagement to personalize training and technical assistance responses.

The ACTAT program employs multiple strategies to achieve project goals and objectives including customized, on-site technical assistance at water utilities, regional in-person and virtual trainings, and the development and distribution of educational materials. The ACTAT program is utility-driven providing flexible assistance and educational options to meet utility-specific needs to small rural water utilities throughout Kentucky (KY), Tennessee (TN), and West Virginia (WV). The TNWRRC has helped several communities in east Tennessee, and now is developing a survey of needs to be completed by the rural utilities.

Research Experiences for Undergraduates: Green Infrastructure for Sustainable Urban Environments (GI4SUrE)

In this NSF funded Research Experiences for Undergraduates (REU) Site Program, Green Infrastructure for Sustainable Urban Environments (GI4SUrE), a diverse cohort of undergrads participates in research supporting the advancement of Green Infrastructure to improve public and ecological health in urban environments. Green Infrastructure can be described as the interconnected natural spaces in urban environments such as parks, riparian areas, and nature-based storm water control measures that serve to clean storm water runoff, reduce urbanization impacts to local surface waters, and offer protection from flooding. Research includes state of the art field, laboratory, and modeling studies to better understand and optimize these systems.

Students who participate in this REU will have the chance to improve their research and critical thinking skills while bolstering their ability to communicate with technical and non-technical audiences through oral and written mediums. Additional experiences include access to new mentors, exposure to the various career pathways made possible by a graduate degree in engineering, and training on how to collaborate with, learn from, communicate with, and consider the perspectives of colleagues outside their discipline. This program will serve to improve the diversity of the engineering profession and student participation in graduate school by extending opportunities to traditionally underrepresented groups in science and engineering.



Outreach, Collaborations & Partnerships

ETCF Partners with SEED Knoxville Solar Home Project

Wesleigh Wright, Community Engagement Liaison for ETCleanFuels, and **Lily Lovingood**, ETCF Program Manager, are heading up the effort by DOE Clean Cities’ Energy & Environmental Justice Deep Dives program. Their job is to identify a local community to help produce a **Community Transportation Action Plan** and work to implement the plan in Knoxville communities. As a Clean Cities Coalition member, ETCF is helping improve equitable access to clean transportation options by engaging local communities to co-develop projects and solutions that meet real, on-the-ground needs. SEED, Socially Equal Energy Efficient Development, is a registered 501(c)3 located in the heart of East Knoxville. SEED was founded in 2009 as a response to growing community concerns about gun violence, lack of youth opportunities, and unaffordable utility and housing burdens.

TN BEEP Partnership with Drive Electric TN

ETCF Director **Jonathan Overly** and DET Coordinator **Alex Strong** continue working to support school districts across the state as they apply (or consider applying) for EPA grants and rebates available for organizations that switch to alternative fuel fleets. The **TN BEEP (Bus Electrification, Education and Planning)** partnership provides no-cost education and assistance services to school district leadership and fleet management personnel in Tennessee. Significant funding will come through EPA over the next five years and this partnership can help any districts that want to make the switch to electric or other alternative-fuel school buses. DET aims to promote the adoption of electric vehicles for fleets and individuals across Tennessee with a goal of getting 200,000 EVs on Tennessee’s roads by 2028.



ISSE Represents UT at United Nations Climate Change Conference in Dubai



The 28th meeting of the Conference of the Parties (COP) to the United Nations Climate Change Conference (UNFCCC) took place in Dubai, United Arab Emirates in December 2023. ISSE is an observer non-governmental organization (NGOs) member of UNFCCC for the University of Tennessee. ISSE Director Dr. **Mingzhou Jin** leads this effort, and he attended multiple panels at COP 28 related to climate change, energy, economic development, and health. Also representing UT at the conference was Dr. **Chika Okafor** of UTIA. In close alignment with UNFCCC's visions, Drs. **Chien-fei Chen, Mingzhou Jin, and Leon Tolbert** will start a new project addressing climate change, energy, and health funded by the **Wellcome Trust**. This global stocktake is the central outcome of COP28 and contains every element that was under negotiation and can now be used by countries to develop stronger climate action plans, which are due by 2025. COP28 calls for actions towards achieving clean energy transition, mitigating health risks posed by climate change, and promoting social justice.

above: Julia Gillard, Chair of Wellcome Trust and former Prime Minister of Australia, with Dr. Mingzhou Jin at COP 28.

*left: Washington County school system unveils Tennessee's first electric school bus
right: ALI Team Activate Appalachia pose with their facilitator, Dr. Tim Ezzell, at the December ALI session in Spartanburg, SC.*

TN Water Resources teams up with TN Tech and National Institute of Technology in Warangal, India

TNWRRRC Director Dr. **John Schwartz** is developing low-cost, open-hardware-enabled sensors for quantitative assessment of real-time hydrologic and water quality parameters. Project partners are Drs. **Alfred Kalyanapu** and **Tania Datta** at Tennessee Tech University. They are working with a research team from the **National Institute of Technology, Warangal, India**. Real-time data acquisition of hydrologic and water quality data is critical for understanding the spatiotemporal variations of water resources with watersheds and supports advances in watershed modeling.

Funding for the project comes from the Indian government's Scheme for Promotion of Academic and Research Collaboration (SPARC) program. The team is developing real-time sensors for flow stage and turbidity in the Oostanaula Creek near Athens Tennessee and the Kamalapur drainage near Warangal, India. Schwartz, Kalyanapu, and Datta will travel to Warangal this summer to install prototype devices for testing.

Appalachian Leadership Institute Enters Year 5

Year five of the **Appalachian Leadership Institute** launched in Fayetteville, West Virginia in October 2023 with 40 fellows from 13 states. As always, the class explores topics ranging from workforce development to infrastructure, capacity building, and natural and cultural assets. Fellows engage in active learning through "team challenges." These include creating a Blue Ocean strategy for a community, long-term regional visioning, and development of a local targeted leadership program. This year's class will graduate in Washington in July. Applications for year six will open in April 2024.



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Presentations

- Akin, A., & Hathaway, J. (2023). Smart Stormwater Technologies for Watershed Management. In Tennessee AWRA Symposium. Montgomery Bell State Park.
- Chen, Chien-fei, Keynote Speaker, Taiwan-US Net-Zero Justice Transition Workshop—Challenges and Solutions of Improving Equity, Urban Heat and Energy Transition in the Era of Global Boiling, September 11th, 2023, National Cheng Kung University, Taiwan.
- Community Engagement and Energy and Environmental Justice and their Connection to DEI, February, 17, 2023, NSF Engineering Research Center DEI Director Meeting
- Ellis, K. N., J. First, K. Kintziger, and E. Hunter: Beat the heat: Building adaptive capacity of vulnerable populations in Knox County to combined stressors from climate change and urban heat. GEOSYM. 9 February 2023.
- Ellis, K. N., J. First, K. Kintziger, C. Fuhrmann, and E. Hunter: Overnight heat in indoor and outdoor living spaces of Knoxville residents. Annual Meeting of the Southeast Division of the American Association of Geographers. 20 November 2022.
- Energy and Internet Insecurity Impacts and Justice, to Industry Program of CURENT, March 3rd, 2023, University of Tennessee
- Energy and Internet Insecurity Impacts: A Mixed Methods Approach with Micro and Macro-level Analysis, February 15th, 2023, Department of Architecture Engineering, Penn State University
- Energy Justice, Concentrated Disadvantage and Social-Psychological Factors Affecting Technology Adoption on February 28th, 2023, University of Idaho
- Energy justice: Exploring the Multidimensionality of Energy and Internet Insecurity by Using a Mixed-methods Approach, March 24th, 2023, School of Public Policy and Environment Affairs, Indiana University.
- Fengxian Chen, Bin Zhou, Liqiong Yang, Xijuan Chen, Jie Zhuang. Predicting bacterial transport through saturated porous media using an automated machine learning model. The General Assembly 2023 of European Geosciences Union (EDU), Vienna, Austria, April 23-28, 2023.
- First, JM, Lee, S, Norris, E, Kintziger, K, Ellis, K. (2023). Building community capacity to respond to urban extreme heat in Knoxville, Tennessee. Oral presentation at the Natural Hazards Center Annual Workshop, 10 July, 2023
- Hathaway, J. (2023). Climate Change Impacts on Stormwater Control Measures: A Summary and Path Forward. In ASCE EWRI Congress.
- Hathaway, J., & Akin, A. (2023). TURBIDITY INFORMED REAL-TIME CONTROL OF A DRY DETENTION BASIN. In ASCE EWRI Congress. Henderson, NV.
- Hazen, T. C. Invited Webinar. Repsol Oil Spill in Peru. Online. Lima, Peru. February 8, 2022. National Service of Protected Areas (SER-NANP) from the Ministry of Environment (MINAM).
- He, Q. (2023). Sourcing Microbial Contamination in Aerosol Facemasks during Nebulized Treatment in the Hospital. Invited presentation at the 2023 Sino-Micro Annual Meeting. Changchun, China.
- Huff, J., Watts, J., Khojandi, A., & Hathaway, J. (2023). Deep Temporal Neural Networks for Water Level Predictions of Watershed Systems. In 2023 Systems and Information Engineering Design Symposium, SIEDS 2023 (pp. 108-113).

- Huihui Sun, Mark Radosevich, Jaehoon Lee, Jie Zhuang. Adhesion to soil surfaces inhibits bacterial cell-to-cell interactions. ASA-CS-SA-SSSA International Meeting, St. Louis, Missouri, USA, October 29-November 1, 2023.
- Jie Zhuang, A perspective on food-energy-water nexus for net-zero urban system. Goldschmidt 2023, Lyon, France, July 9-14, 2023.
- Jie Zhuang. "Food-Energy-Water Nexus for Net-Zero Transition." AAPRESID Congress 2023, Rosario, Argentina, August 9-11, 2023. (invited Talk)
- Jie Zhuang. "Optimizing Food-Energy-Water Nexus for Net-Zero Emission Goal." The First International Research and Innovation Conference on Education, Engineering and Agriculture, Bacnotan, La Union, Philippine, December 4-6, 2023. (Invited Keynote Talk)
- Kintziger, K., J. First, and K. Ellis: Understanding Urban Heat Island Vulnerabilities to Build Adaptive Capacity Among Vulnerable Populations in a Southeastern City. American Meteorological Society's 14th Conference on Environment and Health. 11 January 2023.
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- "ISSE Represents UT at United Nations Climate Change Conference in Dubai" (<https://unfccc.int/cop28>)

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