Institute for a Secure & Sustainable Environment

2023-2024 Annual Report

TICKLE COLLEGE OF ENGINEERING

INSTITUTE FOR A SECURE & SUSTAINABLE ENVIRONMENT

ISSE Mission Statement

The University of Tennessee's Institute for a Secure and Sustainable Environment (ISSE) seeks to promote the development of policies, technologies, and educational programs that cut across multiple disciplines, engage the university's research faculty and staff, and grow in response to pressing environmental and security issues facing the state, the nation, and the globe.

cover photo: Researchers and students from Japan and the US gathered for dinner at Calhoun's on the River during the Second EXCET Workshop, September 2024.

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Message from the Director

Over this past year, ISSE's research portfolio has held steady and achieved tremendous growth and resilience in our core areas: clean energy & energy efficiency, climate change, building environments, regional sustainability, sustainable food systems, water resources research & training, and energy & environmental justice.

One measure of our research success is the number of active sponsored projects within ISSE. Included in the overall total of 49 are 20 continuing projects, 24 newly awarded projects, and five completed projects, all of which were funded by international, national, state, and local agencies. Our research expenditure in FY24 increased to $3.9 million, which is a record high. Over the last five years, ISSE's research expenditure has increased by 158%.

Notable examples of ISSE's ongoing research include:

- Building the Institute for Energy and Environment gateway initiative with ORIED
- Developing a sensor platform for rapid on-site detection of field-relevant levels of pfas in the environment, fund as a 2023 ISSE Seed Grant and leading to a USGS 104g project
- ISSE and UTIA are collaborating to address decision-making tools for flash droughts and floods with a $1M grant funded by the Foundation for Food and Agricultural Research.
- UT and the City of Knoxville received $4.3 million to plant trees in urban areas, with Jon Hathaway leading the UT team.
- Impactful publications in top journals, such as Nature, Water Research, Environmental Research Letters, and Journal of Hydrology

ISSE continues to implement its five-year strategic plan to increase its research, educational, and outreach activities at the University of Tennessee. ISSE will promote the development of policies, technologies, and educational programs that will address and help remedy critical environmental issues around the world. We will strengthen our emphasis on cross-disciplinary collaborations that will help bring about global sustainability and environmental equity and justice.

Dr. Mingzhou Jin, ISSE Director

Executive Summary

During 2023-2024, ISSE continued to expand its research and outreach, and this report describes the activities carried out by ISSE staff, students, and ISSE-affiliated faculty.

ISSE has a robust internal operation with 11 support staff, 15 research staff, and four research faculty members as well as several visiting scholars. Our 20 affiliated faculty members come from Haslam College of Business, the departments of Ecology & Evolutionary Biology, Biosystems Engineering & Soil Science, Electrical Engineering and Computer Science, Sociology, Economics, Mechanical Engineering, the Baker School for Public Policy, Civil & Environmental Engineering, and Industrial & Systems Engineering. Our advisory board members represent Bioresource Science & Engineering and Transportation Divisions at Oak Ridge National Lab, TN Department of Environment & Conservation's Office of Sustainability, TN Valley Authority's Office of Sustainability, City of Knoxville's Office of Sustainability, AgResearch at UT Institute of Agriculture, and Civil & Environmental Engineering, Tickle College of Engineering, and the Office of Sustainability at UTK.

ISSE principal investigators are currently leading 49 active, sponsored projects, and 30 individual agencies are funding these projects. Demonstrating our growth, ISSE was awarded 24 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 as well as a number of industry leaders, including Volkswagen, Eastman Chemical, and Sneider Electric.

ISSE has funded seven seed grant projects: five that are in progress and two 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 solider fly.

ISSE's research collaborations have grown with the addition of the Global Energy Ecosystems (GE2) initiative, which has evolved into the **Institute for Energy and Environment (IEE) gateway**. Our partner in this effort is the Office of Research, Innovation & Economic Development. IEE aims to secure the future of our planet through innovations that begin in Tennessee and cover five areas: Circular Bioeconomy, Clean Energy Systems, Engaged Community, Sustainable Environment, and Sustainable Infrastructure. ISSE has active research, educational programing, and community engagement in all aspects of these five areas.

EXCET, the US-Japan Researcher Exchange program that ISSE is leading, held two international workshops in 2024. In January, a delegation from UT visited Tokyo, and in September, ISSE hosted this group of researchers for a two-day workshop at UTK Student Union Center. The goal is for long-term collaboration among researchers, industrial leaders, investors, community leaders, and policy makers in both countries. EXCET is a high-level collaboration among the University of Tennessee, Clemson University, Waseda University, and Osaka University.

Using its recent $1million EPA award, the Water Resources Research Center has helped rural, small, and Tribal communities plan for and access funding from the Infrastructure Investment and Jobs Act and other sources. TNWRRC has assessed communities' most pressing challenges, provided training on water infrastructure and management best practices, helped communities navigate the federal funding application process and strategically invest in reliable infrastructure solutions.

ISSE Centers & Programs

FEWSUS International Research Coordination Network

FEWSUS stands for International Research Coordination Network to Create Transdisciplinary Nodes of Food-Energy-Water to Support Sustainable Urban Systems. It is funded by the US National Science Foundation. The grant, awarded to faculty and scientists at UT and ORNL, supports the development of an International Research Coordination Network to facilitatw multinational communications and accelerate the development and transfer of multisectoral data, standards, analysis tools, new technologies, and a trained workforce among differently urbanized countries.

Tennessee Water Resources Research Center (TNWRRC)

TNWRRC is a federally designated state research institute supported in part by the US Geological Survey. TNWRRC partners with the state of Tennessee as a primary resource to develop and implement programs that can achieve sustainable quantities of quality water in Tennessee and the nation. Dr. John S. Schwartz directs TNWRRC and is a professor in Civil & Environmental Engineering.

East Tennessee Clean Fuels (ETCF)

ETCF works to increase the use of cleaner American fuels and vehicles and energy saving transportation technologies to improve air quality and health, curb dependence on imported petroleum, and support Tennessee's economy. Its mission is to implement alternative fuel projects in East Tennessee and to make ETCF a sustainable coalition of involved participants from across East Tennessee. ETCF is a 501(c)3 under the umbrella of Transportation Energy Partners. Mr. Jonathan Overly is the Executive Director and Coordinator.

Energy & Environmental Justice Lab

EEJ is dedicated to interdisciplinary exploration into social justice, clean energy, accessibility to renewable resources, and infrastructure resilience. Dr. Chien-fei Chen directs a team of experts to examine social-psychological and policy factors that influence energy and environmental justice, particularly in water systems, built environment, energy efficiency, microgrids, electric vehicles, and solar technology adoption. EEJ's practical research initiatives empower academics, communities, utilities, and policymakers alike, fostering a shared commitment to equitable access to clean energy and a sustainable future.

Appalachian Leadership Institute (ALI)

ISSE partnered with ARC to launch this program focused on the unique challenges and solutions around Appalachia's economic development. ALI trains community leaders who live and work in the region through skill-building seminars, best-practice reviews, and field visits across the 13 states that make up the Appalachian region. The goal is to create leaders who can help the region adapt to these changes and use opportunities to create thriving, equitable, and sustainable communities. Dr. Timothy Ezzell is the PI for this program and a Research Professor in Political Science.

Climate Change Initiative

Researchers at ISSE, working closely with the Climate Change Science Institute at Oak Ridge National Lab, are advancing our understanding of climate change and its impacts on human and natural systems. We use Earth system modeling, integrated ground and remote sensing observations, and advanced data analytical tools to study climate change and its effects on water availability, soil moisture, wildfires, and vegetation. Team members are Drs. Yaoping Yao, Yulong Zhang, Jiafu Mao, Joshua Fu, Mingzhou Jin.

Worker Health and Safety Training at Department of Energy Facilities

DOE Worker Training was developed to protect and inform DOE communities and their workers by delivering quality and flexible safety and health training to target populations of hazardous waste workers and emergency responders. Its mission is to prevent work-related harm by training workers to protect themselves and their communities from exposure during hazardous waste operations and transportation, environmental restoration at nuclear weapons facilities, or chemical emergency responses.

East Tennessee Initiative for Smart Energy Management

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. The Department of Energy funds ETISE through the Office of Energy Efficiency & Renewable Energy (EERE), Industrial Efficiency & Decarbonization Office (IEDO), Oak Ridge National Laboratory (ORNL), and the Advanced Materials and Manufacturing Technologies Office (AMMTO).

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.

Sponsored Research

PI	Project Title	Sponsor	Co-PI	Start/Stop dates
John Schwartz	Improving the GRSMs understanding of its natural resources and processes and thereby enhancing protection of the Park's resources	US Dept Interior National Park Service - Great Smoky Mountains National Park		6/18/2014 - 6/29/2024
John Schwartz	Increasing water treatment resiliency by using natural flood records to reduce the uncertainty of water hazard predictions under changing climate-University of Alabama	US Dept Interior - US Geological Survey	Timothy Gangaware	12/15/2021 - 12/14/2023
John Schwartz	TN Stream Quantification Tool Training	TN Dept Environment and Conservation		5/1/2020 - 4/30/2024
John Schwartz	Urban Waters Report Card	Metro Gov Nashville	Timothy Gangaware	3/1/2021 - 12/31/2023
John Schwartz	Urban Waters Report Card	Hamilton County Government	Timothy Gangaware	4/1/2022 - 11/30/2023
John Schwartz	Appalachian Community Technical Assistance and Training (ACTAT) Program	West Virginia University		10/1/2018 - 9/30/2024
Jon Hathaway	Wetland Restoration with RSC's	Environmental Protection Agency	John Schwartz	10/1/19 - 9/30/2023
Jon Hathaway	REU Site: Green Infrastructure for Sustainable Urban Environments	National Science Foundation		10/1/2021 - 9/30/2024
Jon Hathaway	Collaborative Research: Reimagining Urban Watershed Management: A Systems Approach to Stormwater Control and Ecological Rehabilitation	National Science Foundation	Anahita Khojandi, Michael Blum	8/1/2022 - 7/31/2025
Khalid Ahmed Alshibli	3D dynamic evolution of pore water-air interaction within saturated sheared sand	National Science Foundation		7/15/2020 - 6/30/2024
Mingzhou Jin	Smart Manufacturing	US Dept Energy/UT-Battelle/Oak Ridge National Laboratory		11/10/2020 - 11/9/2024
Mingzhou Jin	US Food, Loss, and Waste and Its Relationship with Energy consumption and Carbon Emissions	US Dept Energy/UT-Battelle/Oak Ridge National Laboratory		5/27/2022 - 6/30/2024
Mingzhou Jin	East Tennessee Clean Fuels Initiative	East Tennessee Clean Fuels Coalition		7/1/2011 - 6/30/2024
Mingzhou Jin	INFEWS: U.S.-China: Coupled FEWS Modeling for Sustainability of the Global Crop Supply Chain with a Focus on China - US Interactions	National Science Foundation		7/1/2019 - 6/30/2024
Mingzhou Jin	SRS RN: People-Centric Integrated Assessment Model for Regional Sustainability (PIAMRS): Focusing on the Central Appalachian Region	National Science Foundation	Timothy Ezzell, Yulong Zhang, Lisa Zottarelli, Thankam Sunil, Wendy Tate, Paul Armsworth, Liem Tran	1/1/2022 - 12/31/2023
Nick Zhou	Utilizing coal-derived solid carbon materials towards next-generation smart and multifunction pavements	US Dept Energy - National Energy Technology Lab	Baoshan Huang, Wei Hu	1/5/2021 - 3/31/2024
Qiang He	AOP for wastewater treatment from the oil/gas industry	Aramco		3/9/2022 - 3/8/2024
Sheila Webster	Worker Training at DOE facilities	National Partnership for Environmental Technology Education		9/1/2020 - 7/31/2024
Timothy Ezzell	ASPIRE: Appalachian Students Promoting the Integration of Research in Education	National Science Foundation		9/5/2016 - 8/31/2024
Timothy Ezzell	Appalachian Leadership Institute	Appalachian Regional Commission	Katie Cahill, Catherine Wilt	2/6/2019 - 7/31/2024

Newly Awarded Sponsored Research

PI	Project Title	Sponsor	Co-PI	Start/Stop dates
Chien-fei Chen	Advancing Human-Centered Sociotechnical Research for Enabling Independent Mobility in People with Physical Disabilities	University of Michigan		10/1/2022 - 9/30/2026
Chien-fei Chen	Community-centered Decision-making Framework for Microgrid Deployment ot Enhance Energy Justice and Power System Resilience	Iowa State University		9/15/2022 - 8/31/2025
Chien-fei Chen	Planning: Southeast Center for Just, Resilient, and Sustainable Ecosystems (SECURE)	National Science Foundation	Kelsey Ellis, Jennifer First, Fangxing Li, Mingzhou Jin	9/1/2023 - 8/31/2024
Chien-fei Chen	SAI: Integrating human cognition, behavioral mechanisms and societal impacts for large-scale deployment of public charging infrastructure	University of Alabama		9/15/23 - 8/31/2026
Chien-fei Chen	Workshop and survey on understanding charging patterns of reluctant EV adopters, and assessment of research products	Sandia National Lab		4/15/2024 - 12/31/2024
Chien-fei Chen	A Community Co-Designed Weatherization and Micro-grid Plan for Equitalbe Energy Security and Environmental Health	Wellcome Trust	Mingzhou Jin, Leon Tolbert	8/1/23 - 5/31/2026
Jie Wu	Developing a sensor platform for rapid on-site detection of field-relevant levels of PFAS in the environment	US Dept Interior - US Geological Survey	Qiang He, John Schwartz	1/1/2024 - 12/31/2025
John Schwartz	Urban Waters Report Card	City of Chattanooga	Timothy Gangaware	9/18/2022 - 11/30/2023
John Schwartz	Urban Waters Report Card	Knox County		9/18/2022 - 11/30/2023
John Schwartz	Statewide University-Utility Partnership for Technical, Managerial, and Financial Assistance to Wastewater Systems in Rural Tennessee	Environmental Protection Agency	Qiang He	8/1/2023 - 7/31/2026
John Schwartz	Erosion and Sediment Control Handbook Update Project	Tennessee Department of Environment and Conservation	Jon Hathaway, Timothy Gangaware, Ian Simpson	2/15/2024 - 1/31/2026
John Schwartz	Preparing New Entrants to the Workforce for Sustainable Careers in the Water Sector in Central Appalachia	West Virginia University	Steven Hoagland	10/1/2023 - 9/30/2026
John Schwartz	A multi-source remote sensing-based framework and decision-support tool for flash droughts and floods under climate change	Foundation for Food and Agricultural Research	Mingzhou Jin, Yuefeng Hao	1/1/2024 - 12/31/2026
John Schwartz	FY2024 Water Resources Program Year 3	US Dept Interior - US Geological Survey	Timothy Gangaware	9/1/2023 - 8/31/2024
Jon Hathaway	Innovative Stormwater Management for Tennessee: A Training Program	Tennessee Department of Agriculture	John Schwartz	5/31/2024 - 7/31/2027
Jon Hathaway	Gravel Tree Stormwater Systems: Bringing Ecosystem Services, Education, and Workforce Development to East Knoxville	USDA - Forest Service	Kelsey Ellis	5/16/2024 - 5/15/2029
Joshua Fu	Estimating Soil Organic Carbon Changes from SAF Feedstock Production in the US with Integrative Satellite Data and Machine Learning	US Dept Transportation Federal Aviation Administration		12/22/2022 - 12/31/2023
Mingzhou Jin	Center for Freight Transportation for Efficient and Resilient Supply Chain (FERSC)	US Dept Transportation	Lee Han, Kevin Heaslip	6-1-2023 - 5/31/2029

Newly Awarded Sponsored Research, continued

PI	Project Title	Sponsor	Co-PI	Start/Stop dates
Mingzhou Jin	Quantification of Boreal and Temperate Ecosystem Vulnerabilities and Their Model Uncertainties	DOE - ORNL - UT Battelle	Yuefeng Hao	1/1/2024 - 9/30/2028
Mingzhou Jin	Literature Review of Mass Flow Analysis for Enhancing Sustainability	Eastman Chemical Co.		12/1/2023 - 8/31/2024
Mingzhou Jin	Life Cycle Analysis of Automotive Composite Materials	Volkswagen of America		1/1/2024 - 1/31/2025
Mingzhou Jin	ETISE: East Tennessee Inititiative of Smart Manufacturing for Energy Efficiency	US Dept Energy Office of Energy Efficiency		3/01/2023 - 2/29/2024
Mingzhou Jin	U.S.-Japan Exchange Program fgor Green Growth Collaboration through Clean Energy Technologies (EXCET)	US Department of State	Chien-fei Chen, Kevin Tomsovic	9/1/23 - 8/31/2025
Timothy Ezzell	Closing the Regional Tourism Gap: Promoting Multi-jurisdictional tourism in Cumberland Gap Communities	East Tennessee State University		8/15/2023 - 6/30/2024

Completed Sponsored Research

Faculty/PI	Project Title	Sponsor	Co-PI	Duration
Mingzhou Jin	Anyalysis for Regional and Global Land Ecosystem Modeling	DOE - ORNL - UT-Battelle - Oak Ridge National Laboratory		8/1/2020 - 12/31/2022
Timothy Ezzell	Increasing Economic and Entrepreneurial Opportunities by Promoting Outdoor Recreation Among Underrepresented Visitor Groups	East Tennessee State University		8/15/2019 - 6/30/2023
Jonathan Overly	TDOT I-40 Alternative Fuels Continuation	US Dept Transportation via UT Center for Transportation Research	Yulong Zhang	7/1/2021 - 6/30/2023
John Schwartz	FY2021 and FY2022 Water Resources Program Year 1	US Dept Interior - US Geological Survey	Jon Hathaway, Yaoping Wang, Timothy Gangaware	9/1/2021 - 4/30/2023
John Schwartz	FY2022 and FY2023 Water Resources Program Year 2	US Dept Interior - US Geological Survey	Timothy Gangaware	9/1/2021 - 8/31/2023
John Schwartz	Urban Waters Report Card	City of Memphis	Timothy Gangaware	3/7/2022 - 6/30/2023

Active Seed Grants

Faculty/PI	Project Title	Co-PI	Duration
Jiangang Chen	Assessing the levels of forever chemicals (PFAS) in surface water in Tennessee aquatic ecosystems	Jie Wu, Qiang He	7/1/2022 - 12/31/2023
Alison Buchan	Identification of novel pathways for bacterial degradation of polycyclic aromatic hydrocarbons	Qiang He	7/1/2022 - 12/31/2024
Baoshan Huang	Utilization of Waste Plastics	Qiang He, Brian Long, Pawel Polaczyk	7/1/2022 - 9/30/2023
Kai Sun	Assessing the Implications of Large-Scale Hydrogen Production on Power Transmission Systems	Feng Zhang	7/1/23 - 6/30/2024
Anna Herring	Couple Mass Transfer Processes during Underground Hydrogen Storage	Haochen Li	7/1/23 - 6/30/2024
Tong Wang	Transformational Production of Sustainable Aviation Fuel and Biofertilizer from Black Solider Fly		7/1/23 - 6/30/2024

Completed Seed Grants

Faculty/PI	Project Title	Co-PI	Duration
Khalid Alshibli Ahmed	Geochemical Interaction between CO2 and Caprock for Safe Carbon Sequestration	Nicholas Dygert	1/1/2021-12/31/2022
Qiang He	Toward Precision Environmental Health Risk Management	Cronley & Li	1/1/2021-12/31/2022
Kelsey Ellis	Beat the Heat: Builiding adaptive capacity of vulverable populations in Knox County to combined stressors from climate change and urban heat.	First & Kintziger	7/1/2021 - 12/31/2022
Frank Loeffler	Microbial transformation and degradation of sulfonated per- and polyfluoroalkyl substances.	Shawn Campagna	7/1/2021 - 12/31/2022
Jie Wu	Socioeconomic inequalities and drinking water quality: assessin arsenic concentrations in community water systems by novel field deployable biosensors.	Cronley & He	7/1/2021 - 12/31/2022
Chris Cherry	Micromobility Vehicle Second-Life Battery Applications: Market Inventory and End Use Feasibility Analysis	Daniel Costinett	7/1/2022 - 6/30/2023

ISSE Research Staff, Support Staff, Affiliated Faculty & Advisory Board

Research Staff	
Mingzhou Jin	ISSE Director, Professor of Industrial & Systems Engineering and Civil & Environmental Engineering
Jason Brown	Research Associate II
Chein-fei Chen	Director of Energy and Environmental Justice, Research Associate Professor
Tim Ezzell	Director, Appalachian Leadership Institute, Research Assistant Professor
Tim Gangaware	Research Director, Tennessee Water Resources Research Center
Jon Hathaway	Associate Director, TNWRRC
Qiang He	Associate Director, ISSE
Steven Hoagland	Research Associate II
Jiafu Mao	ORNL Joint Faculty Professor
Jonathan Overly	Director, East Tennessee Clean Fuels
John Schwartz	Director, Tennessee Water Resources Research Center; Professor, Civil & Environmental Engineering
Danniel Siksay	Chief of Staff, East Tennessee Clean Fuels
Ian Simpson	Research Assistant Professor
Sheila Webster	Director, Technology Research and Development Program
Catherine Wilt	Research Associate

Advisory Board	
Erin Webb	Senior R&D Engineer and Group Leader, Bioresource Science & Engineering, ORNL
James Parks	Section Head of Energy and Transportation Division, ORNL
Matthew K. Taylor	Deputy Director of Sustainability Office, TDEC
Rebecca Tolene	VP Environment-Chief Sustainability Officer, TVA
Tim Rials	Associate Dean at UT AgResearch, UTIA
Chris Cox	Department Head, Civil & Environmental Engineering, UTK
Brian Blackmon	Director, Office of Sustainability, City of Knoxville
Jay Price	Sustainability Manager, UTK
Bill Dunne (observer)	Associate Dean for Research and Facilities, Tickle College of Engineering, UTK

Support Staff	
Darcy Ayers	Project Coordinator, East TN Clean Fuels
Kellie Caughorn	Senior Administrative Services Assistant, Tennessee Water Resources Research Center
Katie Davis	Project Coordinator, East TN Clean Fuels
Lissa Gay	ISSE Communications Director
Jennifer Kidd	Project Coordinator, East TN Clean Fuels
Lily Lovingood	Project Coordinator, East TN Clean Fuels
Susan Lutman	Financial Associate
Sherry Russell	ISSE Business Manager
Alex Strong	Drive Electric Coordinator, East TN Clean Fuels
Kim Williams	East TN Clean Fuels Administrative Coordinator
Wesleigh Wright	Community Engagement Liaison, East TN Clean Fuels

Affiliated Faculty	
Charles Sims	Baker Center for Public Policy, Department of Economics
Sean Schaeffer	Biosystems Engineering & Soil Science
Walker Forbes	Biosystems Engineering & Soil Science
Jie Zhuang	Biosystems Engineering & Soil Science
Joshua Fu	Civil & Environmental Engineering
Jon Hathaway	Civil & Environmental Engineering
Terry Hazen	Civil & Environmental Engineering
Qiang He	Civil & Environmental Engineering
John Schwartz	Civil & Environmental Engineering
Shua Li	Civil & Environmental Engineering
Nick Zhou	Civil & Environmental Engineering
Paul Armsworth	Ecology & Evolutionary Biology
Kevin Tomsovic	Clemson University
Michael Galbreth	Haslam College of Business
Wendy Tate	Haslam College of Business
Mingzhou Jin	Industrial & Systems Engineering
Anahita Khojandi	Industrial & Systems Engineering
Jiafu Mao	Industrial & Systems Engineering
Feng-Yuan Zhang	Mechanical, Aerospace & Biomedical Engineering
Robert Jones	Sociology

ISSE Welcomes New Staff

Susan Lutman
ISSE
Financial Associate

Kim Williams
East TN Clean Fuels
Administrative Coordinator

Katie Davis
East TN Clean Fuels
Project Coordinator

Alex Strong
East TN Clean Fuels
Drive Electric TN Coordinator

ISSE Advisors & Students

ISSE researchers advised a record number of students this year. Of these 64 advisees, 26 are undergraduate students.

Allison Buchan
- Evelyn Saunders (U) Microbiology
- Taylor Smith (U) Microbiology

Anna Herring
- Joe-Sam Nkuah (G)

Baoshan Huang
- Danni Li (G) Civil
- Guantao Cheng (G) Civil
- Jingtao Zhong (G) Civil
- Jingyu Zhang (G) Civil
- Yanhai Wang (G) Civil

Chien-fei Chen
- Elizabeth Parham (U) ISSE
- Julia Craven (U) ISSE
- Kassidi Knight (U) ISSE
- Maggie Sullens (G) ISSE
- Margaret Knight (G) ISSE
- Robin Rickard (U) ISSE
- Sage Gray (U) ISSE
- Sally Grigsby (U) ISSE
- Stephanie Tomasik (G) ISSE

Chris Cherry
- Kepler Barnhart (G) Civil

Joshua Fu
- Hannah Rubin (G) Civil
- Leyuan Zhang (G) Civil

John Schwartz
- Asma Itmaizah (U) Civil
- Augustus Rightmyer (G) Civil
- Ceara Parks Oliver (G) Civil
- Celia Jackson (G) Civil
- Crispin Martin (U) Civil
- Jackson Reeves (U) Civil
- Jian Song (G) Civil
- Katherine Ermer (U) Civil
- Lydia Pierce (U) Civil
- Matthew Tolson (G) Civil

Jon Hathaway
- Abby Knauer (U) Civil
- Campbell Butler (U) Civil
- Ghada Diab (G) Civil
- Gillian Palino (G) Civil
- Isabelle Hamby (U) Civil
- Isadora Flether (G) Civil
- Theo Kyriakopoulos (G) Civil
- Victoria Rexhausen (G) Civil

Kai Sun
- Kaiyang Huang (G) EECS

Khalid Alshibli
- Mohammed Elnur (G) Civil

Nick Zhou
- Yanhai Wang (G) Civil
- Yawen He (G) Civil
- Yucen Li (G) Civil

Mingzhou Jin
- Alexander Perry (U) ISE
- Choloe Carouso (U) ISE
- Christian Lee (U) ISE
- David Vance (G) ISE
- Eli Macon (U) ISE
- Lucienne Reinhard (U) ISE
- Maria Caballero (G) ISE
- Marion Anderews (U) ISE
- Maura Ellen O'Driscoll (U) ISE
- Olivia Lahair (U) ISE
- Rui Zhou (G) ISE
- Ryan Hulsey (U) ISE
- Saraita Rattanakunuprakarn (G) ISE
- Stuart Spaugh (U) ISE
- Vinh Khac Le (U) ISE
- Yue Yao (G) ISE
- Ziwei Liu (G) ISE

Qiang He
- Chenyang Wang (G) Civil
- Xinghan Zhao (G) Civil

Timothy Ezzell
- Prince Brown (G) ISSE

Toni Wang
- Madison Fomich (G) Food Science

G - graduate student
U - undergraduate student

ISSE Student Highlights

Mohammed Elnur is a fourth-year Ph.D. candidate at the Department of Civil and Environmental Engineering, UTK. He was awarded B.Sc. in Civil Engineering from the University of Khartoum, Sudan. Mohammed received his M.Sc. in Civil Engineering from the University of Glasgow, Scotland, UK. The goal of his current research is to evaluate the integrity of limestone caprock for safe geological carbon trapping by examining the geochemical interaction between supercritical carbon dioxide and limestone rock. Mohammed's research employs multiple techniques including 3D CT imaging, X-ray diffraction, X-ray fluorescence, and flow experiments. His research interests include the behavior of granular material, constitutive modeling of soils, and unsaturated soil mechanics. Mohammed recently published a paper on the Influence of X-ray exposure on triaxial testing when using 3D synchrotron micro-computed tomography.

Ceara Parks Oliver is a third year PhD student in Civil and Environmental Engineering. She earned her BS in 2013 from the University of Oklahoma. For the next nine years, Ceara worked for Burns & McDonnell in Dallas, Texas, as a stormwater engineer. Her main responsibilities included project management, performing H&H tasks for transportation-related projects, and public outreach. For her dissertation, Ceara's research will be centered on stream restoration while complimenting it with her stormwater engineering background. The main theme of her dissertation will be focused on applying storm water control measures as an innovative stream restoration approach with respect to compensatory mitigation. Although still early on in her research, she plans on utilizing sediment transport and habitat modeling to develop a currency for compensatory mitigation. The summary will concentrate on the 2008 Compensatory Mitigation Rule of the Clean Water Act and how this research can be used to advocate for innovative stream restoration approaches.

Yue Yao is a fourth-year Ph.D student in UTK's Department of Industrial and Systems Engineering (ISE). In 2018, Yue completed his Bachelor of Science, followed by his Master of Engineering in 2020, both in ISE at Virginia Tech. He current works as a Graduate Research Assistantship, and his research interest includes climate change, optimization, and supply chain. Yue's ongoing research focuses on evaluating the impact of food shelf-life technologies on reducing food loss and waste, as well as their influence on greenhouse gas emissions and energy consumption within the United States' food supply chain. The project is funded by the Department of Energy (DOE) and involves collaboration with Oak Ridge National Laboratory.

Chenyang Wang is a second-year Ph.D. student in UTK's Department of Civil and Environmental Engineering. Chenyang received her Master of Science in Engineering from the University of Chinese Academy of Science, Beijing, China, in 2022. Her current research uses electrochemical technology for organic pollutants in produced water, revealing the process and key factors of pollutant degradation. Ms. Chenyang is dedicated to the development of innovative and environmentally sustainable technology for the efficient elimination of organic contaminants such as BTEX and oil from produced water, leveraging H2S/SO42-as co-contaminants to generate powerful oxidants through self-sustained electrochemical radicalization, aiming to simplify the process of produced water treatment through eliminating the need for complex catalysts.

Yucen Li is a fourth-year Ph.D. student in UTK's Department of Civil and Environmental Engineering. Yucen received his Bachelor of Engineering in the Beijing University of Technology, Beijing, China, in 2017 and Master of Engineering in Northeastern University, Boston, USA, in 2020. His current research focuses on the electrical conductivity estimation of asphalt concrete with conductive granular carbon particles. Mr. Li also employs multiple techniques to study phase separation during melting/freezing of salt hydrate phase change material. Mr. Li research interests include thermal energy storage of inorganic materials, heat transfer, phase segregation of salt hydrates, numerical methods in engineering problem and digital image processing of X-ray/Neutron beam on materials. Mr. Li recent publication as a co-author is Towards building homeostasis through a low-cost biomimetic synthetic foam for building surface cooling and energy saving.

Jian Song is a fourth-year Ph.D. student in UTK's Department of Civil and Environmental Engineering. Jian received his Bachelor of Engineering in 2017 and Master of Engineering in 2020 in the College of Water Resource and Civil Engineering from China Agricultural University, Beijing, China. Jian's research interests include developing, improving, and utilizing agricultural and hydrological models. He is currently developing an agricultural model for pasture management.

Isidora Fletcher received her Bachelor of Science degree in Physics from the University of Tennessee, Knoxville. She is currently completing her PhD in Data Science and Engineering Program at UTK. She is a graduate research assistant at the Bredesen Center. She is working with Drs. Jon Hathaway and Anahita Khojandi. The research project she is working on focuses on using reinforcement learning for water management problems. Her interests focus on the use of machine learning to address problems from different areas of research. Her current area of interest is environmental research.

Celia Jackson is a second-year master's student in UTK's Department of Environmental Engineering. Celia received her Bachelor of Science in Biology from the University of North Carolina at Chapel Hill in 2018. Her current research focuses on the functioning and efficiency of water resource utilities in rural and tribal communities in eastern Tennessee. Her current research techniques involve obtaining and analyzing data metrics on system, financial, and operating characteristics for these local water utility services. Ms. Jackson's research interests include sustainable methods for water resource management and mitigating climate impacts from urbanization via green design. Her past publication as a co-first author focuses on the effect of land use and stormwater control measures in the Jordan Lake watershed of North Carolina.

Sarita Rattanakunuprakarn is a fourth-year Ph.D. student in UTK's Department of Industrial and System Engineering. Sarita received her Bachelor of Science in the Industrial Engineering from Kasetsart University, Nakhon Pathom, Thailand, in 2017 and master's degree in Industrial Engineering and Management Systems from University of Central Florida in 2020. Her current research focuses on comparative evaluation of highways and railways construction projects using life-cycle benefit cost analysis. The scope of the methodology not only captures typical financial investment and operating costs, but we consider overall impacts over the lifecycle of the infrastructure and transportation equipment, including monetized values of the projects' environmental and social impacts. Miss Sarita's research interests include operations research and reliability and maintenance of the system, especially in transportation field.

Kepler Barnhart is a third-year Master's Student and graduate research assistant in UTK's Department of Civil and Environmental Engineering. Kepler received his Bachelor of Science in Business Administration as a Supply Chain Management major from Haslam College of Business in 2017. For five years, Kepler worked in supply chain management roles in the electric bike industry, experiencing the electrification of the transportation industry firsthand. Kepler's current research focuses on second-life battery inventory within the micromobility sector and applications for energy storage. Other research interests include scooter/two-wheel vehicle safety and intelligent transportation system technologies for vulnerable road users. At ISSE's first annual research conference, Kepler was awarded second place in the student poster competition.

Matthew Tolson is a third-year graduate student in UTK's Department of Civil & Environmental Engineering pursuing a master's degree in Environmental Engineering with a concentration in water resources. Matthew received his bachelor's degree in Civil & Environmental Engineering from the University of Tennessee, Knoxville in 2022. His current research focuses on prioritizing urban stream restoration and rehabilitation projects based on watershed models. Mr. Tolson utilizes SWMM modeling, incorporating rainfall data, geomorphic characteristics, and obstruction locations along waterways. Mr. Tolson's research interests include stream/wetland restoration and stormwater management with a focus on properly pairing the two fields in practice.

Crispin Martin is a fourth-year undergraduate student in UTK's department of Civil and Environmental Engineering. He is currently exploring concentrations within the department, but hopes to work with water resources, environmental work, and structures. In the future, he would like to research the effects of climate change on coastal infrastructure, specifically as they apply to flooding. A member of the Cook Grand Challenge Honors Program at the university, he is due to finish his undergraduate degree in May of 2025.


High-fidelity prediction of long-term climatic impact on water infrastructure treatment dynamics
2024 ISSE Research Conference
Mohamed Shatarah, Kai Liu, Haochen Li
Water Infrastructure Laboratory, University of Tennessee, Knoxville
Case study: hydrodynamic separator long-term performan
Operator learning framework formulation
Long-term water treatment dynamics prediction
The problem:
Challenges with high-fidelity simulation for long-term
Our solution:
Conclusion:
TICKLE
In recognition of excellence in research communication, the Institute for a Secure & Sustainable Environment presents
Mohamed Shatarah
First Prize in the Student Poster Competition at the Second Annual ISSE Research Conference
ISSE Director
Awarded on September 18, 2024
Haochen Li

Third Annual ISSE Research Conference

For the third year in a row, ISSE hosted its annual research conference, following the format established in the inaugural event in 2022. This year, **Matthew Mench**, Dean of Tickle College of Engineering, gave the opening remarks followed by Director **Mingzhou Jin**'s overview of research programs that are affiliated with ISSE.

ISSE Projects

ISSE Research Showcase included **John Schwartz**, TNWRRC Director, giving a roundup of the Water Resource Research Center activities and **Jonathan Overly**, East TN Clean Fuels Coalitions Director, discussing ETCF's progress in alternative-fuel and electric vehicle adoption.

Seed Projects Presentations

The Seed Grant Projects Showcase highlighted the currently active and recently-completed research funded by ISSE:

- Underground Hydrogen Storage, PI **Anna Herring**, CEE
- Aviation Fuels from Black Soldier Fly, PI **Toni Wang**, Food Science UTIA
- Integration of Hydrogen and Grids, PI **Kai Sun**, EECS
- Particle emission during battery thermal runaway and fires, PI **Peng Zhao**, MABE
- EV Charging Infrastructure for Environmental and Social Justice, PI **Leon Tolbert**, EECS
- Decarbonization of nitrogen fertilizer for agriculture, PI **Xiaofei Ye**, BESS UTIA
- Innovative tandem system for micro-nano-plastics and PFAS removal, PI **Anming Hu**, MABE
- Environmental Justice: Socio-Economic Dimensions of Urban Stream Health, PI **Eminé Fidan**, BESS UTIA

Reports from ISSE Partners

Keynote Presentations covered the sustainability work being done by our partners in the national, state, and local arenas:

- Tennessee Volunteer Emission Reduction Strategy, **Rachael Maitland**, Senior Policy Analyst, TDEC Office of Policy and Planning and **John LeCroy**, Deputy Director, TDEC Division of Stakeholder Engagement
- Design for Sustainability: Circular Bioeconomy Systems at UT and ORNL, **Erin Webb**, Group Leader, ORNL-Bioresource Science & Engineering; Laboratory Relationship Manager, DOE-BETO
- An Overview of the Tennessee Department of Environment and Conservation's Office of Energy Program (TDEC OEP), **Molly Cripps**, Director, TDEC Office of Energy Programs (OEP)

Student Poster Contest

A major conference highlight was the Student Poster Competition. First Prize was awarded to **Mohamed Shatarah** for his poster, *High Fidelity Prediction of Long-term Climatic Impact on Water Infrastructure Treatment Dynamics.* Mr. Shatarah is pictured with his collaborator, Assistant Professor **Haochen Li**, of the Water Infrastructure Lab, which is housed in UTK Department of Civil & Environmental Engineering.

Second Prize went to **Trinity Bissahoyo** (*Validating Arduino-Portable Detection Model for Change in Capacitance*). Ms Bissahoyo is a student in Electrical Engineering & Computer Science, and her advisor is **Jayne Wu**, a professor in EECS.

Third Prize went to **Yue Yao** (*The Overview of Main Food Shelf-life Extension Technologies and the Framework of the Tool for a Comprehensive Analysis*). Mr. Yao is a student in Industrial & Systems Engineering, and his advisor is ISE Department Head **Mingzhou Jin**.

*left: First prize winner **Mohamed Shatarah** with his collaborator, Assistant Professor **Haochen Li.***

*right: **Dr. Jin** and **Associate Dean Bill Dunne** present **Dr. Tim Ezzell** with the 2024 ISSE Outstanding Staff Award.*

Research Highlights

East Tennessee Initiative for Smart Energy Management (ETISE) Survey and Assessments in Budget Year 1

This report summarizes the survey conducted by ETISE among local manufacturers and the technical assistance conducted by the ETISE Team and students at the University of Tennessee, Knoxville. From 09/18/22 to 11/06/2023, we received 16 responses, two of which were from the same company.

We plan to renew our efforts to solicit more responses starting in August 2024. The survey can be found at East Tennessee Initiative for Smart Energy Management (ETISE) Survey (google.com). The survey covers general information, responses regarding energy management, decarbonization, smart manufacturing, and an analysis.

These are the 16 companies that completed the survey. Please note that two responses are from the same company, Camel Manufacturing.

- Dalen Products, Inc.
- Allison Boats, Inc.
- Knox Wire Harnesses
- Technical Response
- England Inc.
- Geon Performance Solution
- Unitrac Railroad Materials
- CCI – Climashield LLC
- Matsuo Industries USA, Inc.
- Reily Foods Co
- Boatmate Trailers, LLC
- Fresenius Medical Care
- JTEKT Vonore
- Camel Expeditionary
- Takahata Precision Tennessee, Inc.
- Camel Manufacturing Company LLC

These are the main findings from the survey:

- One-third of local small- and medium-sized manufacturers have not established any energy management system. The others have some initial management systems but only use the system to partially manage their energy use.

- Most companies do not use any smart manufacturing technologies for their energy management. A few of them automatically collect some data, install submeters, have real-time data, or conduct maintenance based on energy management.

- Most companies stated that the lack of expertise and the concern about the high investment cost are the top challenges for them to implement “smart energy management”.

- Most companies do not have senior management or dedicated energy management teams.

- Most companies do not have any energy policy or collect any energy data beyond utility bills.

- Most companies have no process for identifying energy efficiency opportunities.

- Most companies have either no or irregular energy review process.

- Most companies have little or no consideration of energy or emissions while developing standard operating procedures.

- Most companies do not have a stated net-zero emissions goal. Three companies stated they had estimated scope 1 and 2 emissions and pilot projects underway. Only one company stated they have comprehensively assessed scope 1 and 2 emissions.

- Only one company stated that they had implemented one strategy (Energy efficiency). There are several pilot programs for energy efficiency, power purchase agreements, combined heat and power, carbon accounting, purchase of carbon offset credits, and carbon capture. In our assessments, we did not see any decarbonization strategy in the pilot or implementation phase.

- Only two companies implemented on-site alternative energy sources. We did assessments at both companies, and they both implemented geothermal for space heating.

- Most companies did not have a smart manufacturing strategy.

- Most companies have a central IT department. Some use a service provider.

- No companies had complete functionality in their equipment infrastructure. Most companies did not have machine-to-machine communication or interoperability.

- Companies are collecting data during production. Only one company stated they do not collect machine or process data. Throughput times were the most popular category. This is an area companies can improve on their initial success to drive value.

- Most companies use data in quality management. Some use data to optimize logistics and supply chain, predictive maintenance or the transparency across production processes.

above: PI David Vance works with several UTK undergraduate students to provide technical assistance to a local manufacturer.

- Companies indicated that they are well along with their IT security solutions.
- Most companies are at least investigating SM benefits, but no company indicated that they have a basic investment plan.
- Only one company stated they are not using real-time data for management decisions. The most popular category was production data.
- Based on an ANOVA analysis, it is observed that there is no effect of "company size" on "energy management system implementation". There is a possible but weak impact of "company size" on "net-zero" emissions level and on "smart manufacturing implementation" with a P-value around 0.2.

Estimating Energy Consumption and GHG Emissions in the U.S. Food Supply Chain: Informing the Net-Zero Transformation

In alignment with the goal of the Paris Agreement, which aims to limit global warming below 1.5 or 2 °C, the United States is committed to achieving a 50-52% reduction in economy-wide net greenhouse gas (GHG) emissions from 2005 levels by 2030, and ultimately reaching net-zero emissions by 2050. The U.S. food supply chain (FSC) is widespread and has unique challenges that are not common across other industrial and commercial subsectors (e.g., direct crop and animal emissions, large waste streams, and low potential for electrification).

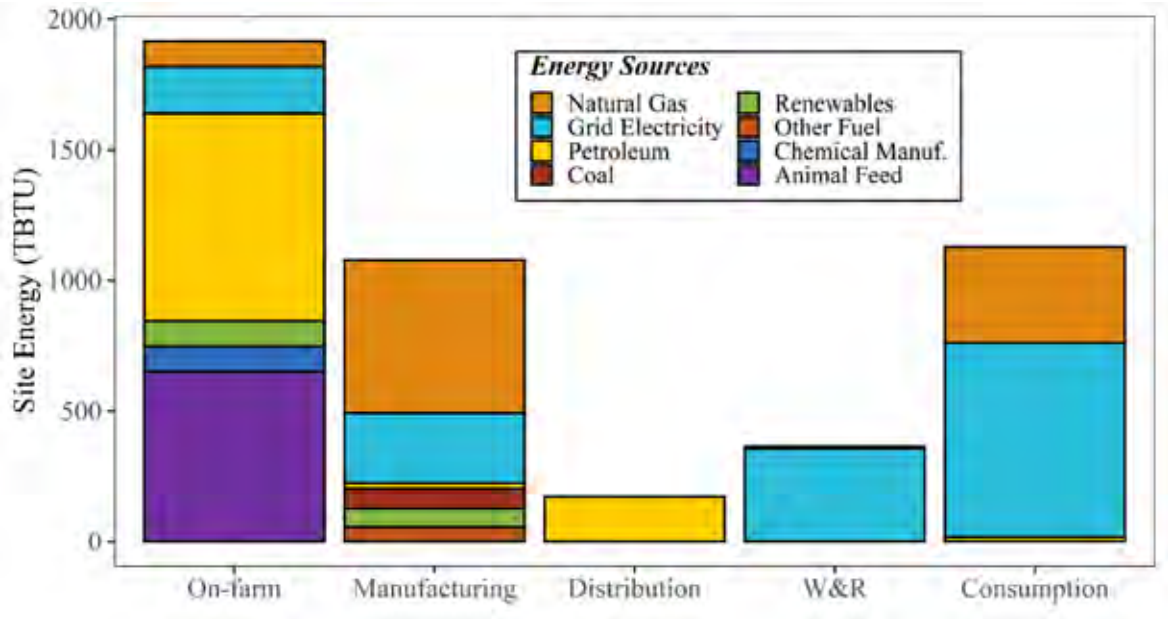
This study considers five reduced commodity groups: grain and oil; fruits, vegetables, and nuts; dairy; sugar; and animal products (meat, and poultry, seafood, and eggs). Impacts from food commodities grown for livestock feed were included, but food crops grown for non-livestock (i.e., pets, horses) were not. The U.S. FSC comprises five stages: on-farm production (including pre- and post-farm activities like agricultural chemical manufacturing and farm-to-manufacturing transportation), manufacturing, distribution, wholesale and retail (W&R), and consumption (i.e., food services and households).

By adopting this supply chain management perspective, the study not only facilitates comparisons of the U.S. FSC with those in other sectors but also underscores the importance of efficient supply chain management in achieving a sustainable U.S. FSC. The energy consumption at each stage is quantified in terms of site energy (i.e., energy consumed at the site of use) and then converted into primary energy, defined as the energy required to produce the energy used on-site (e.g., electricity) plus any losses incurred through transmission and distribution; it is not true embodied energy as it does not include the energy required to refine

fossil fuels or produce fertilizer or pesticide precursors and other starting materials and feedstocks.

According to the model created for this study, the entire U.S. FSC consumed 4,660 TBTU (4,910 PJ) of site energy, 7,130 TBTU (7,510 PJ) of primary energy, and originated 970 MMT CO2e of GHG emissions in 2016. This year was chosen for this modeling effort based on the large spread of date ranges of available data sources (2012 - 2020). When broken down by stages, site energy consumed at on-farm production ranked the highest (1,920 TBTU, 2020 PJ, 41%) in the U.S. food system, followed by food consumption (i.e., food services and households) (1,130 TBTU, 1190 PJ, 24%), food manufacturing (1,080 TBTU, 1140 PJ, 23%), W&R (360 TBTU, 380 PJ, 7.8%), and food distribution (170 TBTU, 180 PJ, 3.7%). Electricity was the largest site energy source (33%) and was mainly used at the W&R and consumption stages (96% and 66%), followed by food manufacturing (25%) and on-farm production (9.2%). Natural gas (23%) and petroleum products (22%) were also major site energy sources for the U.S. food system. On-farm production and food distribution accounted for most of the petroleum combustion, and natural gas was mainly consumed at food manufacturing and food services. Agricultural chemicals manufacturing (fertilizer and pesticides) and animal feed production contributed to 2.0% and 14% of the site energy usage. Only the on-farm production and manufacturing stages had reportable volumes of on-site renewable energy use, representing a small portion (3.6%) of the energy used in the U.S. food system.

right above: analysis boundaries include energy used and GHG emissions of US FSC but exclude embodied energies of chemicals, water, equipment, packaging, and other FSC peripherals.



right below: Site energy (TBTU) use of the 2016 U.S. FSC by stage and energy source.

Closing the Regional Tourism Gap: Promoting Multijurisdictional Tourism in Cumberland Gap Communities

Students in the Fall 2023 Appalachian Collegiate Research Initiative (ACRI) class worked with the town of Cumberland Gap, Tennessee exploring opportunities related to outdoor recreation and tourism development. Class members forged a partnership between the town and developers of the Warriors Path Trail system to help make the community a central hub of the proposed multi-state trail system. At the end of the semester, the class presented their findings before other ACRI schools and the staff and leadership of the ARC in Washington.

This Fall, UT began its 23rd year with the ARC-sponsored program. The 2024 ARCI class is working with the town of Tellico Plains, Tennessee to improve downtown image-ability and infrastructure to help increase tourism from the Cherohala Skyway. Class topics include improving downtown aesthetics, promoting bike and pedestrian infrastructure, and addressing local water and waste constraints.

Appalachian Dark Skies Symposium

In early April, Dr. Tim Ezzell and Cat Wilt spoke at the Appalachian Dark Skies Symposium at Colgate University. This was a first-of-its-kind symposium, bringing together a broad range of people with similar interests in the night sky. The aim of the symposium was to raise awareness in the scholarly community of the cultural significance of a dark night sky, while tying this awareness to the work of advocates working in the Appalachian region, but also across the country and internationally. The symposium brought together like-minded individuals from vastly different academic and scholarly worlds, hoping to build a community of scholars and advocates whose work may be shared broadly in support of dark sky preservation.

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 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, TNWRRC), 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.

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)

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

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 pfos, 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.

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, pfos, and total pfas, which are known to be harmful to public health. It is anticipated to detect pfos, 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.

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.

ETFC to Work with Clean Cities Georgia and Triangle Clean Cities to Expand Coalition Reach and Validate 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 members.

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.

TNWRRC 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 three year project 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 noncompliance 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.

Seed Grants

Transformational Production of Sustainable Aviation Fuel and Biofertilizer from Black Solider Fly, Toni Wang, PI

Our goal is to use chemistry-based approaches to study the separation and properties of lipid and protein of black soldier fly larvae (BSFL), so their high-value and superior-performance applications can be created using feasible and scalable technologies. We intend to use insect as a vehicle to address the challenges of environmental sustainability, renewable energy, and biobased products, achieving a more circular economy. Two unique applications are proposed 1) The lipids to be converted to sustainable aviation fuel (SAF), and 2) BSF protein-extraction residue and hydrolysates to be used as antioxidant and biofertilizer.

Objective 1: BSFL oil and protein fractionation and oil characterization (quarter 1-2)

Oil extraction was done by using the complete lipid removal using the Folch procedure (chloroform:methanol 2:1, which is a suitable solvent for lipid extraction from wet biomass, and there are other alternative and more green solvents too) and hexane extraction (a simulation of commercial method applied to dried biomass). The oils are currently being fully characterized for its impurities that would impact the chemical catalyst's activity during SAF production.

After lipid extraction, approximately 50% of the mass was removed as the lipid fraction. The polar Folch extraction yields slightly more lipid (50.6%) compared to the non-polar hexane extraction (46.0%). However, as shown in Table 1, most of the mineral content (73.4%) remains in the defatted fraction rather than the lipid fraction. Additionally, the lipids extracted using the Folch polar solvent method contain more minerals compared to those extracted with non-polar hexane.

The P, Fe, Ca, Mg, and Si are undesirable components in the oil to be thermal chemically converted to SAF. Therefore, the extracted crude oil must be further refined in our future experiment to achieve less than 5 ppm of these metal species, particularly for P. Absorptive purification as currently practiced for vegetable oils as SAF (gel SorbsilR92, used 0.1-0.5% in oil-hexane miscella) will be tested for their effectiveness in removing impurities.

Objective 2: Making and evaluating functional peptides from BSFL protein

After full lipid removal, the proteins present in the BSFL were first characterized by the classical Osborne fractionation process based on solubility. A low protein content indicates protein is tightly or covalently bound with non-protein components.

Then the alkaline soluble proteins were obtained using the industrial protein isolate preparation method, i.e. by alkaline solubilization, and the biomass residue that is still protein and chitin-rich are being enzymatically treated (by cellulase and protease, as shown in Figure 1) to study if additional protein or peptides can be solubilized, and which residues will be best tested as the biofertilizer.

Figure 2 outlines the additional protease treatment and solubilization methods to achieve the recovery of high-value protein as feed ingredients, and the extraction residue that may still be protein-rich will be further treated to create bioferlilizer. Or, depending on the mass balance of minerals, proteins, and chitins (i.e. total carbohydrate), some of the intermediate hydrolysates will be tested as bioferlilizer.

Procedure details: After the alkaline soluble protein was extracted (at pH 10, 30 min solubilization and centrifugation to collect the soluble protein), hydrolysis using HCl, cellulase and protease were performed on the precipitate (Figure 1).

For cellulase hydrolysis, the residues were treated at pH 5.0, 50°C, with 1% w/w cellulase for 24 hours to reduce the chain length of chitin and increase the solubility of the proteins. For HCl treatment, the residues were mixed with 2M HCl for 2 hours to remove metal ions, improving the yield of the enzymatic treatment.

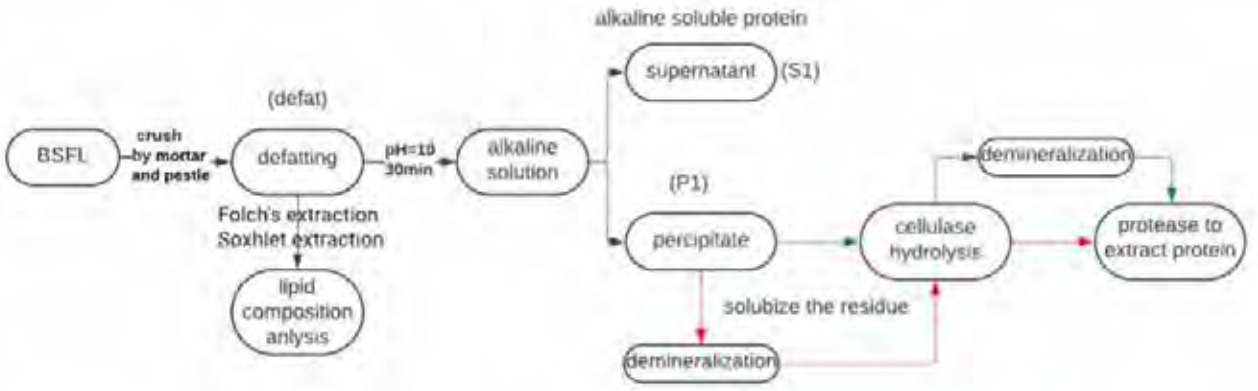


Figure 1. Flow chart of protein solubilization and treatments to improve protein recovery

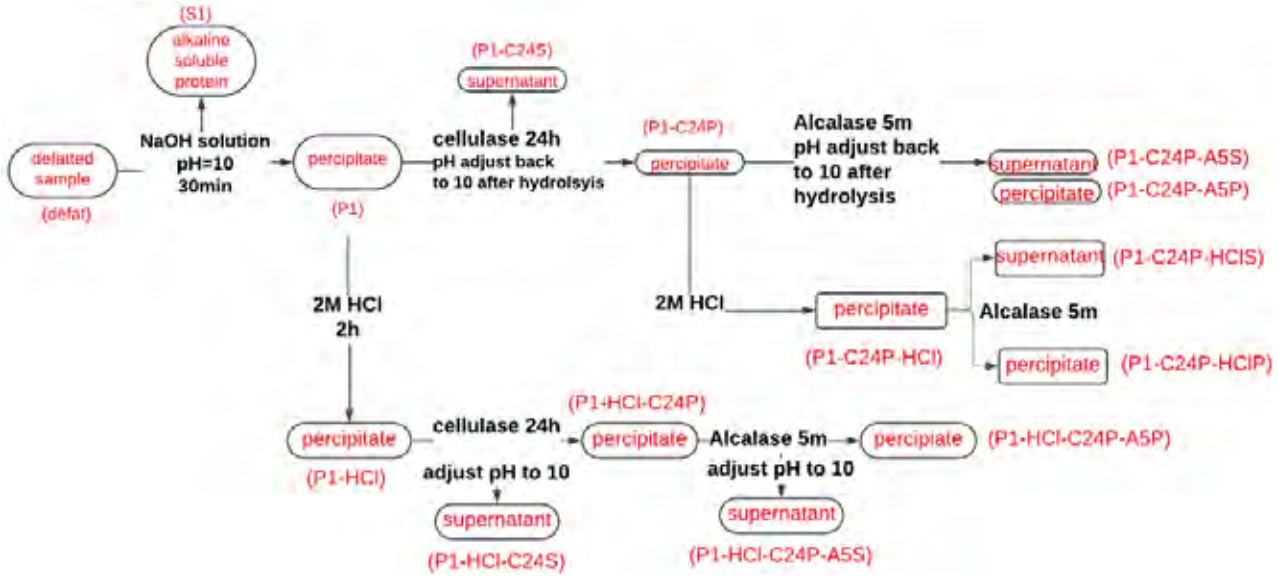


Figure 2. Preparation of hydrolysates from residues of BSFL protein extraction

To investigate the effect of HCl treatment, two different sequences of treatments were studied: 1) cellulase followed by HCl treatment; 2) HCl followed by cellulase treatment.

Following the removal of solubilized proteins, Alcalase protease was applied under optimal conditions (pH 8.5, 55°C, 5% w/w) for 5 minutes to solubilize cross-linked proteins in the precipitate. Preliminary experiments showed that cellulase hydrolysis requires a longer time to release the soluble portion of the precipitate, while the duration of Alcalase hydrolysis did not significantly affect the outcome. Thus, the cellulase hydrolysis time was extended to 24 hours, and the Alcalase hydrolysis time was shortened to 5 minutes.

After all treatments were completed, the samples were centrifuged to separate the supernatant and precipitate, which were then freeze-dried for further analysis.

Compositional profile analyses: For all samples generated, protein content is determined by bicinchoninic acid assay, peptide molecular size is quantified by HPLC. Mineral composition is being analyzed by ICP-OES, and the total carbohydrate is analyzed by phenol sulfuric assay which are all the established methods used in PI's laboratory. All the compositional analyses are on-going.

The protein content in the table is lower than expected due to the limited solubility of these samples in alkaline solution. To obtain more reliable data, a modified method will have to be developed for reanalysis. However, the current data still indicate clear trends. Although treatment with cellulase alone did not reduce the carbohydrate content in the protein extract, subsequent treatment with Alcalase released a significant amount of the soluble fraction (16.7%). Meanwhile, HCl treatment significantly decreased the carbohydrate content and released more metal ions compared to both enzymatic treatments. So, the further studies will focus on how the sequence of HCl treatments impact the final yield of soluble fraction and its protein content.

Upon completion of the assays, mass balance of each component will be calculated to decide the effect of enzyme treatment on protein recovery, and which fraction will be the most suitable for further biofertilizer evaluation.

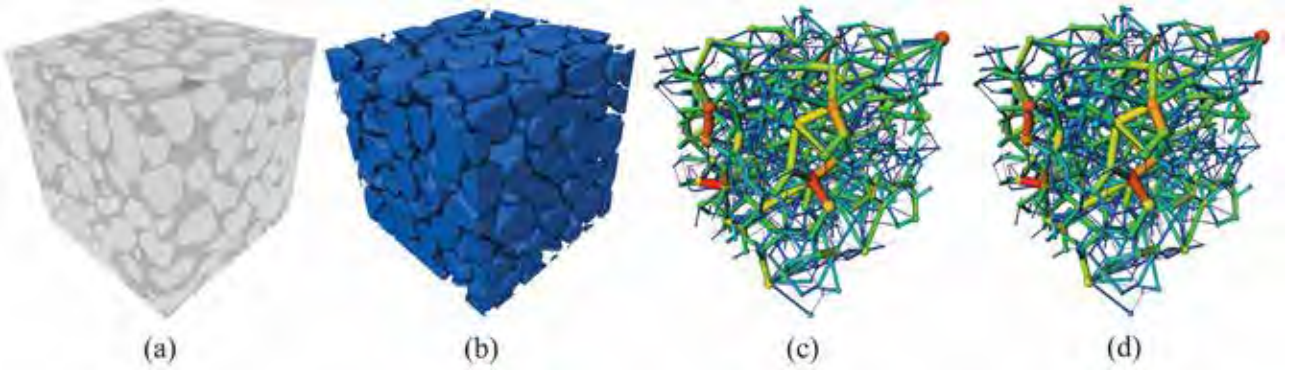
Peptides' antioxidation potential will be evaluated (quarter 4-5). Since the main mechanisms by which antioxidant peptides inhibit oxidation are through inactivation of reactive oxygen species, scavenging free radicals, and chelating prooxidative transition metals, methods of DPPH and ORAC, and Fe/Cu chelating will be used to screen these properties. This will not be conducted for this seed grant but will be covered in future work.

Summary of Findings, Future Directions, Team Building, and Proposal Submission Plan

A manuscript draft is expected in 2025 with proper ISSE acknowledgement. The highlights of this work are: 1) we successfully fractionated the BSFL into lipid and protein, and demonstrated that additional refining of oil is needed for its conversion to SAF; 2) the BSFL protein fractionation is proven to be very challenging compared to oilseed protein separation; the factors of larvae heating/drying on protein fractionation and additional treatments to maximize extraction of proteins to be used as feed are needed; 3) more extensive hydrolysis may be needed to produce easily utilizable biofertilizer. This seed grant and the data obtained will help better focus our USDA grant activities.

Pore Water Pressure Research, Khalid Alshibli, PI

The specific objective for the last year was to investigate the source of the onset of the gas phase within some of the saturated sand specimens by analyzing the experiments that isolated the influence of x-ray exposure on the development of the gas phase. In addition, the research team focused on analyzing the ACT experiments.



3D visualization of (a) greyscale image, (b) binarized solids, (c) extracted pore-network, and (d) filtered pore-network for the same Representative Element Volume (REV).

Analysis of ATC and acrylic tube experiments revealed the following:

1. X-ray exposure may result in the development of gas bubbles due to radiolysis of pore water, the breakdown of water to Hydrogen and Oxygen results in phase change from liquid to gas resulting in gas bubbles developing. The phase changes were dependent on the initial pore water pressure and duration of exposure to the x-ray, with individual gas bubble behavior being dependent on its surrounding sand grains and pore throat sizes leading to changes in the degree of saturation

2. Gas bubbles that develop due to X-ray exposure in saturated ATC experiments may alter the material behavior, invalidating the saturation assumption and possibly changing the constitutive behavior from saturated to unsaturated. Gas bubble development was observed at low pore water pressure of 30 kPa (PWP) in both continuous and intermittent exposures, with intermittent exposure causing significantly less reduction in the degree of saturation (S). Applying sufficiently high PWP of 300 kPa can eliminate the development of gas bubbles due to X-ray exposure in the case of intermittent exposure and significantly reduce gas bubble development in the case of continuous exposure.

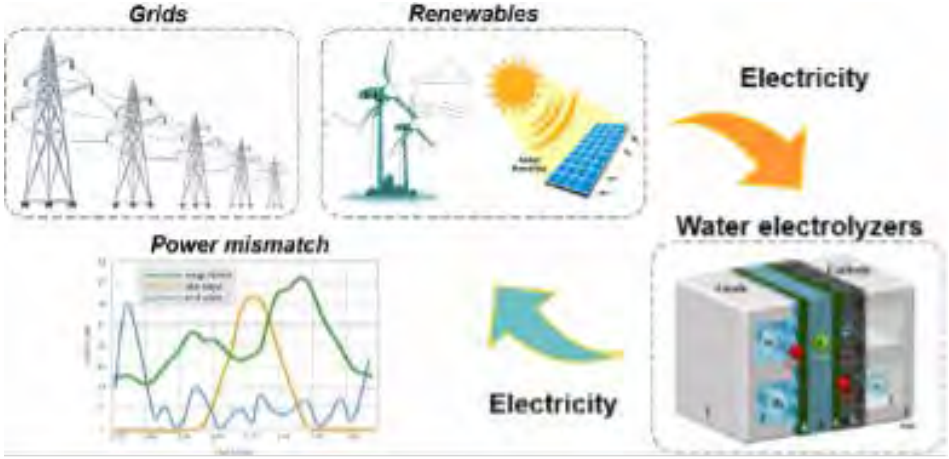
3. Saturated ATC specimens are typically assumed to exhibit no volumetric changes when they are sheared under undrained condition. The analysis of both high and low BP undrained experiments SMT scans revealed that the specimens undergoing volume changes under drained and undrained conditions. This was confirmed by indirect measurement of volume change through the measurement of the cell volume change while maintaining a constant cell pressure for typical laboratory-size specimens. Part of the measured volume change was attributed to the water phase, which was not expected, raising the question of the validity of the no volume change assumption even if the sheared specimen remained fully saturated.

4. The second component of the observed volume change was due to air, this component varied significantly between low and high BP experiments. Comparison between high and low BP experiments for both drained and undrained conditions indicated that low BP experiments exhibited a significant change in the degree of saturation, reaching about 13% change in some cases, while high BP experiments had a slight variation in the degree of saturation. Stress-strain relationships based on volumes from scans were recalculated resulting in a reduction in deviatoric stress estimates and the sand strength specifically for low BP experiments.

5. The high reduction in the S for low BP experiments was due to an increase in air volume within the specimen pore space. This reduction in S was beyond the air entry value obtained from soil water characteristic curves (SWCC) of representative elementary volumes (REVs), indicating that matric suction influences the strength of the soil, hence, the need to adopt the unsaturated soil mechanics principle. This is significant because most laboratory testing is conducted under high BP to achieve a high S, whereas, in many geotechnical problems, the zone of interest is typically near the surface where pore water pressure is low. This results in the triaxial testing being conducted under a continuous saturated state, while in the field, the soil could transition from a saturated to an unsaturated constitutive behavior.

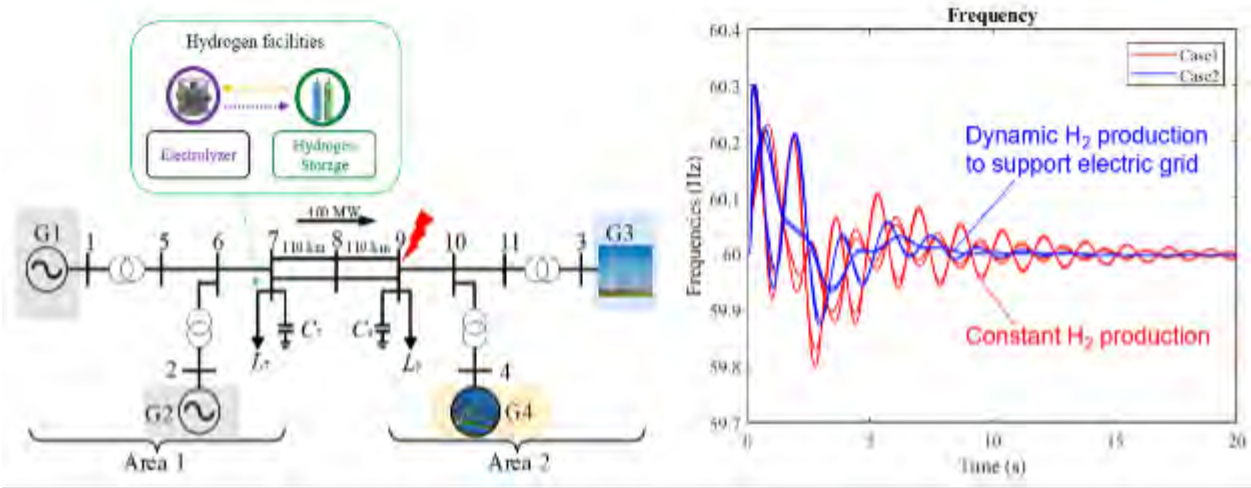
Assessing Implications of Large-Scale Hydrogen Production on Electric Grids, Kai Sun, PI

Supported by the ISSE Seed Grant, Prof. Kai Sun and Prof. Feng Yuan Zhang have collaborated to assess the implications of large-scale hydrogen production on electric grids. Prof. Zhang's team studied static and dynamic modeling of water electrolyzers, demonstrating that electrolyzer cells can respond to load changes within milliseconds. This makes hydrogen production more grid-friendly and responsive to the real-time conditions of the electric grid. Prof. Sun's team conducted numerical simulations to investigate the impact of large-scale integration of water electrolyzers on the reliability and stability of electric grids, and developed efficient multi-timescale simulation methods for future grids that integrate renewable and clean energy sources.



left: Water electrolysis-based hydrogen production to support electric grids with renewables

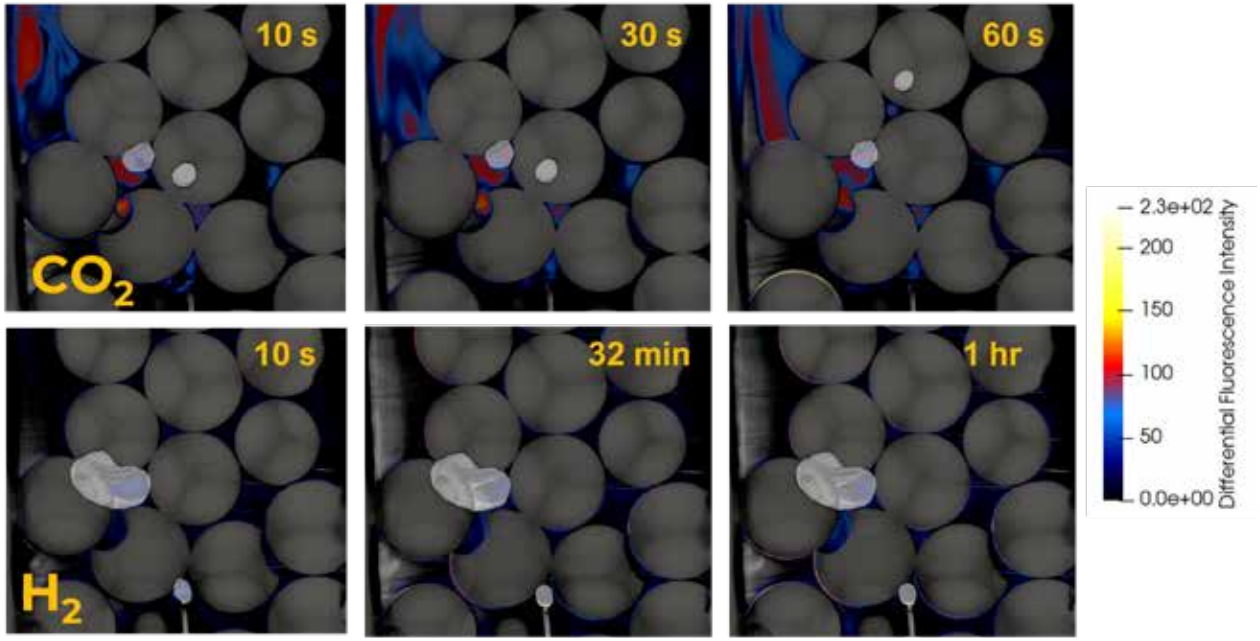
right: Simulation study of the impacts of water electrolyzers on grid reliability and stability



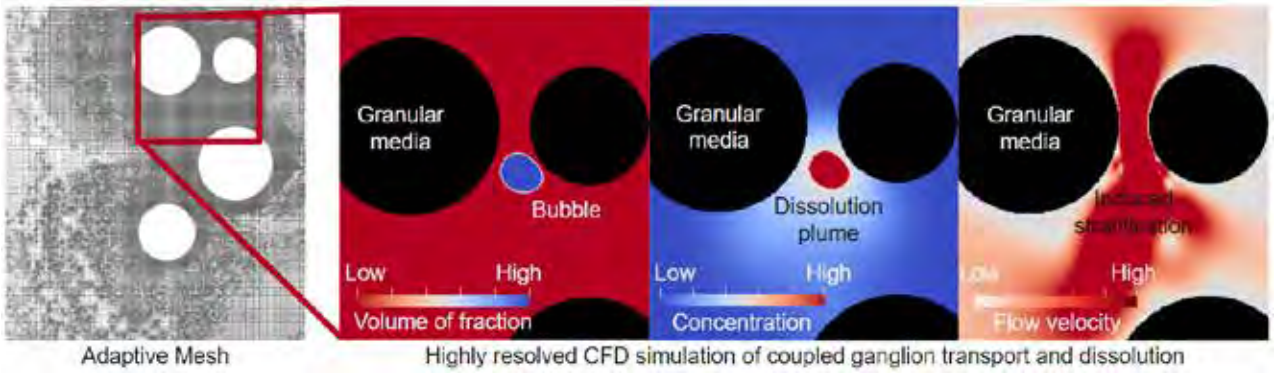
Coupled Mass Transfer Processes During Underground Hydrogen Storage Supported by UTK's ISSE and GE2 Seed Grant, Anna Herring and Haochen Li, PIs

Primary Outcomes

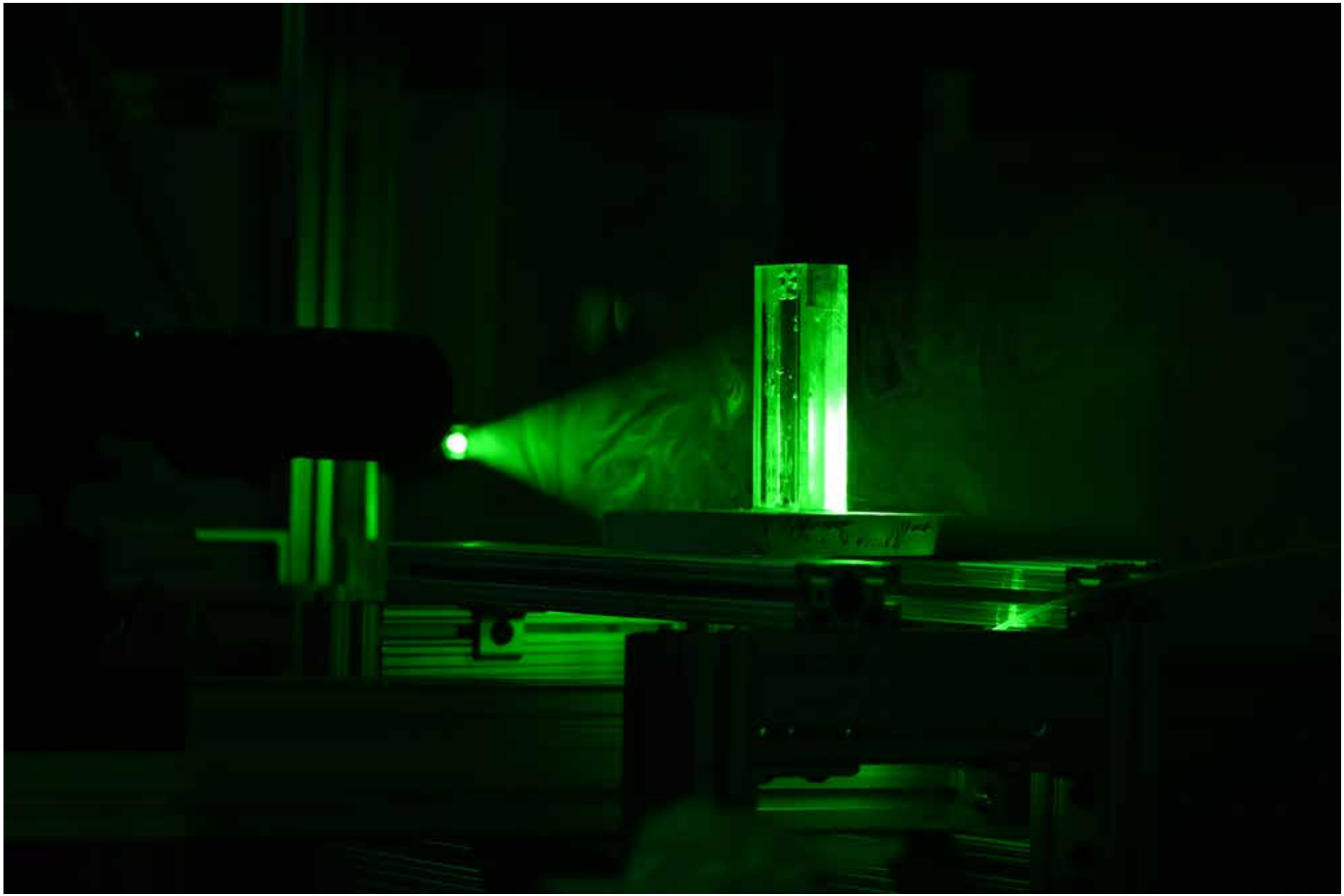
- Safety plans for working with carbon dioxide (CO2) and hydrogen (H2) gasses have been established, approved by UTK EHS, and implemented in SERF 702C and ASB Lab.
- Determination of appropriate laser-fluorescent pH indicator (7 × 10–5 mol/L 5-(and-6)-Carboxy SNARF™-1), laser calibration parameters, and experimental protocols.
- Preliminary images of CO2 and H2 gasses in porous media demonstrate ability to dynamically monitor gas dissolution, pH evolution near gas bubbles, and density-driven convection (Figure 1).
- Formulation and development of computational fluid dynamics (CFD) model for bubble dissolution and trans- port simulation.
- The project supported PhD student Joe-Sam Nkuah during the 2023-2024 academic year. Nkuah is preparing a manuscript in preparation as first author (section 3) and also a presented a poster at the prestigious Gordon Research Conference on Flow and Transport in Permeable Media (section 4).



Preliminary data showing the relative stability of H2 ganglia compared to CO2 ganglia in the same packing. Ganglia locations are artificially highlighted for clarity. Although dissolution of H2 is expected to have a very subtle impact to solution pH, the tested PLIF technique shows measurable changes in pore spaces adjacent to the H2 ganglia at long times.



High-fidelity CFD simulations of CO2 ganglia dissolving into water. The adaptive mesh refinement (left panel) enables CFD simulation of pore scale dynamics at very high resolution within a large simulation domain. Our experiments and simulations determine isolated and combined rates of transport, quantitatively linked to mass transfer through the interfaces, and to shrinking ganglion stability.



The laser illuminates the sample prior to bubble injection.

Training & Education

Tennessee Water Resources Research Center Overview of Technical Assistance and Training Projects

During the reporting period, TNWRRC was involved in four technical assistance and training projects for rural water and wastewater systems. All projects are listed below with information on geographic scope, project timeline, funding source, and TNWRRC project staff as well as a summary of activities for each project.

- Appalachian Community Technical Assistance and Training (ACTAT) Program, CY2022-23 Extension
- Appalachian Community Technical Assistance and Training (ACTAT) Program, CY2023-24
- Technical Assistance for Rural and Small Wastewater Systems in Tennessee
- Workforce Opportunities for Rural Communities

Two additional projects were funded during the reporting period and are scheduled to begin October 1, 2024. These projects are:

- Appalachian Community Technical Assistance and Training (ACTAT) Program, CY2024-25: funded by the United States Department of Agriculture, Rural Utilities Service, through West Virginia University

- Hydraulic Modeling for Small Water Distribution Systems in the United States: funded by the United States Environmental Protection Agency, through Southwest Environmental Finance Center

Appalachian Community Technical Assistance and Training (ACTAT) Program, CY2022-23 Extension

- Geographic Scope: Appalachian counties in Tennessee
- Project Timeline: October 2022 – September 2023; extension through January 2024
- TNWRRC Project Staff: John Schwartz, Steven Hoagland
- Funding Source: United States Department of Agriculture, Rural Utilities Service, through West Virginia University
- Project Overview: TNWRRC has partnered with West Virginia University (lead) and the Kentucky Water Research Institute to provide free technical assistance and training to rural water and wastewater systems in Appalachian counties, with TNWRRC focusing on TN counties. TNWRRC reviews assistance needs for small systems, implements a water workforce survey, develops an asset management training module, conducts a regional workshop, provides individual technical assistance for at least two utilities, and coordinates with state agencies and other technical assistance providers.

Training

Virtual Workshop, April 23, 2024: Fundamentals of Asset Management for Water and Wastewater Systems (3 CEUs). There were 71 attendees for both morning and afternoon sessions.

Technical Assistance

TNWRRC provided technical assistance for two small systems in East TN:

- Newport Utilities, Cocke County, TN: TNWRRC developed a unit cost calculator for wastewater treatment in Microsoft Excel based on a WWTP operator request
- Town of Cumberland Gap, TN: TNWRRC developed a hydraulic model for the water distribution system of Cumberland Gap using EPANET, a free hydraulic modeling software

Other Tasks:

- TNWRRC partnered with TDEC's Fleming Training Center to implement the TN Water Workforce Survey, which solicited feedback from utility operators and managers regarding workforce-related challenges. The survey was open for seven weeks from April 1, 2024, through May 20, 2024. Almost eight hundred (800) survey responses were received from operators and utility managers across the state.

Appalachian Community Technical Assistance and Training (ACTAT) Program, CY2023-24

- Geographic Scope: Appalachian counties in Tennessee
- Project Timeline: February 2024 – January 2025
- TNWRRC Project Staff: John Schwartz, Steven Hoagland, Celia Jackson (GRA), Katherine Ermer (Intern), Jackson Reeves (Intern)
- Funding Source: United States Department of Agriculture, Rural Utilities Service, through West Virginia University
- Project Overview: Same as CY2022-23 Extension.

Training

TNWRRC is currently developing the GIS training module; once completed, a virtual workshop will be conducted in January 2025.

Technical Assistance

TNWRRC is currently providing technical assistance to the following systems:

- Old Knoxville Highway Utility District (Greene County, TN) – TNWRRC has developed a digital map of the water system and is also working on developing an asset management plan and a preliminary hydraulic model

- Newport Utilities (Cocke County, TN) – TNWRRC has synthesized a year's worth of customer meter data for comparison to an existing hydraulic model scenario; TNWRRC will discuss updates to the model demands with utility staff
- Holiday Out RV Park (Cumberland County, TN) – TNWRRC assisted utility manager with analyzing and extracting flow data metrics for a flow sampler application

Ongoing Work

TNWRRC will present preliminary results from the TN Water Workforce Survey at the Universities Council on Water Resources Conference in St. Louis, MO, on October 2, 2024. TNWRRC is also working on a final report, which will include all findings from the survey. This report will be posted on the TNWRRC website.

Technical Assistance for Rural and Small Wastewater Systems in Tennessee

- Geographic Scope: Tennessee
- Project Timeline: October 2023 – September 2026
- TNWRRC Project Staff: John Schwartz, Steven Hoagland
- Funding Source: United States Environmental Protection Agency
- Project Overview: TNWRRC has partnered with University of Tennessee Institute of Agriculture (UTIA), Tennessee Tech University (TTU), and the University of Memphis (UofM) to provide free technical assistance and training to rural wastewater systems in TN. This project is aimed at helping small systems become eligible for SRF funding by assisting them with asset management plan development and financial planning. As part of the project, the team will meet regulators to identify system needs, conduct regional trainings, visit wastewater systems to meet with utility staff, and assist with asset management plan development.

Training

TNWRRC and UTIA staff have prepared two training modules for workshops that will commence this fall, one on asset management and one on financial sufficiency. Both workshops will be presented in West, Middle, and East TN for a total of 6 workshops this fall. TNWRRC and UTIA has received approval from Fleming Training Center for continuing education hours for operators who attend the trainings.

Technical Assistance

Site visits have been conducted for three (3) systems in East TN, two (2) systems in Middle TN, and three (3) systems in West TN. Needs in these communities have been identified and documented. TNWRRC staff are developing an asset management plan template to help small systems get started with this process.

Ongoing Work

TNWRRC and UTIA staff will conduct the first round of trainings this fall. The project team will continue to meet with representatives of the state regulatory agency to identify systems that may need our assistance and will continue to conduct regular site visits to wastewater systems across the state.

Workforce Opportunities for Rural Communities

- Geographic Scope: Greene County, TN, and Cocke County, TN
- Project Timeline: October 2023 – September 2026
- TNWRRC Project Staff: John Schwartz, Steven Hoagland
- Funding Source: United States Department of Labor, through West Virginia University
- Project Overview: TNWRRC has partnered with West Virginia University (lead), the Kentucky Water Research Institute, and Virginia Tech to provide opportunities for new water workforce entrants in rural Appalachian communities. TNWRRC will help small water systems establish a paid summer internship program for high school and post-secondary students and use program funds to cover the cost of intern hourly wages and personal protective equipment. In addition to gaining experience in the water industry, interns will receive on-the-job mentorship from utility staff and weekly training from university partners.

Training

Virtual Workshop, July 29, 2024: Fundamentals of Asset Management for Water and Wastewater Systems; part of 10-week training series offered by university partners for interns.

Technical Assistance

TNWRRC assisted utility staff with setting up and coordinating the summer internship program, including reaching out to high schools for student recruitment, collecting applications, and conducting weekly virtual trainings.

Ongoing Work

TNWRRC continues to work with utility staff to collect feedback on the internship program and to ensure utility invoices are paid. Planning for the next round of summer internships will commence during the winter months. TNWRRC are also planning to coordinate with the Tennessee Association of Utility Districts (TAUD) on a potential partnership between the internship program and TAUD's pre-apprenticeship program; planning for this potential partnership will commence in the winter months.

GI4SUrE Research Experience for Undergraduates Program

Summer 2024 was the last funded year of the GI4SUrE REU program. We had 10 undergraduate students from 10 universities around the country who took part in the program.. Students participated in training sessions to bolster their understanding of research and graduate school, conducted their own research, and attended a number of cohort-building events at several off campus venues.

Outreach & Collaboration

East Tennessee Clean Fuels Outreach, Jonathan Overly

From October 1, 2023, through September 30, 2024, East Tennessee Clean Fuels Coalition hosted 16 Outreach Events across Tennessee:

October 2023

Tri-Cities National Drive Electric Week 2023, Kingsport TN
IEEE Energy Conversion Congress and Expo, Nashville TN

December 2023

Tennessee Smart Mobility Conference, Nashville TN

February 2024

Northwest Tennessee EV Day, Martin TN

March 2024

Connecting Kingsport EVSE Workshop, Kingsport TN

April 2024

TeamTN Ride & Drive, Knoxville TN
Blount County EV Day, Alcoa TN
Drive Electric Appalachian Highlands Earth Day, Kingsport TN
Y-12 Earth Day Event, Oak Ridge TN
ORNL Earth Day Event, Oak Ridge TN
Dogwood Arts Festival, Knoxville TN

May 2024

Drive Electric Tennessee Momentum Summit, Murfreesboro TN

June 2024

Tennessee Association of Pupil Transportation (TAPT), Pigeon Forge TN

July 2024

EVs in the Smokies, Townsend TN

August 2024

Micromobility Open House, Knoxville TN

September 2024

EV Ride & Drive presented by CO.LAB for NDEW, Chattanooga TN

2023-24 Appalachian Leadership Fellows

Appalachian Leadership Institute

Last July the UT-led ALI team, in partnership with the Appalachian Regional Commission (ARC), graduated our fifth class of Appalachian Leadership fellows. The 40 fellows come from 13 Appalachian states and, over the course of seven sessions, explore topics related to economic growth, workforce development, natural resources, tourism, and infrastructure. This October, our team will welcome our sixth class of ALI fellows to a kickoff session in Knoxville.

Our team also helped host two ALI alumni sessions this year, which focused on housing, funding, and capacity building. After five years we now have a network of almost 200 alumni across the 13 state region. We are working with the ARC and alumni representatives to create a vision for this group to help transform the Appalachian Region.

We also welcomed our new ALI student fellow, Maggie Lingle. Maggie is a second-year MPA student from Signal Mountain, Tennessee with a strong interest in sustainable economic and community development.

Publications, Presentations, Awards & Recognition

Publications

Amirrahmat, S. and Alshibli, K. A. (2024) "Subgraph centrality: A complex network metric to characterize the contact network between sheared sand particles", Computers and Geotechnics, Vol. 169, Article: 10621, May 2024, https://doi.org/10.1016/j.compgeo.2024.106211

Cai, J.; Chen, J.; Hu, Y.; Li, S.; He, Q. 2023. Digital twin for healthy indoor environment: A vision for the post-pandemic era. Front. Eng. Manag. 10: 300-318. DOI: 10.1007/s42524-022-0244-y

Cai, J.; Li, S.; Hu, D.; Xu, Y.; He, Q. 2022. Nationwide assessment of energy costs and policies to limit airborne infection risks in U.S. schools. J. Buid. Eng. 45: 103533. DOI: 10.1016/j.jobe.2021.103533

Cao, L.; Cox, C.D.; He, Q. 2021. Patterns of syntrophic interactions in methanogenic conversion of propionate. Appl. Microbiol. Biotechnol. 105(23): 8937-8949. DOI: 10.1007/s00253-021-11645-9

Chen, C-F., Feng, J., Luke, N., Kuo, C-P, & Fu, J.S. (2022). Localized energy burdens and concentrated disadvantage and the feminization of energy poverty. iScience, 25, 104139.

Chen, C.-F., Dietz, T., Fefferman, N., Greig, J., Cetin, K., Robinson, C., Arpan, L., Schweiker, M., Dong, B., Wu, W., Li, Y., Zhou, H., Wu, J., Wen, J., Fu, J., Hong, T., Yan, D., Nelson, H., Zhu, Y., Li., X., Xie, L., & Fu, R. (2022). Extreme events, energy security and equality through micro and macro levels: Concepts, challenges and methods. Energy Research and Social Science, 85, 102401.

Chen, C.-F., Greig, J., Nelson, H., & Li, F. (2022). When disadvantage collides: The concentrated effects on energy insecurity and internet burdens in the U.S. Energy Research and Social Science, 91, 102713.

Chen, C.-F., Liu, Y., Greig, J., Shen, Z., & Shi, Y. (2022). The impacts of COVID-19 on clean energy labor markets: Evidence from multifaceted analysis of public health interventions and COVID-health factors. Energy Policy, 164, 112880.

Chen, C.-F., Xu, X., Cao, Z. Mockus, A., & Shi, Q. (2023). Analysis of Social-psychological Factors and Financial Incentives in Demand Response and Residential Energy Behavior. Frontiers in Energy Research, 11, 932134.

Chen, C.-F., Xu., X., Adua, L., Briggs, M. Nelson, H. (2022). Exploring the interconnected factors that influence energy use intensity across low-, middle-, and high-income households in the United States. Energy Policy, 168, 113071.

Chen, S.; Wang, Y.; Cheng, H.; Hazen, T.C.; He, C.; He, Q. 2022. Identification of propionate-degrading microbial populations in methanogenic processes for waste treatment: Methanosaeta and Methanoculleus. Environ. Eng. Sci. 39(3): 202-211. DOI: 10.1089/ees.2021.0067

Cianciolo, Charles. "Response of Urban Stream Microbial Community to Storm Events and Urbanization," in preparation.

Courtney, S., Hyman, A.A., McNeal, K.S., Maudlin, L.C., Armsworth, P.R. 2022. Development of a survey instrument to assess individual and organizational use of climate adaptation science. Environmental Science and Policy, 137, 271-279.

D. Vance, M. Jin*, C. Price, S. U. Nimbalkar, and T. Wenning. "Smart manufacturing maturity models and their applicability: a review." Journal of Manufacturing Technology Management ahead-of-print, 2023

D. Vance, M. Jin*, C. Price, S. U. Nimbalkar, and T. Wenning. "Smart manufacturing maturity models and their applicability: a review." Journal of Manufacturing Technology Management ahead-of-print, 2023,

D. Zhang, B. Chen, K. Hubacek, J. Meng, M. Sun, J. Mao, M. Jin et al. "Potential impacts of Fukushima nuclear wastewater discharge on nutrient supply and greenhouse gas emissions of food systems." Resources, Conservation and Recycling 193, 2023.

D. Zhang, B. Chen, K. Hubacek, J. Meng, M. Sun, J. Mao, M. Jin et al. "Potential impacts of Fukushima nuclear wastewater discharge on nutrient supply and greenhouse gas emissions of food systems." Resources, Conservation and Recycling 193, 2023.

Dong, W., M. Jin*, P. Kelle, and Y. Wang, "Retrieval Scheduling in Crane-based 3D Automated Retrieval and Storage Systems with Shuttles," Accepted by Annals of Operations Research, 2021.

Ellis, K. N., J. M. First, K. W. Kintziger, and E. K. Hunter. Overnight heat in sleep spaces of housed and unhoused residents: Results and recommendations from a Knoxville, Tennessee, case study. International Journal of Biometeorology, in review.

Fengxian Chen, Bin Zhou, Liqiong Yang, Xijuan Chen,* Jie Zhuang. 2023. Predicting bacterial transport through saturated porous media using an automated machine learning model. Frontiers in Microbiology, 14, 1152059. doi: 10.3389/fmicb.2023.1152059

First, JM, Lee, S., Norris, E., Kintziger, K., Ellis, K. Building community capacity to respond to extreme heat in Knoxville, Tennessee. Journal of Community Practice, in review

Griffin, C., J. Hale, and M. Jin*, "Framework for Assessing Investment Costs of Additive Manufacturing," Accepted by Progress in Additive Manufacturing, 2022.

H. Sun, Y. Sun, M. Jin, S.A. Ripp, G.S. Sayler, and J. Zhuang*, "Domestic plant food loss and waste in the United States: Environmental footprints and mitigation strategies. Waste Management, 150, pp.202-207, 2022.

Harik, A.-M., Z. Griffiths, and T. C. Hazen. 2022. Omics of Oil Biodegradation. Current Opinion in Chemical Engineering 36:100800. https://doi.org/10.1016/j.coche.2022.100800 (5.163, 0).

Hathaway, J.M., E.Z. Bean, J. Bernagros, D. Christian, H. Davani, A. Ebrahimian, C. Fairbaugh, J. Gulliver, L. McPhillips, G. Palino, E. Strecker, R.A. Tirpak, B. van Duin, N. Weinstein, and R.J, Winston (accepted). "A synthesis of climate change impacts on stormwater control measures in the U.S.: Designing for resiliency and future challenges." Journal of Sustainable Water in the Built Environment.

Hinenoya, A.; Wang H.; Patrick, E.M.; Zeng, X; Cao, L.; Li, X.-P.; Lindsey, R.L.; Gillespie, B.; He, Q.; Yamasaki, S.; Lin, J. 2022. Longitudinal surveillance and comparative characterization of Escherichia albertii in wild raccoons in the United States. Microbiol. Res. 262: 127109. DOI: 10.1016/j.micres.2022.127109

Horan, Matthew F.; Fulden Batibeniz; Fred Kucharski; Mansour Almazroui; Muhammad Adnan Abid; Joshua S. Fu & Moetasim Ashfaq (2023) Moisture sources for precipitation variability over the Arabian Peninsula. Climate Dynamics. DOI:10.1007/s00382-023-06762-2 [PDF]

Huang, Ruqi; Xinyi Dong; Manqiu Cheng; Yaman Liu; Xuexu Wu; Yuan Liang; Minghuai Wang; Joshua S. Fu & Matthew Tipton (2023) A Plant Species Dependent Wildfire Black Carbon Emission Inventory in Northern Eurasia. Geophysical Research Letters. DOI:10.1029/2023GL104184 [PDF]

J. Hu and M. Jin*, "Minimizing Total Tardiness for the Single-machine Identical-job Order Scheduling Problem with a Learning Effect," Accepted by Mathematical Programming Computation, 2024.

J. Zhang, A. Herring, and H. Li, "CFD Simulations of Coupled Bubble Dissolution and Transport in Porous Media", in prep. (anticipated submission: Jan. 2025)

J.-S. Nkuah, H. Li, and A. Herring, "Observations of Dynamic Multiphase Mass Transfer via Planar Laser Induced Fluorescence", in prep for submission to Phys. Rev. Lett. (anticipated submission: Dec. 2024)

Jie Zhuang,* Tom Gill, Frank Löffler, Mingzhou Jin, Gary S. Sayler. 2023. Can food-energy-water nexus research keep pace with agricultural innovation? Engineering, 23, 24-28. doi: 10.1016/j.eng.2022.08.014

K. Zhang, X. Li*, M. Jin, "Efficient Solution Methods for A General R-Interdiction Median Problem with Fortification," INFORM Journal on Computing, 34(2), pp.1272-1290. 2022.

Kuo, C.-P. & Joshua S Fu (2023). Ozone response modeling to NOx and VOC emissions: Examining machine learning models. Environment International. DOI:10.1016/j.envint.2023.107969 [PDF]

L. Feng, G. Chen, S. Zhou, X. Zhou, X., and M. Jin, "An Energy-Efficient Unrelated Parallel Machine Scheduling Problem with Batch Processing and Time-of-Use Electricity Prices. Mathematics, 12(3), p.376. 2024.

L. Feng, G. Chen, S. Zhou, X. Zhou, X., and M. Jin, "An Energy-Efficient Unrelated Parallel Machine Scheduling Problem with Batch Processing and Time-of-Use Electricity Prices. Mathematics, 12(3), p.376. 2024.

Li, J., T.B. Culver, P.P. Persaud, J.M. Hathaway. (2023). "Developing nitrogen removal models for stormwater bioretenton systems." Water Research. 243(120381).

Li, J.X., Chen, C-F., Walzem, A., Nelson, H., Shuai, C.M. (2022). National goals or sense of community: Exploring social-psychological influence of household solar energy adoption in rural China. Energy Research & Social Science, 89, 102669.

Li, L.; Zhou, L.; Jiang, C.; Liu, Z.; Meng, D.; Luo, F.; He, Q.; Yin, H. 2023. AI-driven pan-proteome analyses reveal insights into the biohydrometallurgical properties of Acidithiobacillia. Front. Microbiol. 14:1243987. DOI: 10.3389/fmicb.2023.1243987

Liu, N., Xie, F., Lin, Z., & Jin, M. (n.d.). Empirical Estimation of Shortest Route Length along U.S. Interstate Highways Based on Great Circle Distance. Transportation Research Record: Journal of the Transportation Research Board, 036119812110152. doi:10.1177/03611981211015251

M. Dai, M. Sun, B. Chen, L. Shi, M. Jin, Y. Man, Z. Liang, C.M.V.B.D. Almeida, J. Li, P. Zhang, A.S. Chiu, A.S., M. Xu, H. Yu, J. Meng and Y. Wang*, "Country-specific net-zero strategies of the pulp and paper industry," Nature, pp.1-3. 2023

M. Dai, M. Sun, B. Chen, L. Shi, M. Jin, Y. Man, Z. Liang, C.M.V.B.D. Almeida, J. Li, P. Zhang, A.S. Chiu, A.S., M. Xu, H. Yu, J. Meng and Y. Wang*, "Country-specific net-zero strategies of the pulp and paper industry," Nature, pp.1-3. 2023

M. Erkoc, H. Gurnani*, S. Ray, and M. Jin, "Quality Investment, Inspection Policy and Pricing Decisions in a Decentralized Supply Chain," Production and Operations Management, 32 (1), 2023.

Mahalder, B., J.S. Schwartz, A.M. Palomino, and J. Zirkle. 2024. Influence of cumulative effective stream power on scour depth prediction around bridge piers in cohesive material. Transportation Research Board 1-14. doi 10.1177/03611981241230514.

Meng, J.; Huang, J.; Oueslati, R.; Jiang, Y.; Li. S.; Chen, J.; Dai, S.; He, Q.; Wu, J. 2021. A single-step DNAzyme sensor for ultra-sensitive and rapid detection of Pb2+ ions. Electrochim. Acta 368: 137551.DOI: 10.1016/j.electacta.2020.137551

Micah A. Wyssmann, M.A., J.G. Coder, J.S. Schwartz, and A.N. Papanicolaou. 2024. Atypical turbulent junction flow characteristics upstream of boulders mounted atop a rough, permeable bed and the effects of submergence. Experiments in Fluids.65(9). doi 10.1007/s00348-023-03748-y

N Amin, J Chen, Q He, JS Schwartz, JJ Wu, "Ultra-sensitive and rapid detection of perfluorooctanesulfonic acid by a capacitive molecularly-imprinted-polymer sensor integrated with AC electrokinetic acceleration," Sensors and Actuators B, Vol 420, 136464, 2024.

Paradis, C. J., J. I. Miller, J.-W. Moon, S. J. Spencer, L. M. Lui, J. D. Van Nostrand, D. Ning, A. D. Steen, L. D. McKay, A. P. Arkin, J. Zhou, E. J. Alm, and T. C. Hazen. 2022. Sustained ability of a natural microbial community to remove nitrate from groundwater. Groundwater 60:99-111. doi:10.1111/gwat.13132. (2.671, 0)

Peng, M., D. Wang, L. M. Lui, T. Nielsen, R. Tian, M. L. Kempher, X. Tao, C. Pan, R. Chakraborty, A. M. Deutschbauer, M. Adams, M. W. Fields, T. C. Hazen, A. P. Arkin, A. Zhou, and J. Zhou. 2022. Genomic features and pervasive negative selection in Rhodanobacter strains isolated from nitrate and heavy metal contaminated aquifer. mSystems 10(1): e02591-2. https://doi.org/10.1128/spectrum.02591-21 (6.496, 0)

Persaud, P.P., J.M. Hathaway, B. Kerkez, D.T. McCarthy. (accepted). "Real-time control and bioretention: Implications for hydrology." Journal of Sustainable Water in the Built Environment.

Putt, A. D., E. R. Kelly, K. A. Lowe, M. Rodriquez Jr., and T. C. Hazen. 2022. Effects of Cone Penetrometer Testing on Shallow Hydrogeology at a Contaminated Site. Frontiers in Environmental Sciences 9: DOI:10.3389/fenvs.2021.821882. (4.581, 0)

Qian, L.; Yu, X.; Gu, H.; Liu, F.; Fan, Y.; Wang, C.; He, Q.; Tian, Y.; Peng, Y.; Shu, L.; Wang, S.; Huang, Z.; Yan, Q.; He, J.; Liu, G.; Tu, Q.; He, Z. 2023. Vertically stratified methane, nitrogen and sulphur cycling and coupling mechanisms in mangrove sediment microbiomes. Microbiome 11: 71. DOI: 10.1186/s40168-023-01501-5

Qian, L.; Yu, X.; Zhou, J.; Gu, H.; Ding, J.; Peng, Y.; He, Q.; Tian, Y.; Liu, J.; Wang, S.; Wang, C.; Shu, L.; Yan, Q.; Liu, G.; Tu, Q.; He, Z. 2022. MCycDB: a curated database for comprehensively profiling methane cycling processes of environmental microbiomes. Mol. Ecol. Resour. 22(5): 1803-1823. DOI: 10.1111/1755-0998.13589

Qixin, Tan; Baozhu Ge; Syuichi Itahashi; Lu Gan; Ying Zhang; Shuyan Xie; Ying Liu; Danhui Xu; et al. (2024). Unexpected high contribution of in-cloud wet scavenging to nitrogen deposition induced by pumping effect of typhoon landfall in China. Environmental Research Communications. DOI:10.1088/2515-7620/acb90b [PDF]

R. Li, M. Jin*, Z. Pei, and D. Wang, "Geometrical Defect Detection on Additive Manufacturing Parts with Curvature Feature and Machine Learning," The International Journal of Advanced Manufacturing Technology, 120(5), pp.3719-3729, 2022.

R. Tang, M. Jin*, J. Mao, D.M. Ricciuto, A. Chen, and Y. Zhang, Y., "TSECfire v1. 0: Quantifying Wildfire Drivers and Predictability in Boreal Peatlands Using a Two-Step Error-Correcting Machine Learning Framework," Geoscientific Model Development, 17 (4), 1525-1542, 2024.

R. Tang[1], M. Jin *, J. Mao, D.M. Ricciuto, A. Chen, and Y. Zhang, Y., "TSECfire v1. 0: Quantifying Wildfire Drivers and Predictability in Boreal Peatlands Using a Two-Step Error-Correcting Machine Learning Framework," Accepted by Geoscientific Model Development. 2024.

R. Zhou, Y. Wang, M. Jin*, J. Mao, and X. Zheng, "Coffee Supply Chain Planning under Climate Change," the Journal of Integrative Environmental Sciences, 19, 1-15, 2022.

Rimer, S.P., A. Mullapudi, S.C. Troutman, G. Ewing, B.D. Bowes, A.A. Akin, J. Sadler, R. Kertesz, B. McDonnell, L. Montestruque, J.M. Hathaway, J.L. Goodall, J. Norton, B. Kerkez. (2023). "A simulation sandbox for the development and evaluation of stormwater control algorithms." Environmental Modeling and Software. 162(105635).

Rubin, Hannah J.; Joshua S. Fu; Frank Dentener; Rui Li; Kan Huang & Hongbo Fu (2023) Global nitrogen and sulfur deposition mapping using a measurement-model fusion approach. Atmospheric Chemisty and Physics. DOI:10.5194/acp-23-7091-2023 [PDF]

S. Zhou, M. Jin*, C. Liu, X. Zheng, and H. Chen, Scheduling a single batch processing machine with non-identical two-dimensional job sizes. Expert Systems with Applications, 201, p.116907, 2022.

S. Zhou, Z. Jia, M. Jin*, and N. Du, Minimizing makespan on parallel batch processing machines with two-dimensional rectangular jobs. Computers & Industrial Engineering, 169, p.108167, 2022.

S. Rattanakunuprakarn , M. Jin*, M. Sussman, and P. Felix "Comparative Evaluation of Highways and Railroads Using Life-Cycle Benefit-Cost Analysis," Accepted by the International Journal of Sustainable Transportation, 2024.

S. Rezaei, A. Khojandi, A. Haque, C. Brakewood, M. Jin, and C. Cherry, "Performance Evaluation of Mode Choice Models Under Balanced and Imbalanced Data Assumptions," Accepted by Transportation letters, 2021.

S. Rezaei, A. Khojandi, A.M. Haque, C. Brakewood, M. Jin and C.R. Cherry, Park-and-ride facility location optimization: A case study for Nashville, Tennessee. Transportation Research Interdisciplinary Perspectives, 13, p.100578, 2022.

Saha, P., J.M. Hathaway, J.S. Schwartz, C.G. Wilson, B.K. Abban, and A.N. Papanicolaou. (accepted). "Climate change impacts on spatio-temporal soil water extremes in geophysically diverse watersheds: A comparison between east and west Tennessee." Journal of Hydrologic Engineering.

Scarbrough, K., P. Persaud, I. Fletcher, A.A. Akin, J.M. Hathaway, and A. Khojandi. (2023). "Real-time sensor-based prediction of soil moisture in green infrastructure: A case study." Environmental modeling and Software. 162(105638).

Scarbrough, K., Persaud, P., Akin, A.A., Hathaway, J.M., A. Khojandi. Real-Time Sensor-Based Prediction of Soil Moisture in Green Infrastructure: A Case Study (under second review at Environmental Modelling and Software).

Sharma, Reena, and Scott C. Lenaghan. "Duckweed: a potential phytosensor for heavy metals." Plant Cell Reports (2022): 1-13.

Shen, Z., Chen, C.-F., H., Zhou, Fefferman, N. & Shrestha, S. (2023). Community vulnerability is the key determinant of diverse energy burdens in the United States. Energy Research and Social Science, 97, 102949.

Simpson, I. M., and R. J. Winston. "Effects of land use on thermal enrichment of urban stormwater and potential mitigation of runoff temperature by watershed-scale stormwater control measures." Ecological Engineering, 184, 106792. 2022.

Simpson, I. M., J. S. Schwartz, J. M. Hathaway, and R. J. Winston. "Environmental regulations in the United States lead to improvements in untreated stormwater quality over four decades." Water Research, 243, 120386. 2023.

Simpson, I. M., R. J. Winston, and J. D. Dorsey. "Monitoring the effects of urban and forested land uses on runoff quality: Implications for improved stormwater management." Science of The Total Environment, 862, 160827. 2023.

Simpson, I.M., J.S. Schwartz, J.M. Hathaway, R.J. Winston. (2023). "Environmental regulations in the United States lead to improvements in untreated stormwater quality over four decades." Water Research. 243(120386).

Simpson, I.M., R.J. Winston, R.A. Tirpak, J.D. Dorsey, J.H. Stagge, and J.M. Hathaway. (2023). "Hydrologic responses in urban and forested watersheds and their relationship to existing and novel runoff models." Journal of Hydrology. 620(129430).

Sun, Zhixu; Jiani Tan; Fangting Wang; Rui Li; Xinxin Zhang; Jiaqiang Liao; Yangjun Wang; Ling Huang; Kun Zhang; Joshua S. Fu; L. Li (2024) Regional background ozone estimation for China through data fusion of observation and simulation Science of the Total Environment DOI:10.1016/j.scitotenv.2023.169411 [PDF]

Swanson, C.S.; Dhand, R.; Cao, L.; Ferris, J.; Elder, C.S.; He, Q. 2022. Microbiome-based source identification of microbial contamination in nebulizers used by inpatients. J. Hosp. Infect. 122: 157-161. DOI: 10.1016/j.jhin.2022.01.008

Swanson, C.S.; Dhand, R.; Cao, L.; Ferris, J.; Elder, C.S.; He, Q. 2023. Microbiome-scale analysis of aerosol facemask contamination during nebulization therapy in hospital. J. Hosp. Infect. 134: 80-88. DOI: 10.1016/j.jhin.2023.01.008

Swanson, C.S.; Williams, J.M.; He, Q. 2023. Risks of exposure to microbial contamination in eye-wash stations. Am. J. Infect. Control 51: 838-840. DOI: 10.1016/j.ajic.2022.11.009

T. Cokyasar and M. Jin*, "Additive Manufacturing Capacity Allocation Problem over a Network," IISE Transactions, 55(8), 807-820, 2023.

T. Cokyasar and M. Jin*, "Additive Manufacturing Capacity Allocation Problem over a Network," IISE Transactions, 55(8), 807-820, 2023.

Tipton, Matthew; Terry L Lathem; Joshua S Fu; Michael F Tschantz (2023). Corrigendum: Effectiveness of emissions standards on automotive evaporative emissions in Europe under normal and extreme temperature conditions. Environmental Research Communications (2022 Environ. Res. Commun. 4. 081003). DOI:10.1088/2515-7620/acb6d6 [PDF]

Vlassis, N., Sun, W-C, Alshibli, K., and Regueiro, R. (2024). "Synthesizing realistic sand assemblies with denoising diffusion in latent space", International Journal for Numerical and Analytical Methods in Geomechanics, August 14, 2024, https://doi.org/10.1002/nag.3818

W. Dong and M. Jin*, "Automated Storage and Retrieval System Design with Variant Lane Depths," European Journal of Operational Research, 314(2), pp.630-646. 2024.

W. Dong and M. Jin*, "Automated Storage and Retrieval System Design with Variant Lane Depths," European Journal of Operational Research, 314(2), pp.630-646. 2024.

W. Dong, K. Armstrong, M. Jin*, S. Nimbalkar, W. Guo, J. Zhuang and J. Cresko, A framework to quantify mass flow and assess food loss and waste in the US food supply chain. Communications Earth & Environment, 3(1), pp.1-11, 2022.

W. Li, M. Jin, and M.R. Galbreth*, "Should original equipment manufacturers authorize third-party remanufacturers? European Journal of Operational Research, 314(3), pp.1013-1028. 2024.

W. Li, M. Jin, and M.R. Galbreth*, "Should original equipment manufacturers authorize third-party remanufacturers?. European Journal of Operational Research, 314(3), pp.1013-1028. 2024.

Wang, Weitian, Lei Ding, Jun Li, Zhiqiang Xie, Matthew M. Mench, and Feng-Yuan Zhang. "An ink-free integrated dual electrode assembly for economical proton electrolyzer membrane water electrolysis at ultrahigh current densities." Chemical Engineering Journal (2024): 153015.

Wang, Y., Chen, C.-F., Kong, P.-Y., Li, H.S. & Wen, Q.-S. (2022). A Cyber-physical-social perspective on future smart distribution systems. Proceedings of the IEEE, 1-31.

Wang, Y., Mao, J., Hoffman, F. M., Bonfils, C. J. W., Douville, H., Jin, M., Thornton, P. E., Ricciuto, D. M., Shi, X., Chen, H., Wullschleger, S. D., Piao, S., and Dai, Y.: Quantification of human contribution to soil moisture–based terrestrial aridity, Nat. Commun., n.a., Accepted.

Weathers, M.W., J.M. Hathaway, R.A. Tirpak, and A. Khojandi. (2023). "Evaluating the Impact of Climate Change on Future Bioretention Performance Across the Contiguous United States." Journal of Hydrology. DOI: 10.1016/j.jhydrol.2022.128771

Weipeng Liu, Liqiong Yang,* Xijuan Chen, Steven A. Ripp, Mark A. Radosevich, Jie Zhuang.* 2023. Depth-specific transport of bacteriophages MS2 and X174 in intact soils. Soil & Tillage Research, 228, 105650. doi: 10.1016/j.still.2023.105650

Weitian Wang, Zhiqiang Xie, Lei Ding, Jun Li, and Fen-Yuan Zhang. "Innovative Design and Manufacturing of a Reaction-Enhanced Liquid/Gas Diffusion Layer with Boosted Catalyst Utilization for Green Hydrogen Production", Applied Energy, 2024. (In Press)

Whaley, Cynthia H; Kathy S Law; Jens Liengaard Hjorth; Henrik Skov; Stephen R Arnold; et al. (2023). Arctic tropospheric ozone: assessment of current knowledge and model performance. Atmospheric Chemistry and Physics, 23, 637-661. https://acp.copernicus.org/articles/23/637/2023/ [PDF]

Wood-Ponce, R., G. Diab, Z. Liu, R, Blanchette, A. Khojandi, and J.M. Hathaway. (accepted). "Developing Data-Driven Learning Models to Predict Urban Stormwater: A Case Study." Urban Water Journal.

Wu, B.; Guan, X.; Deng, T.; Yang, X.; Li, J.; Zhou, M.; Wang, C.; Wang, S.; Yan, Q.; Shu, L.; He, Q.; He, Z. 2023. Synthetic denitrifying communities reveal a positive and dynamic biodiversity-ecosystem functioning relationship during experimental evolution. Microbiol. Spectr. 11(3): e04528-22. DOI: 10.1128/spectrum.04528-22

Wu, L.; Yang, Y.; Ning, D.; Gao, Q.; Yin, H.; Xiao, N.; Zhou, B.Y.; Chen, S.; He, Q.; Zhou, J. 2023. Assessing mechanisms for microbial taxa and community dynamics using process models. mLife In press. DOI: 10.1002/mlf2.12076

X. Kong, J. Mao*, H. Chen, Y. Wang, Y. Zhang, X. Shi, X., and M. Jin, "Exploring the environmental drivers of vegetation seasonality changes in the northern extratropical latitudes: a quantitative analysis." Environmental Research Letters, 18(9), p.094071. 2023.

X. Kong, J. Mao*, H. Chen, Y. Wang, Y. Zhang, X. Shi, X., and M. Jin, "Exploring the environmental drivers of vegetation seasonality changes in the northern extratropical latitudes: a quantitative analysis." Environmental Research Letters, 18(9), p.094071. 2023.

Xiaolong Liang, Mark A. Radosevich, Jennifer Debruyn, Jie Zhuang, Regan W. McDearis, Steven W. Wilhelm. 2024. Incorporating viruses into soil ecology: a new dimension to understand biogeochemical cycling. Critical Reviews in Environmental Science and Technology, 54(2), 117-137. doi: 10.1080/10643389.2023.2223123

Xu, Y.; Chen, J.; Cai, J.; Li, S.; He, Q. 2023. Simulation-based trade-off modeling for indoor infection risk of airborne diseases, energy consumption, and thermal comfort. J. Buid. Eng. 76: 107137. DOI: 10.1016/j.jobe.2023.107137

Xue, Jin; Fangting Wang; Kun Zhang; Hehe Zhai; Dan Jin; Yusen Duan; Elly Yaluk; Yangjun Wang; Ling Huang; Yuewu Li; Thomas Lei; Qingyan Fu; Joshua S. Fu & Li Li (2023) Elucidate long-term changes of ozone in Shanghai based on an integrated machine learning method. Frontiers of Environmental Science & Engineering. DOI:10.1007/s11783-023-1738-5 [PDF]

Y. Wang, J. Mao*, F. Hoffman, C. Bonfils, H. Douville, M. Jin, P. Thornton, D. Ricciuto, X. Shi, H. Chen, S. Wullschleger, S. Piao, and Y Dai, "Quantification of human contribution to soil moisture–based terrestrial aridity," Nature Communications, 13(1), 1-11, 2022.

Y. Wang, Z. Yu, L. Shen, and M. Jin*, "Operational modes of E-closed loop supply chain considering platforms' services," International Journal of Production Economics, p.108551, 2022.

Y. Zhang, C. Song, T. Hwang, K. Novick, J. W. Coulston, J. Vose, M. P. Dannenberg, C. R. Hakkenberg, J. Mao, C. E. Woodcock, 2021. Land cover change-induced decline in terrestrial gross primary production over the conterminous United States from 2001 to 2016. Agricultural and Forest Meteorology [Accepted]

Y. Zhang, J. Mao, D. M. Ricciuto, M. Jin, Y. Yu, X. Shi, S. Wullschleger, R. Tang, and J. Liu. "Global fire modelling and control attributions based on the ensemble machine learning and satellite observations." Science of Remote Sensing 7, 2023.

Y. Zhang, J. Mao, D. M. Ricciuto, M. Jin, Y. Yu, X. Shi, S. Wullschleger, R. Tang, and J. Liu. "Global fire modelling and control attributions based on the ensemble machine learning and satellite observations." Science of Remote Sensing 7, 2023.

Yang, X.; Yu, X.; He, Q.; Deng, T.; Guan, X.; Lian, Y.; Xu, K.; Shu, L.; Wang, C.; Yan, Q.; Yang, Y.; Wu, B.; He, Z. 2022. Niche differentiation among comammox (Nitrospira inopinata) and other metabolically distinct nitrifiers. Front. Microbiol. 13: 956860. DOI: 10.3389/fmicb.2022.956860

Yu, X.; Qian, L.; Tu, Q.; Peng, Y.; Wang, C.; Wu, D.; He, Z.; Shu, L.; He, Q.; Tian, Y.; Yin, K.; Wang, S.; Yan, Q.; Zhong, Q.; He, Z. 2023.Chemoautotrophic sulfur oxidizers dominate microbial necromass carbon formation in coastal blue carbon ecosystems. Funct. Ecol. In press. DOI: 10.1111/1365-2435.14417

Yu, X.; Tu, Q.; Liu, J.; Peng, Y.; Wang, C.; Xiao, F.; Lian, Y.; Yang, X.; Hu, R.; Yu, H.; Qiang, L.; Wu, D.; He, Z.; Shu, L.; He, Q.; Tian, Y.; Wang, F.; Wang, S.; Wu, B.; Huang, Z.; He, G.; Yan, Q.; He, Z. 2023. Environmental selection and evolutionary process jointly shape genomic and functional profiles of mangrove rhizosphere microbiomes. mLife In press. DOI: 10.1002/mlf2.12077

Yuchuan Fan, Jie Zhuang, Michael Essington, Sindhu Jagadamma, John Schwartz, Jaehoon Lee.* 2023. Global significance of substrates for nitrate removal in denitrifying bioreactors revealed by meta-analysis. Engineering, 21(2), 213-225. doi: 10.1016/j.eng.2022.08.017

Yuchuan Fan, Jie Zhuang, Michael Essington, Xi Zhang, Guanghui Hua, Jehangir Bhadha, Shaopan Xia, Xuanyu Lu, Jaehoon Lee.* 2023. Characterizing the role of hydraulic retention time on

nitrate removal indices in denitrifying bioreactors in nonlinear models. Environmental Technology & Innovation, 32, 103341. doi:10.1016/j.eti.2023.103431

Yuchuan Fan, Michael Essington, Jie Zhuang, Xi Zhang, Sindu Jagadamma, John Schwartz, Jinsheng Huang, Jehangir Bhadha, Jaehoon Lee.* 2023. Recycling silage leachate and biochar for improving nitrate removal by woodchip bioreactor. Journal of Environmental Management, 345, 118735. doi: 10.1016/j.jenvman.2023.118735

Z. Liu, Y. Xu, M. Jin *, and S. Li, "Disinfection Robots Scheduling and Routing Problem for Healthy Buildings," Accepted by the Journal of Building Engineering. 2024

Z. Liu, Y. Xu, Y., M. Jin* and S. Li, "Disinfection robots scheduling and routing problem for healthy buildings," Journal of Building Engineering, p.108894, 2024.

Zeng, J.; Pan, Y.; Hu, R.; Liu, F.; Gu, H.; Ding, J.; Liu, S.; Liu, S.; Yang, X.; Peng, Y.; Tian, Y.; He, Q.; Wu, Y.; Yan, Q.; Shu, L.; He, Z.; Wang, C. 2023. The vertically-stratified resistome in mangrove sediments was driven by the bacterial diversity. J. Hazard. Mater. 458: 131974. DOI: 10.1016/j.jhazmat.2023.131974

Zhai, Hehe; Ling Huang; Chris Emery; Xinxin Zhang; Yangjun Wang; Greg Yarwood; Joshua S. Fu & Li Li (2024) Recommendations on benchmarks for photochemical air quality model applications in China — NO2, SO2, CO and PM10. Atmospheric Environment DOI:10.1016/j.atmosenv.2023.120290 [PDF]

Zhang, J., Wu, J. J., & Chen, L. (2022). Editorial: Advanced Strategies for the Recognition, Enrichment, and Detection of Low Abundance Target Bioanalytes. Frontiers in bioengineering and biotechnology, 10, 957878. https://doi.org/10.3389/fbioe.2022.957878

Zhang, Y., Mao, J., Ricciuto, D.M., Jin, M., Yu, Y., Shi, X., Wullschleger, S., Tang, R. and Liu, J., 2023. Global fire modelling and control attributions based on the ensemble machine learning and satellite observations. Science of Remote Sensing, 7, p.100088.

Zhou, M.; Guan, X.; Deng, T.; Hu, R.; Qian, L.; Yang, X.; Wu, B.; Li, J.; He, Q.; Shu, L.; Yan, Q.; He, Z. 2023. Synthetic phylogenetically diverse communities promote denitrification and stability. Environ. Res. 231: 116184. DOI: 10.1016/j.envres.2023.116184

Zhu, G., Giam, X., Armsworth, P.R., Papeş, M. 2022. Biodiversity conservation adaptation to climate change: protecting the actors or the stage. Ecological Applications, in press.

Zhuang, F.; Huang, J.; Li, H.; Peng, X.; Xia, L.; Zhou, L.; Zhang, T.; Liu, Z.; He, Q.; Luo, F.; Yin, H.; Meng, D. 2023. Biogeochemical behavior and pollution control of arsenic in mining areas: A review. Front. Microbiol. 14: 1043024. DOI: 10.3389/fmicb.2023.1043024

Book chapter:

Ewald Schnug,* Xijuan Chen, Jie Zhuang, S. Haneklaus. 2023. Silent alienation of soils through microplastic in the anthropocene–a constraint for soil productivity? Soil Constraints and Productivity, pp. 133-156, CRC Press, May 28, 2023.

Presentations

Akin, A., & Hathaway, J. (2023). Smart Stormwater Technologies for Watershed Management. In Tennessee AWRA Symposium. Montgomery Bell State Park.

Alex Strong. "Drive Electric TN Overview and Roadmap." DET Roadmap Refresh. August 26, 2024.

Alex Strong. "DriveElectricTN: Program Overview." TN GO program. June 7, 2024.

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.

Chen, J. and Jin, M., 2024, May. Assessing the Impact of Green Practices on Life Cycle Emissions and Energy Costs In Pulps and Paper Industry. In 2024 IISE Annual Conference and Expo. IISE.

Community Engagement and Energy and Environmental Justice and their Connection to DEI, February, 17, 2023, NSF Engineering Research Center DEI Director Meeting

Cronley, C., A. Fackler, J.M. First, S. Lee, I. Tsouris**. (2024). "Persons experiencing homelessness during extreme temperatures: lessons for promoting socially inclusive adaptive capacity." Royal Geographical Society Conference, London, UK.

Danniel Siksay. "East Tennessee Clean Fuels Coalition and Drive Electric TN." EXCET Conference. September 12, 2024.

Danniel Siksay. "EV Opportunities Across Tennessee." Tennessee Show of the South. May 16, 2024.

Danniel Siksay. “Progress in Electric Vehicle Fleet Adoption in Tennessee.” Pollution Prevention webinar. September 18, 2024.

Darcy Ayers. “East Tennessee Clean Fuels Coalition and Drive Electric TN.” Maryville Huddle. May 30, 2024.

Darcy Ayers. “EMPOWER: EV Friendly Workplaces.” Connecting Kingsport EVSE Workshop. March 14, 2024.

Darcy Ayers. “EMPOWER: EV Friendly Workplaces.” National Electric Vehicle Consortium Conference. February 28, 2024.

Ellis, K. N., J. First, K. Kintziger, and E. Hunter: Beat the heat: 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.

Elnur, M., & Alshibli, K. A. (2024). “Evolution of Shear bands in Saturated Sand Tested using Triaxial Compression”, ICTMS2024: International Conference on Tomography of Materials and Structures, Cape Town, South Africa, July 1-5, 2024.

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

Hao, Y., Mao, J., Jin, M., Wang, Y., Tang, R. and Lee, Z.W., 2023. Evaluating the effects of heatwave events on hydrological processes in the contiguous United States (2003–2022). AGU 23, December 2023, San Fransisco

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. Exxon Valdez vs. Deepwater Horizon and Considerations for Peru Repsol Spill. Online. Lima, Peru. January 27, 2022. Pontificia Universidad Católica del Perú. https://pucp.zoom.us/webinar/register/WN_fxuMvZBkTmanioIkjgJ_Qw

Hazen, T. C. Invited Webinar. Repsol Oil Spill in Peru. Online. Lima, Peru. February 8, 2022. National Service of Protected Areas (SERNANP) 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.

Herring, A.L. “Coupled Mass Transfer and Ganglion Destabilization in Multiphase Systems”. Invited Seminar presented to the 2024 Gordon Research Conference on Flow and Transport in Permeable Media. Newry, Maine, USA; July 2024.

Herring, A.L. “Visualizing Mass Transfer Across Fluid-Fluid Interfaces”. Talk presented to the 2024 Interpore Annual Meeting. Qingdao, China; May 2024.

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). doi:10.1109/SIEDS58326.2023.10137869

Huihui Sun, Mark Radosevich, Jaehoon Lee, Jie Zhuang. Adhesion to soil surfaces inhibits bacterial cell-to-cell interactions. ASA-CSSA-SSSA International Meeting, St. Louis, Missouri, USA, October 29-November 1, 2023.

Jennifer Kidd. "East Tennessee Clean Fuels Coalition and Drive Electric TN." Citizen's Climate Lobby. August 20, 2024.

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)

Jonathan Overly. "DRIVE Electric USA." Clean Cities and Communities Nationals Training. September 11, 2024.

Jonathan Overly. "Electric Vehicles & Charging 101." Northwest TN EV Day. February 22, 2024.

Jonathan Overly. "EMPOWER: EV Friendly Workplaces." Northwest TN EV Day. February 22, 2024.

Jonathan Overly. "ETCleanFuels & DriveElectricTN: Encouraging Equitable Electric Mobility." Understanding Potential EV Charging Behavior and Infrastructure Workshop. May 29, 2024.

Jonathan Overly. "Managing a Growing Team." Clean Cities and Communities Nationals Training. September 12, 2024.

Jonathan Overly. "National and Tennessee EV and EVSE Trends, Numbers." 2023 Tennessee Valley Solar Conference. October 19, 2023.

Jonathan Overly. "Progress in Alternative Fuel & Electric Vehicle Adoption in Tennessee." ISSE Research Conference. September 16, 2024.

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.

Liu, Z. and Jin, M., 2024, May. Sensor Network-Based Optimization of Energy Consumption, Health, and Productivity in Office Buildings. In 2024 IISE Annual Conference and Expo. IISE.

N. Amin, J. Chen, Q. He, J. Schwartz, and J. Wu, "Real-time and ultrasensitive detection of Perfluorooctanesulfonic acid by a capacitive molecularly-imprinted-polymer sensor integrated with AC electrokinetics," ACS Fall 2024 Meeting, Denver, CO., Aug. 18-22, 2024.

Newberry, H., Chen, S., & He, Q (2023). Dissecting the Microbial Food Web in Anaerobic Wastewater Treatment Processes. In the 32nd Tennessee Water Resources Symposium. Montgomery Bell State Park, TN.

Nkuah, J.-S. "Characterization of Mass Transfer Processes in a Porous Media Using PLIF". Poster presented at the 2024 Gordon Research Conference on Flow and Transport in Permeable Media. Newry, Maine, USA; July 2024.

Palino GM, Arias M. USF Departmental Seminar. Hydraulic Modeling of Regenerative Stormwater Conveyances. April 2024.

Palino GM, Rodriguez Sanchez JP, Pangle LA. GSU GEOS8097: Directed Study in Geosciences. Regenerative Stormwater Conveyances: An Overview. December 2023.

Palino GM, Schwartz J, Hathaway J. 2024. Presentation. Regenerative Stormwater Conveyance Impact on Groundwater Hydrology: A Case Study, Powell, TN. The Universities Council on Water Resources 2024 Annual Conference. St. Louis, MO. October 1.

Palino, G., Hathaway, J., & Schwartz, J. (2023). Hydraulic modeling of regenerative stormwater conveyances. In ASCE EWRI Congress. Henderson, NV.

Rattanakunuprakam, S. and Jin, M., 2024, May. Stochastic Optimization of Intermodal Freight Transportation. In 2024 IISE Annual Conference and Expo. IISE.

Rubin, H. and Fu, J.S. (2023) Mapping Long-Term Trends in Soil Organic Carbon with Machine Learning. [Poster] Institute for Secure and Sustainable Environment Second Annual Research Conference. University of Tennessee, Knoxville.

Smugor, C., Swanson, C., & He, Q. (2023). Potential of Electrochemical Oxidation for the Removal of Water Contaminants. In the 32nd Tennessee Water Resources Symposium. Montgomery Bell State Park, TN.

Swanson, C., Cianciolo, C., & He, Q. (2023). Microbiome-Scale Identification of Biomarkers in Streams Impacted by Urbanization. In the 2023 Association of Environmental Engineering and Science Professors (AEESP) Research and Education Conference. Boston, MA.

Swanson, C., Cianciolo, C., & He, Q. (2023). Microbiome-Scale Identification of Potential Microbial Biomarkers in Streams Impacted by Urbanization. In the 32nd Tennessee Water Resources Symposium. Montgomery Bell State Park, TN.

T. Xia, D. Ramasubramanian, W. Wang, K. Sun, K. Huang, "Grid-forming Inverter Placement for the System with High Inverter-based Resource Penetration Based on Participation Factors," to be presented at IEEE Energy Conversion Congress & Expo, Phoenix, Arizona, October 20-24, 2024.

T. Xia, K. Huang, K. Sun, "A Tensor Contraction-Based Approach for Efficient Computation of Nonlinear Participation Factors," IEEE Power & Energy Society General Meeting in Seattle, MA, July 21-25, 2024.

Wesleigh Wright. "CCEEJI Pilot Cohort." Forth Mobility Conference. September 26, 2024.

Wesleigh Wright. "East Tennessee Clean Fuels CEL Showcase." Forth Mobility Conference. September 25, 2024.

Wesleigh Wright. "Federal Projects at the Community Level." BGE Leadership Retreat. June 27, 2024.

Wesleigh Wright. "Intro to Community Co-Design." Micromobility Open House. August 9, 2024.

Xijuan Chen, Jie Zhuang. A hydrobiological mechanism controlling the synergistic effects of unsaturated flow and soil organic matter on transport and degradation of EOCs in soils. Goldschmidt 2023, Lyon, France, July 9-14, 2023.

Zhang Y, Mao J, Ricciuto DM, Jin M, Yu Y, Shi X, Wullschleger S, Tang R, Liu J. , 2023 Global fire modelling and control attributions based on the ensemble machine learning and satellite observations. AGU 23, December 2023, San Francisco

Zhou, R. and Jin, M., 2024, May. Circular Biomass-bioenergy and Biofuel with Carbon Capture and Storage Supply Chain Network Optimization. In 2024 IISE Annual Conference and Expo. IISE.

Awards & Recognition

The Success in Multidisciplinary Research award is given to a team of faculty members in more than one academic college that has succeeded in gaining major external resources and recognition for multidisciplinary research. Led by Joe Zhuang (Environmental & Soil Sciences), with members Tom Gill (Agriculture & Rural Development), Frank Löffler (Civil & Environmental Engineering) and ISSE Director Mingzhou Jin (Industrial & Systems Engineering), the team assessed food-energy-water (FEW) nexus grand challenges arising from climate and sociodemographic changes, aiming to minimize regional and global FEW tradeoffs.

2024 UTK Success in Multidisciplinary Research Award, Mingzhou Jin, Joe Zhuang, Frank Loeffler, and Tom Gill

Dr. Mingzhou Jin was named a 2024 SEC Academic Leadership Development Fellow. This program seeks to identify, prepare, and advance academic leaders for roles within SEC institutions and beyond. Representing a range of leadership positions and academic interests, the fellows were named through a competitive process after being nominated by their dean, provost or faculty senate president.

Jonathan Overly was named one of four 2024 Natural Gas Vehicle Public Policy Champions

ISSE Goals for 2024—25

Director's Goals

ISSE continues to make global and local impacts on all aspects of sustainability, from the environment to people and society. ISSE will engage more faculty members at UT, especially those in colleges beyond the Tickle College of Engineering and UT Institute of Agriculture, to further grow interdisciplinary research and provide and implement solutions to pressing sustainability issues that will benefit people and societies. ISSE will strengthen its collaboration with other stakeholders, including state and local governments, non-profit organizations, and national labs. Globally, ISSE will increase its international research collaborations with our partners in Japan, the United Kingdom, Argentina, Turkey, and many others.

With the large grants from National Science Foundation, US Department of Agriculture, US Department of Energy, US Geographic Survey, Environmental Protection Agent, Wellcome Trust, and Foundation for Food and Agriculture Research, ISSE will expand its research and outreach activities focusing on the interaction between environment and people, especially those in disadvantaged areas. While keeping its focus on original and impactful research that will help address global issues, ISSE will strengthen its collaboration with regional and local stakeholders to co-produce solutions to benefit our city, region, state, and nation. ISSE will further engage local corporations and governments to help them achieve net-zero goals. East Tennessee Clean Fuels will continue to be the national leader promoting the adoption of EV and other alternative fuel vehicles and helping to build charging and other infrastructure for those vehicles.

Besides research, ISSE plans to grow its training programs through its TN Water Resource Research Center, Appalachian Leadership Institute, and East Tennessee Clean Fuels to better serve the State of Tennessee and the Appalachian region, continue to support graduate and undergraduate students to be ready for their careers, and engage high school and middle students to attract them into the STEM field, including the continuation of a summer STEM program.

East Tennessee Clean Fuels, Jonathan Overly

In the upcoming year, ETCF hopes to add a few new team members (Development Coordinator and Communications Coordinator), maintain the success of our current projects, and support other Clean Cities and Communities Coalitions as they seek to grow their organizations. Additionally, we will continue to seek funding opportunities and either apply on our own behalf or support other organizations as we can. We will continue to hold outreach events for the public, focusing on educating people about alternative fuels and their uses, and giving people an opportunity to experience driving an Alt Fuel vehicle. We also hope to strengthen our relationship with the University of Tennessee through developing a UT EV-owners Working Group and pursuing funding to hold outreach events targeting students, faculty, and staff at the University.

Pore Water Pressure, Khalid Alshibli

Research effort for the last year of the project focused on analyzing the Synchrotron microcomputed tomography (SMT) images of the 17 miniature axisymmetric Triaxial Compression experiments. One of the objectives of the experiments was to investigate the influence of back pressure (BP) value on the degree of saturation of sheared sand, preliminary investigation of results indicated that the SMT scanning setup and duration play a critical role in the development of gas bubbles within specimens. An additional four experiments using acrylic tubes were conducted to better understand and isolate the effect of x-ray exposure on the specimens.

Transformational Production of Sustainable Aviation Fuel and Biofertilizer from Black Solider Fly, Toni Wang

A manuscript draft is expected in 2025 with proper ISSE acknowledgement. The highlights of this work are: 1) we successfully fractionated the BSFL into lipid and protein, and demonstrated that additional refining of oil is needed for its conversion to SAF; 2) the BSFL protein fractionation is proven to be very challenging compared to oilseed protein separation; the factors of larvae heating/drying on protein fractionation and additional treatments to maximize extraction of proteins to be used as feed are needed; 3) more extensive hydrolysis may be needed to produce easily usable biofertilizer. This seed grant and the data obtained will help focus our USDA grant activities better. At the time of this ISSE seed grant application, we also submitted a USDA-NIFA grant based on similar concept. This 4-year full-scope study is funded in 2024 (PI: Tong Wang, Co-PIs: Sindhu Jagadamma, Nour Abdoulmoumine, Jennifer DeBruyn, titled Bioprocessing of black soldier fly larvae for the production of sustainable aviation fuel and bioactive soil enhancer, $591,324).

right: East TN Clean Fuels Director Jonathan Overly really gets into a demonstration of EVs at a recent Ride & Drive event.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