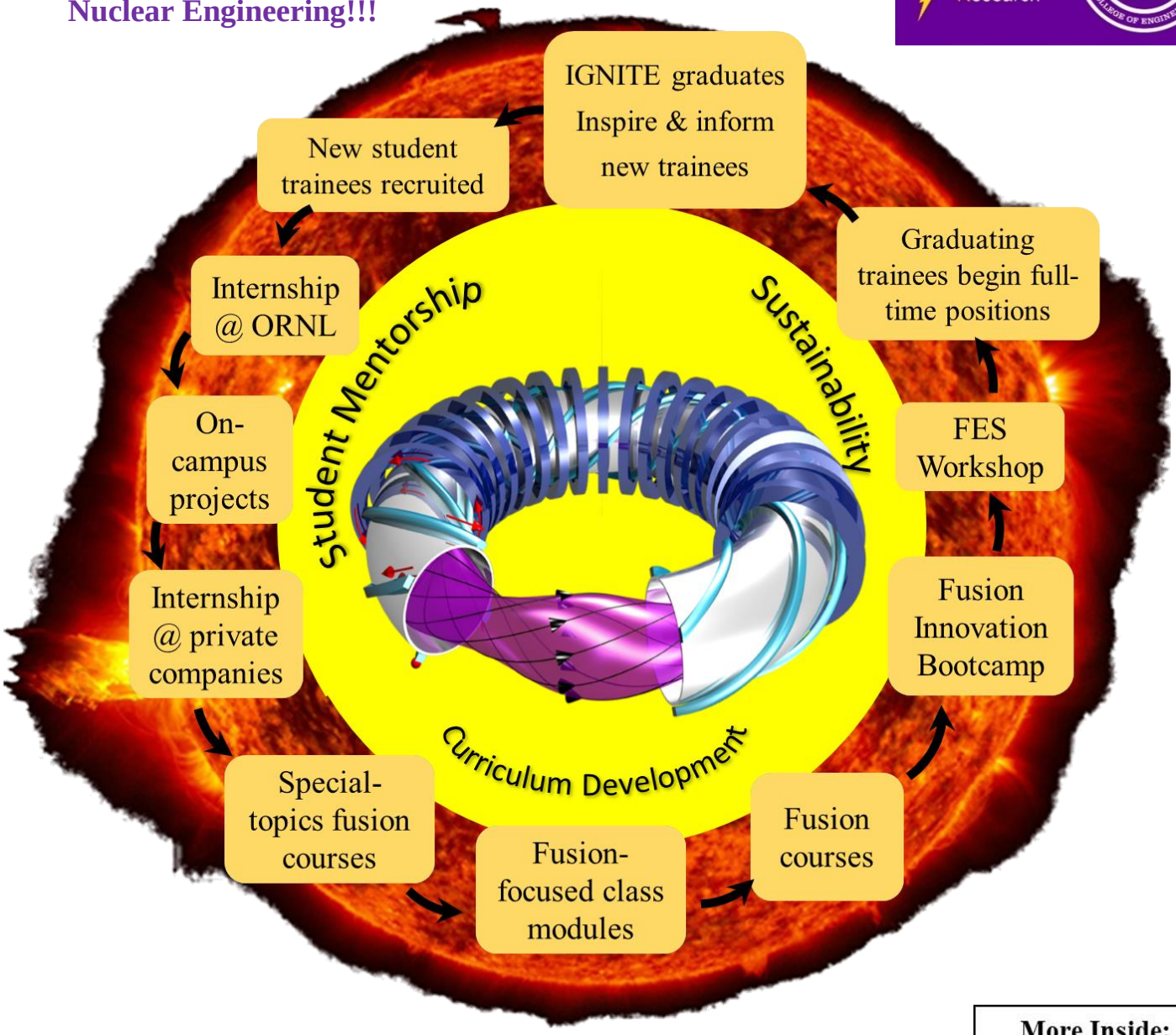
Center for Energy Systems Research

Tennessee Tech College of Engineering

Nuclear Engineering!!!



Center for Energy Systems Research

Annual Report for Fiscal Year 2025

More Inside:

DOE IGNITE

NSF NRT

TDOT UTAP

COVER DESCRIPTION:

The cover depicts Dr. Peng Zhang's exciting project with ORNL and 5 other academic institutions and industrial partners to promote fusion energy advancement.[1] The rapid advancements in fusion energy research underlines an urgent need for a strong workforce capable of driving future fusion engineering and technology developments. Recent achievements, such as the first experimental demonstration of fusion implosion with a target gain larger than unity at the National Ignition Facility, have unveiled the potential for fusion to serve as a sustainable energy source. These advancements, coupled with the White House's bold decadal vision for commercial fusion energy, highlight the pressing need to grow, diversify, and sustainably develop the talent pipeline in fusion engineering and technology. To address this critical demand, this RENEW project aims to leverage the collective strengths of six academic institutions (Tennessee Tech University, Tennessee State University, Tuskegee University, Southern Adventist University, Missouri University of Science and Technology, and University of Tennessee – Knoxville), Oak Ridge National Laboratory (ORNL), and nearly ten private fusion companies to create workforce training initiatives and enhance curriculum development, thereby preparing a new generation of researchers for careers in fusion engineering and technology.

This initiative is developed around the following three objectives. (1) We will establish a student mentoring program to involve undergraduate and graduate students through consecutive summer internships at ORNL and a private fusion company, where they will gain hands-on experience with cutting-edge research and commercial applications of fusion technology. Students will also benefit from continued mentorship in the form of career guidance and professional development during academic semesters. (2) We will collectively develop a series of new courses and special-topics modules to be implemented at participating universities, which will be shared publicly with the broader academic community. This curriculum development effort will be guided by private fusion companies and national lab leaders, reflecting the needs and recent advancements in fusion engineering and technology. (3) To promote the sustainability of the project efforts, we will create an inaugural entrepreneurship and innovation focused bootcamp – the Fusion Innovation Bootcamp – designed for sustained training and participation of students in fusion engineering. Student trainees will engage with fusion startup professionals, national lab researchers, and university faculties in a dynamic curriculum featuring lectures, panels, hands-on sessions, and pitch presentations. Key findings and insights from student mentorship, curriculum development, and bootcamp training in this RENEW project will be disseminated at a fusion engineering and technology workshop during a major national conference.

The integration of student mentoring, curriculum development, and bootcamp engagement ensures that the training and involvement of participants is sustained beyond the duration of this RENEW project and into the future of fusion engineering and technology. This RENEW project aims to sustainably improve workforce conversion and retention, increase representation of underrepresented and economically disadvantaged minorities in the fusion industry, enrich fusion engineering curricula across academia with vital course materials, and establish a sustainable talent pipeline from academic institutions to the public and private fusion sectors.

The image of the fusion reactor and fields came from an IAEA web site that gives credit to the Max Planck Institute for Plasma Physics (Germany).[2]

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[1] https://www.ornl.gov/organization-news/ignite-fusion-energy-program-seeks-input-fusion-focused-curriculum-and-fusion

[2] https://www.iaea.org/bulletin/magnetic-fusion-confinement-with-tokamaks-and-stellarators

Center for Energy Systems Research

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TENNESSEE TECH UNIVERSITY

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YEAR IN REVIEW

Dr. Satish M. Mahajan continued as the Director of the Center for Energy Systems Research (CESR) for fiscal year 2024-2025. The CESR has added a fourth strategic research area to focus on, Nuclear Energy, as well as the previous Smart Grid, Resilient Infrastructure, and Wireless Power Transfer.

Fiscal Year 2024-2025 was another successful year for the CESR. This year, the external funding was **$6,687,947.39**. It certainly represents the extra energy put in by the Center faculty associates, and the extra support given to them by the center staff. It is the nineth time since 1985 that the CESR activations have crossed $2 million, and now seven years in a row out of those nine years.

The CESR has completed 40 years at TN Tech University. The Center has come a long way in establishing a research culture at TN Tech, while helping students and industry in Tennessee. The proposal activity of $11M in 2024-2025 represents continuation of those efforts in the future. The Center has plans to join the nuclear renaissance in the USA by initiating a new focus area of 'Nuclear Engineering', in addition to other areas. The Center welcomes Dr. Manish Sharma and Dr. Shoaib Usman in the Nuclear area by supporting their start-ups. In addition, the Center also welcomes Dr. Austin Andrews, and looks forward to their contributions in the future. As federal funding levels remain uncertain, CESR will emphasize expanding partnerships with industry and state agencies to sustain research growth.

In the 2024-2025 fiscal year, the CESR funded 26 M.S. assistantships (14 on grants only, 6 on CESR only, and 6 on grants plus CESR, plus other University sources combined); and 35 Ph.D. assistantships (9 on grants only, 19 on CESR only, and 7 on grants plus CESR, plus other University sources). The CESR supported a total of 20 graduate students on an hourly basis. The combined headcount of the CESR-supported graduate students is 61. The CESR also supported a total of 13 undergraduate students, a significant number of them funded by grants.

The CESR faculty associates received grants from ARC, DOE, TBR, TDOT, NSF, NASA, ACS, US Air Force, US Navy, VentureWell, and some industrial sponsors. The variety of funding agencies represents commitment from both our senior faculty and mid-career faculty. It should be noted there were two separate, 5-year grants from NSF-NRT, a unique achievement in itself.

After bringing stability to CESR over the last 2 years, Ms. Shanae Tyree will be moving on to a different role in the office of Research and Economic Development. Ms. Linda Thurman continues as a Financial Grants Analyst and continues to expand her skills and knowledge with post-award grant management while maintaining excellent customer service to CESRs affiliates. Mr. Robert Craven continues to provide excellent support in his role as the Center's research engineer and has played an invaluable role with the Center's largest grant of its history. The Center acknowledges the significant contributions of each of them for their tireless efforts in support of students and faculty associated with the CESR!

PROGRAMMATIC REPORT

Mission

The Center for Energy Systems Research (CESR) was established to advance and apply scientific and engineering knowledge associated with energy systems and in particular with electric power while supporting the instructional program of Tennessee Technological University (TTU) in academic areas associated with energy systems.

Research efforts, both theoretical and experimental, are focused on solving current and anticipated problems associated with energy systems. Special emphasis is given to the needs of the electric power industry.

Vision

The Center's vision is to enhance research and education in support of its mission. The Center will conduct advanced and applied research to enhance knowledge in currently needed and emerging technical areas of energy systems. The Center also has major interests in the dissemination of knowledge and enhancing education in energy systems.

The Center draws upon the expertise from the faculty in the College of Engineering as well as from other faculty on campus. Participating faculty and faculty associates represent Basic engineering, Chemical Engineering, Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Mechanical Engineering and Manufacturing and Engineering Technology.

History

The State of Tennessee established the Center for Electric Power in 1985 in the College of Engineering at Tennessee Technological University. Reflecting the broadening of the activities of the Center, its name was changed to Center for Energy Systems Research. Over the years, research projects have been sponsored by more than 20 major electric utilities, EPRI, NAVY, Air Force, DOD, federal agencies such as DOE, NASA, NSF, ARPA-e, NST, and ONR, State agencies such as TDOT and Tennessee Department of Education, and industries such as Luna, McHale, VentureWell etc.

In the 2012-2013 academic year, the College of Engineering identified six strategic research areas in which to focus the research efforts of its faculty and students. Of the six areas, the CESR chose two areas, namely, 1) Smart Grid and 2) Resilient Infrastructure to focus its research. In addition, the CESR has started research in the area of 'wirelesspower transfer' from the year 2019. Development of large collaborative research proposals is encouraged in these areas.

To promote the research and innovation, the CESR provides services of an R&D Engineer, Center Manager, Financial Grants Analyst, and Administrative Associate in support of the various research activities performed by faculty and students. The Center has set up laboratories and computational resources for the benefit of researchers.

The Center promotes international collaboration by hosting visiting scholars, scientists and engineers, and establishing Memoranda of Understanding with international academic institutions and research organizations.

RESEARCH FISCAL SUMMARY

The Center is required to at least "match" the funding from the state with external funding from research projects, etc. CESR's new matching funds from July 1, 2024 thru June 30, 2025 total $5,685,532.10. This amount excludes indirect costs of approximately $1,002,415.29 from this year's funded projects. The result is that the 2024-2025 Matching and Indirect Costs total **$6,687,947.39.** The State Appropriation was $1,176,100.00 for 2024-2025. CESR continues to enjoy a broad base of support. The funding categories for 2025 are illustrated in Figure 1. State appropriations are compared to matching, on an annual, cumulative basis, in Figure 2. $6.6 M is a slight decrease from last year but is maintaining the new high plateau. Matching is divided into contracts and grants; equipment and all other items such as software, books and reports; and funding for faculty and student exchange programs. A list of the projects conducted under the major research areas is given in SM-3 in this report.

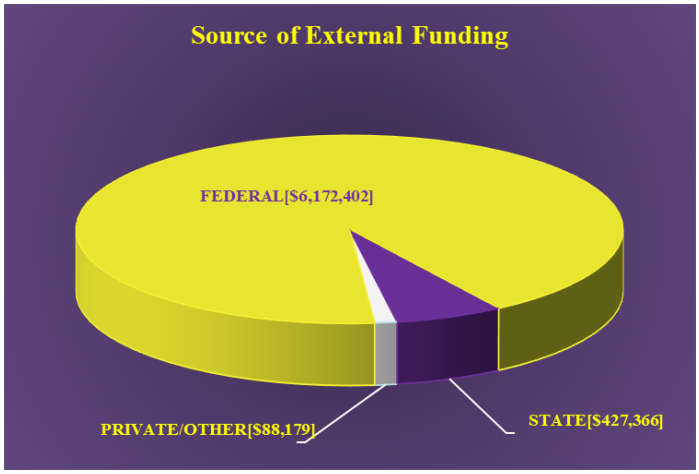


Figure 1: Types of Research Funding

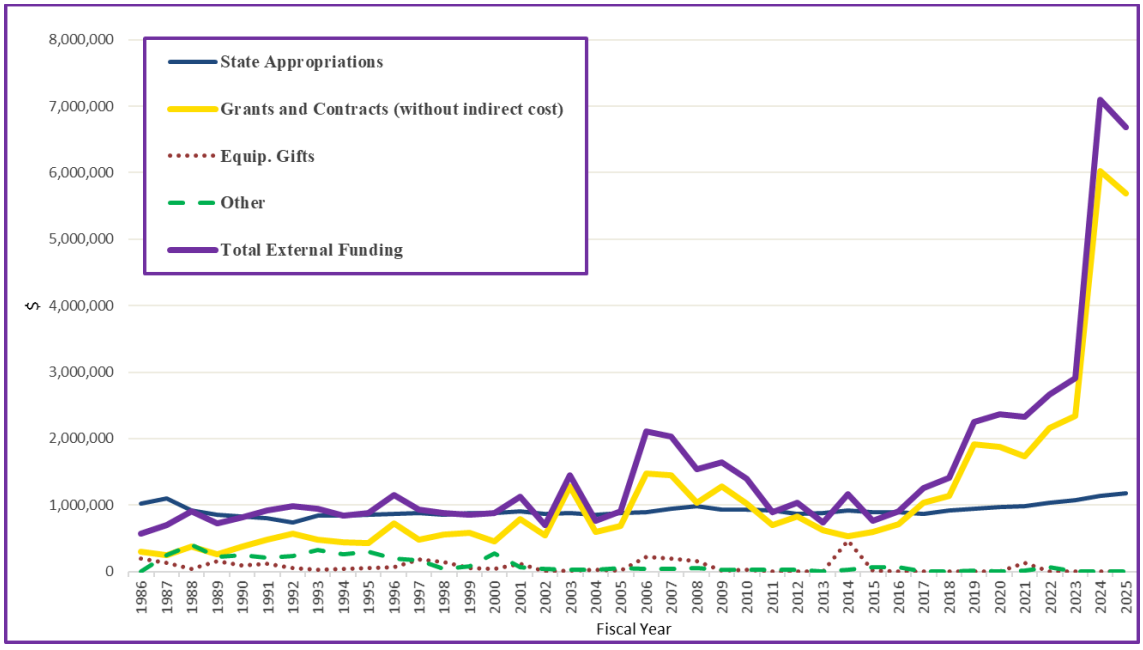
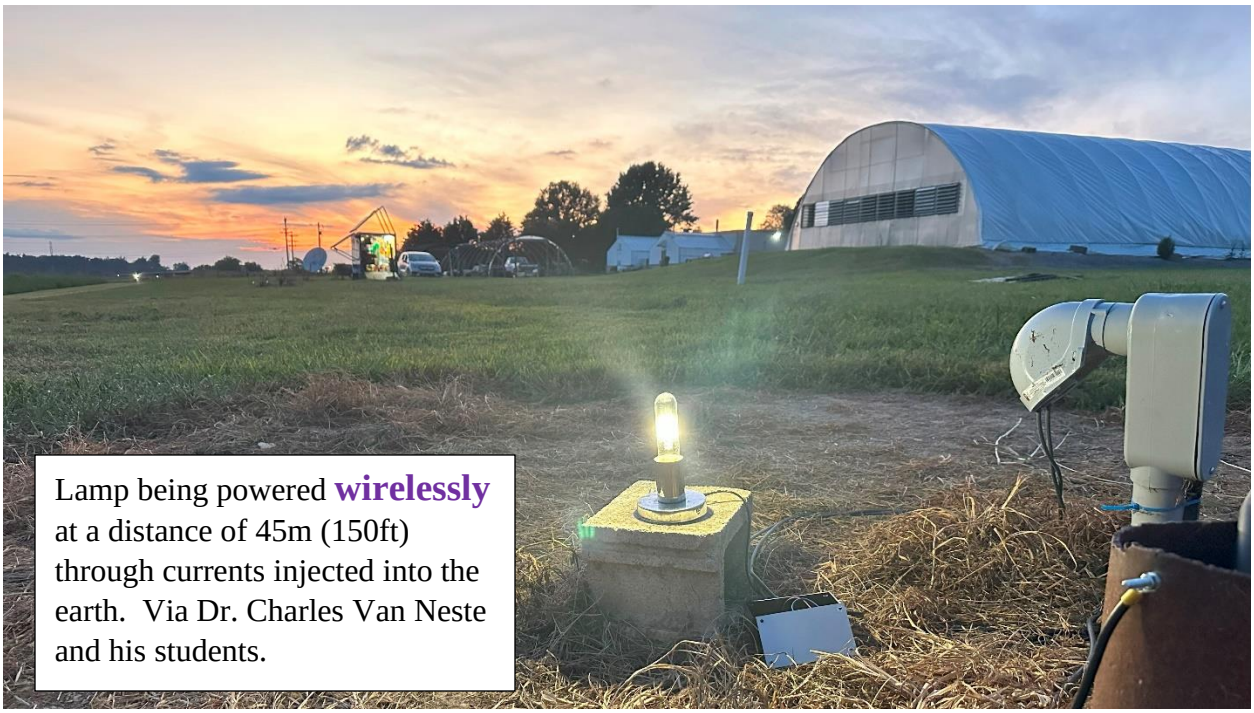


Figure 2: Historical State Appropriations and Matching



Lamp being powered **wirelessly** at a distance of 45m (150ft) through currents injected into the earth. Via Dr. Charles Van Neste and his students.

RET Buried Objects.jpg: PhD student, John Thomas, and NSF RET assistants, Carson Speck and Amy Fricks, conducting experiments to detect buried objections by measuring the electric field created at the air/surface interface of the soil when currents are injected into the earth from a TTS transmitter.

In March 2025, three graduate students (Henry Asamany, Brendan Atarigiya, and Navid Osia) and Dr. VandenBerge attended the GeoInstitute's (American Society of Civil Engineer) annual conference in Louisville, KY. Mr. Atarigiya and Mr. Osia presented two papers (one poster and one podium). They also competed in the student GeoPoster event, for which Mr. Asamany was a finalist. It was a great week of learning and networking!

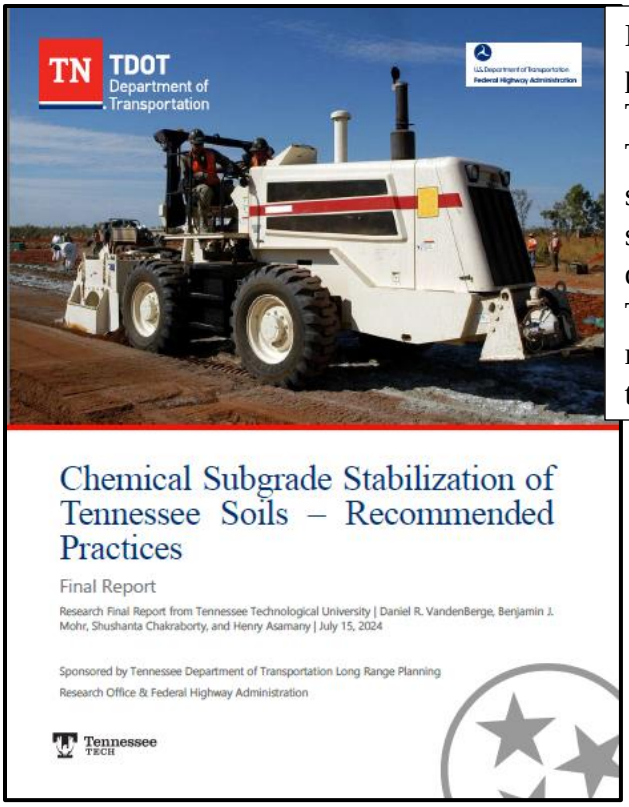
Henry Asamany, Dr. VandenBerge, Navid Osia, Brendan Atarigiya

On March 4, 2025, Dr. VandenBerge was installed as the incoming Vice-Chair of the Embankments, Dams, and Slopes (EDS) Committee of the GeoInstitute of ASCE. He will be responsible for helping to guide the work of this national committee for the next nine years. EDS plays an important role in research and practice related to slope stability in the United States and around the world.

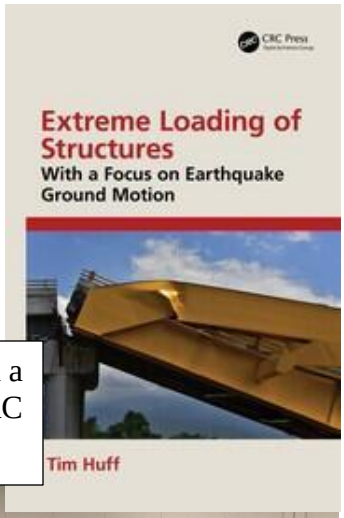
Vice-Chair Dr. Daniel VandenBerge (left), Chair Dr. Farshid Vahedifard, Tufts University (center), and Past-Chair Dr. Chris Meehan, University of Delaware (right)

On March 27, 2025, Dr. VandenBerge presented an overview of the recently published NAVFAC DM 7.2: Foundations and Earth Structures (UFC 3-220-20) on a livestream hosted by the GeoInstitute of ASCE. He was joined in the presentation by co-author, Dr. Michael McGuire from Lafayette College. More than 1,000 people watched the presentation live, and the video has since gained over 2,800 views (https://www.youtube.com/watch?v=s5sA4h4WBXU). DM 7.2 can be downloaded from https://www.wbdg.org/dod/ufc/ufc-3-220-20. The efforts to revise this internationally recognized resource were coordinated by Tennessee Tech with the help of CESR.

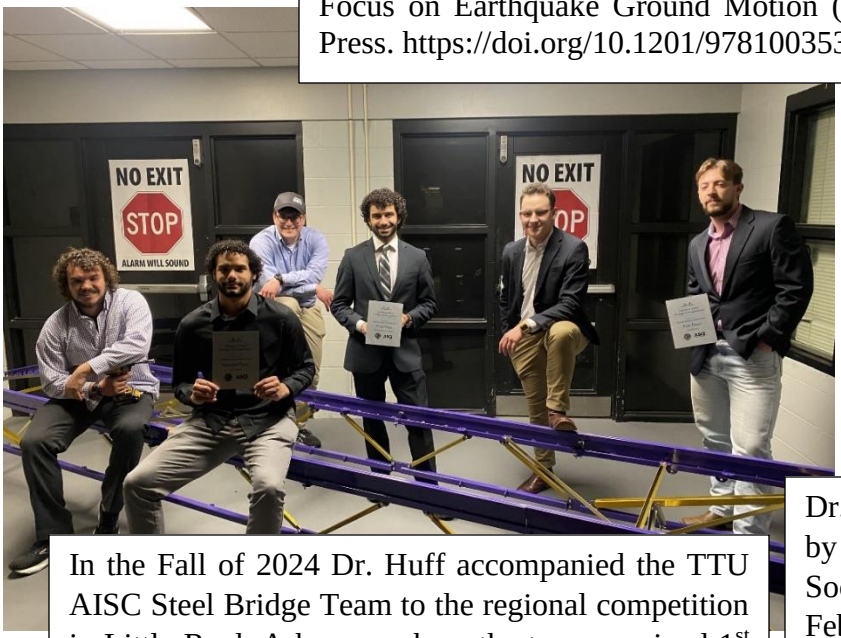
FACULTY AWARDS AND ACCOMPLISHMENTS 2024–2025



Dr. VandenBerge and Dr. Mohr completed and presented their work on Tennessee Department of Transportation (TDOT) RES2023-13 in July 2024. The project represents two years of work summarizing current and best practices in chemical subgrade stabilization, performing representative mix designs, and preparing guidance documents for TDOT. This work fully or partially supported multiple graduate students and was facilitated through CESR



Huff, T. (2025). Extreme Loading of Structures: With a Focus on Earthquake Ground Motion (1st ed.). CRC Press. https://doi.org/10.1201/9781003538363



In the Fall of 2024 Dr. Huff accompanied the TTU AISC Steel Bridge Team to the regional competition in Little Rock Arkansas where the team received 1st place in aesthetics, 1st place in structural efficiency, and 2nd place in stiffness.

Dr. Huff was named Engineer of the Year by the Nashville Chapter of the Tennessee Society of Professional Engineers in February of 2024 for 40 years of service to the profession, including 7 years as full-time faculty at TTU.

PLANS FOR 2025-2026

Increase Research Activity in the Areas of the Center

Generate external funding that will contribute to the long-term growth and sustainability of the Center. As a minimum, the external funding generated per year by the center should match the state funding. Efforts will be made to sustain a $3 million level, on a 3-year moving average basis.

Center faculty and the R&D Engineer will produce at least eight publications in total. This year we had a total of 21 publications and a book chapter.

The Center focus areas also intersect the University Flight Plan focus areas to Create Distinctive Programs and Invigorate Faculty. This activity will continue.

Increase Student Research Activity

Continue pursuing support to the MS and Ph.D. graduate students in the strategic research areas of the Center consistent with the level of external funding.

Support at least two undergraduate research projects per year in the areas related to energy systems.

This goal intersects the University Flight Plan's New Graduate Programs sub goal.

Increase Collaborative Research

Continue pursuing the development and submission of two collaborative proposals with interdisciplinary focus. The number of collaborative proposals submitted should be at least two per year.

This goal intersects the University Flight Plan's Multidisciplinary Research Innovation sub goal.

Add Laboratory Facilities

The CESR will support expansion of the smart grid laboratory in the inductive wireless power transfer area. Support for the Electrolysis and Optics laboratory.

This goal intersects the University Flight Plan's Physical Infrastructure Priorities sub goal and the Technology Service to Students sub goal, and the Technology in Teaching sub goal. Better facilities in areas of national importance like the Smart Grid benefit research, education, and hire-ability of our graduates.

Increase Outreach Activities

We will organize a minimum of two seminars by external speakers.

This goal intersects the University Flight Plan's Co-Curricular Undergraduate Program sub goal and the Multidisciplinary Research Innovation sub goal. By having research area experts from outside the university come and teach seminars, workshops or short courses, the students will be exposed to a broader base of information and hopefully promote collaborative efforts from TTU researchers with those at other institutions.

Mesa Associates Visit to CESR

Chris Brazell of ARC Visit to CESR during the TREEDC conference.

KUB/SevenStates Visit to CESR

SUPPORTING MATERIALS

Seminar

Methods to Improve State Estimation Performance for Real-Time Monitoring on Distribution Systems

Dr. Gokhan Cakir

Senior Engineer, Duke Energy Corporation

Schneider Electric's Innovation Lab and CESR's Smart Grid Lab exchange visits in the birth of new collaborative efforts: Dr. Roy Sreemant of Schneider Electric, Dr. Ali Arzani, Dr. Satish Mahajan, and Robert Craven of TN Tech, and Harvey Abouelata of Area 51 Solar.

CESR FACULTY & STAFF - 2024-2025 SM-1

Center Director:	Dr. Satish M. Mahajan	Director; ECE Professor
Center Faculty:	Dr. Ali Arzani	Assistant Research Professor
	Dr. Jiheng Huang	Assistant Research Professor
Center Staff:	Mr. Robert Craven	Research Engineer
	Ms. Shanae Tyree	Center Manager
	Ms. Linda Thurman	Financial Analyst
	Ms. Chelsea Durham	Administrative Associate
	Dr. Vineeth Vijayan	Post-Doctoral Researcher
	Dr. Prashant Kumar	Post-Doctoral Researcher

CESR Staff (Part Time, Temporary):

Ms. Allison McDaniel	Administrative Associate
Ms. Sherry Velasquez-Perez	Administrative Associate
Dr. Sabrina Buer	Project Manager
Kinwa Leung	IT Specialist
Mr. Allen Nash	Financial Analyst
Ms. Lisa Hoane	Financial Analyst
Mr. Sean Perry	Financial Analyst
Dr. Hany Ahmed	Visiting Research Professor

Smart Grid

- Dr. Ali Arzani
- Dr. Ghadir Radman
- Dr. Satish M. Mahajan
- Dr. Charles Van Neste
- Dr. Sheikh Ghafoor
- Dr. Syed Rafay Hasan
- Dr. Mohamed Mahmoud
- Dr. Maanak Gupta
- Dr. Muhammad Ismail
- Dr. Michael Aikens
- Dr. Mike Rogers
- Dr. Tarek Elfouly
- Dr. Syed Rizvi
- Dr. Rory Roberts
- Dr. Ali Alouani
- Dr. Joseph Ojo
- Dr. Md Zulkar Nine
- Mr. Robert Craven

Resilient Infrastructure

- Dr. Benjamin Mohr
- Dr. Craig Henderson
- Dr. Daniel Badoe
- Dr. Alfred Kalyanapu
- Dr. Ethan Languri
- Dr. Steven Click
- Dr. Mazen Hussein
- Dr. Mohan Rao
- Dr. Mustafa Rajabali
- Dr. Jane Liu
- Dr. Daniel VandenBerge
- Dr. Robby Sanders
- Dr. Pedro Arce
- Dr. Hyung-Jin Yoon
- Dr. Lac Ha Ngyuen
- Dr. Tony Skjellum
- Dr. Bahman Ghorashi
- Dr. Kevin West
- Dr. Tim Huff
- Dr. Ali Estejab
- Dr. Ian Morrell
- Dr. Austin Andrews

Wireless Power Transfer

- Dr. Charles Van Neste
- Dr. Satish M. Mahajan

Nuclear Energy

- Dr. Jeffery King
- Dr. Peng Zhang
- Dr. Manish Sharma
- Dr. Shoaib Usman

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2024 and June 30, 2025

Index	Title	P.I.	Source	Project Dates	Amount
531338	NRT-FW-HTF: Engendering the Spirit of Gadugi at the Food-Energy-Water Nexus	Pedro Arce	National Science Foundation	7/1/2022 to 6/30/2027	$667,509.00
531338	NRT-FW-HTF: Engendering the Spirit of Gadugi at the Food-Energy-Water Nexus	Pedro Arce	National Science Foundation	7/1/2022 to 6/30/2027	$76,000.00
533264	Development of Tennessee UHPC for Bridge Applications	Benjamin Mohr	TDOT-State	8/1/2023 to 7/31/2025	$21,908.38
533265	Development of Tennessee UHPC for Bridge Applications	Benjamin Mohr	TDOT-Federal	8/1/2023 to 7/31/2025	$87,633.52
539216	Smart Grid Development Consortium and HILLTOP Platform Expansion	Satish Mahajan	Appalachian Regional Commission	8/15/2023 to 8/14/2026	$3,262,325.00
531362	NRT-GCR, AL: Immersive Research Traineeship in the Convergence of Artificial Intelligence, Energy and Cyber Security	Indranil Bhattacharya	National Science Foundation	9/1/2024 to 8/31/2029	$347,365.00
531340	Collaborative Research: NeTs:JUNO3: Swift: Softwarization of Intelligence for Efficient 6G Mobile Networks	Muhammad Ismail	National Science Foundation	9/1/2022 to 8/31/2025	$74,999.00
531341	Collaborative Research: SHIELD: Strategic Holistic Framework for Intrusion Prevention Using Multi-modal Data in Power Systems	Muhammad Ismail	National Science Foundation	9/1/2022 to 8/31/2025	$112,891.00
531353	Collaborative Research: CyberTraining: Implementation: Medium: Introductory Computing Course Sequence Exemplars Infused with Parallel and Distributed Computing	Gerald Gannod	National Science Foundation	9/15/2023 to 8/31/2026	$57,810.00
533289	Demographic Changes in Tennessee's Elderly Population between 2009 and 2022 and their Implications for Transportation Planning and Impact on Transferability of Generation Models of Travel by the Elderly	Daniel Badoe	Tennessee Department of Transportation - UTAP	9/1/2024 to 2/28/2026	$92,261.26

Index	Title	P.I.	Source	Project Dates	Amount
535468	Interrogating Carbene Chemistry using Microwave Spectroscopy & Laser Photolysis: Unambiguous Characterization of Triplet Ethylidene (3CH3CH)	Ranil Gurusinghe	American Chemical Society	9/1/2024 to 8/31/2026	$55,000.00
531342	Collaborative Research:SitS: Collaborative: Long Range Wirelessly Powered Multi-variable Sensor Network for Continuous Monitoring of the Soil Health	Charles Van Neste	National Science Foundation	10/1/2022 to 9/30/2025	$113,147.00
539296	Hypersonic Onboard Power and Thermal Management System	Rory Roberts	Special Power Sources Via Air Force Funds	7/15/2024 to 1/15/2025	$10,000.00
532640	Initiatives to Grow New Innovate Talent to Enable Fusion Energy (IGNITE Fusion Energy)	Peng Zhang	Department of Energy	2/1/2025 to 1/31/2028	$168,232.00
539502	Site-Specific Ground Motion for Bridge Design in Tennessee	Timothy Huff	TDOT- State	1/15/2024 to 12/31/2026	$73,351.80
535330	Develop DMI Proprietary Duct Construction Standard for Flat Oval Duct	Jane Liu	Ductmate Industries Inc	11/22/2024 to 8/31/2025	$25,500.00
532479	Center for Agile and Intelligent Power Systems (CAIPS): Cybersecurity	Syed Hasan	DoE via Florida International University	10/1/2024 to 9/30/2026	$160,002.00
531344	IPA Assignment	Sheikh Ghafoor	National Science Foundation	2/13/2024 to 2/12/2026	$201,606.00
532480	Secure energy management for smart power grid using machine learning	Mohamed Mahmoud	United States Agency for International Development (USAID)	1/1/2025 to 12/31/2026	$97,991.26
532461	Lake Observations from Citizen Scientists and Satellites	Sheikh Ghafoor	UNC via NASA	12/25/2022 to 12/24/2025	$81,250.00
535320	Sustainable Transportation Electrification in the Appalachian Region	Tarek Elfouly	VentureWell	2/1/2024 to 8/31/2027	$7,679.00
531345	RET Site: Energize Teachers	Indranil Bhattacharya	National Science Foundation	5/1/2023 to 4/30/2026	$193,557.00

Index	Title	P.I.	Source	Project Dates	Amount
539296	Hypersonic Onboard Power and Thermal Management System	Rory Roberts	Special Power Sources Via Air Force Funds	7/15/2024 to 7/22/2025	$10,000.00
532820	NIBS Academic Review and Rewrite of NAVFAC DM 7.03- "Modification"	Daniel VandenBerge	United States Naval Facilities Command via National Institute of Building Sciences	9/21/2023 to 12/14/2026	$14,960.00
533298	Performance-Based Seismic Design of Bridges in Tennessee	Timothy Huff	TN Department of Transportation	6/1/2025 to 5/31/2027	$231,154.17
533293	Integrating Open Educational resources for Computer Networks Course	Zulkar Nine	Tennessee Board of Regents	7/1/2024 to 6/30/2025	$8,690.50
531357	Beginnings: Creating and Sustaining a Diverse Community of Expertise in Quantum Information Science (EQUIS)	Anthony Skjellum	National Science Foundation	11/1/2024 to 10/31/2025	$42,681.50
532635	PSAAP-III (FIC): Center for Understandable, Performant Exascale Communication Systems (CUP-ECS)	Anthony Skjellum	University of New Mexico	12/1/2024 to 11/30/2025	$153,144.00
532279	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali	Department of Energy	5/1/2025 to 4/30/2026	$165,589.00
532298	Development of Bipolar Complexants for Minor Actinide Separations	Jesse Carrick	Department of Energy	8/16/2024 to 8/15/2027	$73,710.00

TOTAL CONTRACTS AND GRANTS **$6,614,237.39**

CENTER FOR ENERGY SYSTEMS RESEARCH
STATUS OF PROPOSALS
Submitted Between July 1, 2024 through June 30, 2025

TITLE	INVESTIGATORS	SOURCE	AMOUNT
CAREER: Morphing vehicles and vehicle platoons with superior energy efficiency	Peng Zhang	National Science Foundation	$526,554.05
Demographic Changes in Tennessee's Elderly Population between 2009 and 2022 and their implications for Transportation Planning and Impact on Transferability of Generation Models of Travel by the Elderly	Daniel Badoe	Tennessee Department of Transportation	$128,999.23
CAREER: A Control-Theoretic Reinforcement Learning Framework for Observability-Constrained Problems: Exploring Data-Driven Learning Control Through the Lens of Frequency Domain	Syed Rizvi	National Science Foundation	$500,577.48
REU Site: Research and Entrepreneur Experience of Digital Twin-Enabled Smart Cities	Nan Chen	National Science Foundation	$431,368.94
Academic Review and Rewrite of NAVFAC dm 7.03	Daniel VandenBerge	NIBS	$14,962.51
Yielding Behavior of Low Void Ratio Clays	Daniel VandenBerge	National Science Foundation	$232,430.78
CRII: OAC: Towards scalable and energy-efficient data movement for next generation networks	Zulkar Nine	National Science Foundation	$174,999.65
REU Site: Enhancing Smart Monitoring: Development and Deployment of Smart Sensor Technologies for Real-Time Data Collection	Tarek Elfouly	National Science Foundation	$518,247.30

TITLE	INVESTIGATORS	SOURCE	AMOUNT
"STTR: Phase 1: Development of earth-based, long-range wireless power and date transfer for subsurface IoT systems"	Charles Van Neste	National Science Foundation	$92,000.03
Initiatives to Grow New Innovate Talent to Enable Fusion Energy (IGNITE Fusion Energy)	Peng Zhang	US Dept of Energy	$490,150.93
CAREER: Exploring Electromagnetic Coupling Phenomena Over and Through the Soil for Long-Range Wireless Power Transfer, Climate Monitoring and Energy Harvesting	Charles Van Neste	National Science Foundation	$534,821.23
Collaborative Research: PDaSP: Track 1: Private Data Sharing Through Practical and Trustworthy Federated Learning	Mohamed Mahmoud	National Science Foundation	$329,954.05
Develop DMI Proprietary Duct Construction Standard for Flat Oval Duct	Yan Liu	Ductmate Industries Inc	$25,500.00
ERI: Reusable Mass Timber Lateral Connections	Ian Morrell	National Science Foundation	$200,000.00
ERI: Environmental Protection Through Catalytical Processes; Computational With Experimental Validation	Ali Estejab	National Science Foundation	$200,000.00
ERI: Sample-Based Model Predictive Control and Estimation with Deep Neural Network System Identification for Vision-Guided Autonomous Systems	Hyung-Jin Yoon	National Science Foundation	$200,000.00
Flexibility and Fairness by Design at the Grid-Edge	Ali Arzani	Department of Energy	$4,658,254.51
Performance-Based Seismic Design of Bridges in Tennessee	Timothy Huff	Tennessee Department of Transportation	$231,154.17

TITLE	INVESTIGATORS	SOURCE	AMOUNT
A Novel Crystallization Process to Produce Lithium for Battery Production	Bahman Ghorashi	US Dept of the Interior	$244,320.01
Advancing TSMO Knowledge Management with Generative AI	Jiheng Huang	TRBNASEM	$450,000.02
Hypersonic Onboard Power and Thermal Management System	Rory Roberts	Special Power Sources, LLC	$10,000.00
Wireless Power Transmissions for Subsurface Characterization	Charles Van Neste	National Science Foundation	$50,000.00
ONR-Turtle	Kevin West	Office of Naval Research	$200,000.00
Physics-informed Deep Transfer Learning for Multi-city Traffic State Estimation	Jiheng Huang	National Science Foundation	$150,000.00
Artificial-Intelligence-Based Traffic Flow Optimization and Smart Charging for Electrical Vehicles	Jiheng Huang	National Science Foundation	$150,000.00
LEAPS-MPS: Interrogating Deuterium Chemistry as a Foundation for Astrochemistry and Fundamental Physical Chemistry	Ranil Gurusinghe	National Science Foundation	$247,430.00
USDOT Safe Streets and Roads for All	Jiheng Huang	USDOT	$692,693.20
Reinforcement Learning Based Graphical Multi-Agent Games for Optimizing Large-Scale Multi-Zone Building HVAC Controls	Syed Rizvi	National Institute of Standards and Technology	$100,000.00
TOTAL, PROPOSALS FOR 2024-2025			**$11,784,418.09**

Book Chapter:

- Kachroo, P., Agarwal, S., Huang, J. (2025). An Architecture for Signal Free Intersection Involving Autonomous Vehicles. In: Borowik, G., Chmaj, G., Waszkowski, R. (eds) Models and Methods for Systems Engineering. Studies in Big Data, vol 165. Springer, Cham. https://doi.org/10.1007/978-3-031-76440-0_9

Journal Papers:

1. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, "Demand side management considering load–voltage interdependence and optimal topology selection in active distribution networks", IEEE Access, pp. 49107-49120, March 2025.
2. Saleh Mobayen, Mohammadreza Askari Sepestanaki, Seyed Hossein Rouhani, Ali Arzani, Hwai C. Ong, and Chun-lien Su", Continuous adaptive barrier nonsingular integral-type terminal sliding mode control for frequency regulation in renewable integrated shipboard microgrids", Ocean Engineering, 334:121653, May 2025.
3. Chikezie M. Emeghara, Satish M. Mahajan, and Ali Arzani, "Two-stage photovoltaic system with a high-gain fifth-order boost converter", e-Prime - Advances in Electrical Engineering, Electronics and Energy, 13:101038, June 2025.
4. Hany A. Abdelsalam, Ehab M. Attia, Ali Arzani, and Satish M. Mahajan, "Efficient charging coordination of electric vehicles: A consensus tracking control approach", Sustainable Energy, Grids and Networks, 43:101771, June 2025.
5. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, "Enhancing operational planning of active distribution networks considering effective topology selection and thermal energy storage", iEnergy, 4(2), pp. 98–106, June 2025.
6. Ejikeme A. Amako, Ali Arzani, and Satish M. Mahajan, "Heuristic-based scheduling of BESS for multi-community large-scale active distribution network", Electricity, 6(3):36, June 2025.
7. Shampa Banik, Michael Rogers, Satish M. Mahajan, Chikezie Emeghara, Trapa Banik, & Robert Craven; "Survey on vulnerability testing in the smart grid"; IEEE ACCESS, 12, August 2024; 119146–119173. https://doi.org/10.1109/ACCESS.2024.3449642
8. J. Huang, A. Biswas and S. Agarwal, "Incorporating Nonlocal Traffic Flow Model in Physics-Informed Neural Networks," in IEEE Transactions on Intelligent Transportation Systems, vol. 25, no. 11, pp. 16249-16258, Nov. 2024, doi: 10.1109/TITS.2024.3429029. https://ieeexplore.ieee.org/abstract/document/10648894

Conference Papers:

1. Ejikeme A. Amako, Ali Arzani, and Satish M. Mahajan, "Optimal sizing of PV systems in a utility distribution feeder using OpenDSS", IEEE 56th North American Power Symposium (NAPS), El Paso, Texas, October 2024.

2. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, “Unbalance mitigation in an active distribution network considering Volt-VAr optimization and battery energy storage”, IEEE 56th North American Power Symposium (NAPS), El Paso, Texas, October 2024.
3. Sohag K. Saha, Ali Arzani, Reynaldo Salcedo, and Satish M. Mahajan, “Modbus TCP/IP based BESS plant controller operations for a peak shaving application”, IEEE 9th Texas Power and Energy Conference (TPEC), College Station, Texas, USA, February 2025.
4. Ejikeme A. Amako, Ali Arzani, and Satish M. Mahajan, “BESS scheduling for two communities of an active distribution network”, IEEE 9th Texas Power and Energy Conference (TPEC), College Station, Texas, USA, February 2025.
5. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, “A review of topology optimization approaches for active distribution networks”, IEEE 9th Texas Power and Energy Conference (TPEC), College Station, Texas, USA, February 2025.
6. Hany A. Abdelsalam, Ehab M. Attia, Ali Arzani, and Satish M. Mahajan, “A zero consensus-based tracking control for efficient DC-stage charging of EV battery”, IEEE 9th Texas Power and Energy Conference (TPEC), College Station, Texas, USA, February 2025.
7. Prashant Kumar, Ali Arzani, and Satish M. Mahajan, “A multiport converter for seamless PV-grid integration in EV charging systems”, IEEE/AIAA Transportation Electrification Conference and Electric Aircraft Technologies Symposium (iTEC+), Anaheim, CA, USA, June 2025.
8. Prashant Kumar, Ali Arzani, and Satish M. Mahajan, “MV grid integrated multiport configuration for EV fast charging station”, IEEE/AIAA Transportation Electrification Conference and Electric Aircraft Technologies Symposium (iTEC+), Anaheim, CA, USA, June 2025.
9. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, “Resilience planning of active distribution networks: A comprehensive review”, IEEE Industry Applications Society Annual Meeting (IAS), Taipei, Taiwan, June 2025.
10. Vineeth Vijayan, Ali Arzani, and Satish M. Mahajan, “Effective topology selection for improving resilience and voltage profile in electric distribution networks”, IEEE Industry Applications Society Annual Meeting (IAS), Taipei, Taiwan, June 2025.
11. Prashant Kumar, Ali Arzani, and Satish M. Mahajan, “Fault-tolerant control of a single-phase bidirectional dual active bridge DC-DC converter”, IEEE 9th International Conference on Clean Electrical Power, Sardinia, Italy, June 2025.
12. Shanae Tyree, “AI: The Crossroads Where AI and Critical Analyses Meet”, NCURA FRA Conference, San Diego, CA, USA, 2025.
13. Sohag Kumar Saha and Satish M. Mahajan, “Multivariate Optimal Hybrid Deep Learning Model for Forecasting of Day-Ahead Solar Irradiance with Meteorological Constraints”; IEEE 56th North American Power Symposium (NAPS), El Paso, Texas, October 2024.

Posters Presented in the TREEDC Meeting during November 2024:

1. KC. Bishal, and M. Hussein. Location Planning for Electric Vehicle Charging Stations Using a MCDM Approach and Genetic Algorithm", poster presentation at TREEDC Conference, Nov 2024.
2. S. Khadka, A. Arzani, and S.M. Mahajan, "Impact of Uncontrolled EV Charging on a Distribution Network", poster presentation at TREEDC Conference, Nov 2024.
3. E.A. Amako, A. Arzani, and S.M. Mahajan. Optimal Sizing of PV Plants in a Utility Distribution Feeder", poster presentation at TREEDC Conference, Nov 2024.
4. S.K. Saha, A. Arzani, and S.M. Mahajan. HILLTOP-Based BESS Plant for Peak-Shaving Application", poster presentation at TREEDC Conference, Nov 2024.

"An Overview of the Complexities of Flow Through Wind: A Computational Perspective"

Presented by:

Dr. Matthew Churchfield
Research Staff at the Renewable Energy Laboratory

in Colorado, USA.

Date: Thursday, September 5th 2024
Time: 11:00 a.m. to 12:00 p.m.
Location: Prescott Hall 225

Abstract:

Wind is the "fuel" of wind farms. To design and operate wind farms and wind turbines well requires a fundamental understanding of this fuel, the wind. A better fundamental understanding of the wind can come from field observations and from high-fidelity fluid flow simulations. In this talk, I will give an overview of complex wind-energy flow modeling research being performed at the National Renewable Energy Laboratory. I will also show how such research is being used to explore ideas like advanced wind-farm control strategies to maximize energy production.

The wind flow within a wind farm is beautifully complex! The wind is turbulent, and the nature of the turbulence can change throughout the day (i.e., nighttime turbulence is very different than daytime turbulence). The turbulence in the wind also depends upon the regional-scale weather in the area, the terrain, the land surface characteristics (trees vs. barren desert vs. wind over ocean waves). On top of the complexity of turbulence are the low-energy wakes that trail behind each wind turbine in a wind farm and how they interact with downstream turbines. At times, wind farms may even create atmospheric gravity waves. I will discuss all these interesting

Speaker Bio:

Matt Churchfield is a distinguished member of the research staff at the National Renewable Energy Laboratory in Colorado, USA, and he is adjunct faculty in Indiana University's Department of Earth and Atmospheric Science. He holds a PhD in aeronautical engineering from Purdue University where he studied turbulence modeling for aircraft trailing vortex flows. At NREL, Matt specializes in advancing the science of high-fidelity wind-turbine/wind-plant flow modeling, and he is involved in many projects that apply such flow modeling to a variety of applications, including advanced wind plant control, survival of wind turbines in hurricanes, and fixed/ floating wind turbine behavior in the offshore environment. In his spare time, Matt's main hobbies include doing things (hiking, riding bikes, taking care of chickens and bees, cooking) with his wife and four children and working on their 1890s-era farmhouse.

"Optimization and Control of Power Systems with High Integration of Inverter Based Resources."

Presented by:

Mr. Md Shamim Hasan

Ph.D. Candidate at UNC Charlotte, NC

Date: Friday, February 7, 2025
Time: 11:00 a.m. to 12:00 p.m.
Location: Prescott Hall 225

Abstract:

With the increasing integration of inverter-based resources (IBRs) like solar PV and battery storage alongside traditional synchronous generators, the dynamics of modern power systems have become more complex, necessitating the importance of finding optimal operating points of IBRs and other grid-supportive devices. The discussion will focus on developing optimization methods in both transmission and distribution systems and discuss applications, such as optimization-based voltage control methodology for large-scale IBR integration in real-time dynamic simulations with detailed modeling of IBRs. In addition, the talk will briefly focus on developing detailed EMT simulations for various grid components—including transmission and distribution grids, synchronous generators, loads, and IBRs. Emphasis will be given to the challenges and methodologies for simulating large-scale systems, ensuring system stability, enhancing reliability, and improving frequency and voltage regulations in the presence of high integration of IBRs for grid following (GFL) and grid forming (GFM) control of inverters.

Speaker Bio:

Md Shamim Hasan received a B.Sc. degree in Electrical and Electronic Engineering from the Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, in 2016. He is currently a Ph.D. candidate in the Department of Electrical and Computer Engineering at the University of North Carolina at Charlotte, NC, USA. He previously worked as an Engineer at the Power Grid Company of Bangladesh (PGCB), Bangladesh and Gas Transmission Company of Bangladesh (GTCL).

His research interests include power system optimization, control, micro-grid modeling and power system dynamics with inclusion of high inverter-based resources both in bulk and distribution system. He has hands- on experience in power systems convex and non-linear optimization. He has hands-on experience working in dynamic power systems and detailed modeling of grid-supportive devices, like synchronous generators and inverter-based resources, for transmission or distribution grids. His interest also includes developing simulation algorithms that enable large-scale simulations.

He is a member of the IEEE, IEEE Power and Energy Society (PES) and IEEE Industry Application Society (IAS). He is the recipient of the 2024 IEEE Ralph Lee Prize Paper Award. He is a reviewer for several prestigious journals such as, IEEE Transactions on Power Systems, IEEE Transactions on Industry Applications, IEEE Transactions on Sustainable Energy, IEEE Transactions on Vehicular Technology etcetera.

"Artificial Intelligence-Assisted Attack-Resiliency Analytics for Smart Homes"

Presented by:

Dr. Mohammad Ashiqur Rahman

Florida International University

Date: April 8, 2025
Time: 11:00 AM – 12:00 PM
Location Prescott Hall Rm 225

Abstract

As cyber-physical systems (CPSs) evolved with the increasing availability of the internet of things (IoT) and improved communication infrastructures, their security has been a major concern to both practitioners and academicians. Empirical analysis or systematic verification of anticipated attacks, often considering control functions and attack properties in isolation, are not suitable for adequately realizing the threat space or making cost-effective hardening. Formal reasoning-based artificial intelligence has been proven advantageous for threat analysis because it is provable and noninvasive and has the power to model the system holistically. Furthermore, ML-based control techniques are increasingly used in modern IoT/CPSs, which often introduce different threat characteristics than typical physics-based controllers. These ML-based control functions lack systematic mathematical analyses. Therefore, we require mechanisms to conceptualize the control logic from the ML models to facilitate formal threat synthesis concerning such controllers. This talk will present several of our research works where we develop formal synthesis-based analytics to find potential attacks against smart systems, where ML is often used to increase the controller's performance or add security to it.

Speaker Bio:

Dr. Mohammad Ashiqur Rahman is an Associate Professor at the School of Computing and Information Sciences and the Department of Electrical and Computer Engineering at Florida International University. He obtained a PhD in computing and information systems in 2015 from the University of North Carolina at Charlotte (UNC Charlotte). Previously, he received BS and MS in computer science and engineering from Bangladesh University of Engineering and Technology (BUET). Dr. Rahman's primary research interests cover diverse problems in computer networks and cyber-physical systems (CPSs). His research focus primarily includes computer and information security, risk analysis and security hardening, secure and dependable resource allocation, and distributed computing. His research is funded mainly by the National Science Foundation, the Department of Energy, and the Department of Defense He is currently leading multiple grants on CPS security. Dr. Rahman coauthored a book and several book chapters and published over 150 peer-reviewed journals and conference papers. He served on various journal editorial boards and conference technical program committees (TPCs). In particular, Dr. Rahman is the Associate Editor of the IEEE Transactions on Information Forensics & Security (TIFS). He also served as the TPC Co-Chair of IEEE/IFIP NOMS 2023. Dr. Rahman is a senior IEEE member.

"Emerging memory technologies, novel techniques and their applications"

Presented By:

Dr. Kazi Asifuzzaman

Research Scientist at Oak Ridge National Laboratory (ORNL)

Date: April 15, 2025
Time: 11:00 AM-12:00 PM
Location: Prescott Hall Rm 225

Abstract:

Emerging memory technologies and novel techniques are crucial in addressing the performance bottlenecks of traditional memory systems, particularly for high-performance computing (HPC) and neuromorphic computing. Emerging memory technologies such as STT-MRAM, ReRAM, and Phase-change Memory (PCM) offer unique features that can be leveraged to improve performance and energy efficiency. Techniques like Processing in Memory (PIM) and Compute in Memory (CIM) further enhance system performance by minimizing data transfer latency, enabling computations directly within memory, and significantly reducing energy consumption. These advancements are especially crucial in HPC, where large-scale data processing is essential, and neuromorphic computing, which mimics brain-like structures to optimize learning and decision-making processes. As these technologies mature, they promise to overcome traditional memory bottlenecks, enabling faster, more energy-efficient systems for artificial intelligence, real-time analytics, and autonomous applications.

Speaker Bio:

Kazi Asifuzzaman is a Research Scientist at Oak Ridge National Laboratory (ORNL). His primary area of research focuses on memory systems, including in-memory computing, processing-in-memory, and the evaluation of novel and emerging memory technologies for high-performance computing (HPC) and neuromorphic systems. Before joining ORNL, Dr. Asifuzzaman completed his Ph.D. in computer architecture and worked as a researcher at the Barcelona Supercomputing Center in Spain. Previously, he earned his Master's degree in electronic design from Lund University in Sweden and worked on IT systems at a company in Japan.

"Methods to Improve State Estimation Performance for Real-Time Monitoring on Distribution Systems"

Presented by:

Dr. Gokhan Cakir

Senior Engineer, Duke Energy Corporation

Date: June 6, 2025
Time: 11:00 AM-12:00 PM
Location: Prescott Hall Rm 225

Abstract:

This talk will delve into innovative methods to improve the efficiency and reliability of power distribution systems through real-time monitoring and control. We will explore the critical role of Distribution System State Estimation (DSSE) in enabling advanced Smart Grid Applications such as Fault-Location, Isolation and Service Restoration (FLISR) and Volt-Var Optimization (VVO). Key challenges addressed include unbalanced systems, limited real-time measurements, and the integration of renewable energy resources. The presentation will first introduce Current-Based Distribution System State Estimation (C-DSSE). I will discuss Bus Load Allocation (BLA) convergence, identifying factors that impact performance of BLA, and propose a line model tuning methodology to adapt to seasonal and operational changes. A new load estimation approach using Advanced Metering Infrastructure (AMI) data will also be presented, offering more accurate load profiles. I will also give some insights what we are working on and general scheme of Energy Control Center (ECC) studies at Duke Energy.

Speaker Bio:

Gokhan Cakir is a Senior Engineer at Duke Energy Corporation, where he supports Duke Energy System Operations by conducting system reliability studies, analyzing powerflow, and system conditions. He received Ph.D. in Electrical Engineering from North Carolina State University (2024), an M.S. in Electrical & Computer Engineering from Tennessee Tech University (2013), and a B.S. in Electrical Engineering from Gazi University (2008). Gokhan has previously worked as a Senior Electrical and Instrumentation Engineer at Turkish Petroleum Company (2013-2019), and as a Design Engineer at Mitas Energy (2008-2010). His expertise focuses on ensuring the reliability and stability of power systems and research interests include state estimation, improving real-time monitoring of power systems and data analytics applications for power systems

"Power Flow Control with Phase Shifting Transformers (PSTs): Tackling Grid Congestion Challenges"

Presented by:

Dr. Tapan Manna

Technical Consultant: Burns & McDonnell

Date: Friday, June 13, 2025
Time: 11:00 a.m. to 12:00 noon
Location: Prescott Hall 225

Abstract:

Today's power grids face enormous challenges—from growing electricity demand and renewable energy to more power flowing across regions. One major issue is grid congestion; some power lines get overloaded while others are underused. This can hurt the power grid's performance and reliability. Phase-shifting transformers (PSTs) are a proven way to fix this. Changing the phase angle between power lines, PSTs help control where and how much power flows. This makes the grid more balanced and efficient.

In this talk, we will discuss how PSTs work, their key designs, and why they're essential for modern power grids. We'll also share real-world examples from India, Europe, and North America to show how PSTs are being used to reduce congestion and improve reliability.

This session is ideal for students, researchers, and anyone interested in power systems, transmission networks, and smarter grid solutions.

Speaker Bio:

Dr. Tapan Manna is a Technical Consultant at Burns & McDonnell, Kansas City, with over 30 years of experience in the power industry and academia. He has been with Burns since 2009, following previous roles at URS (now AECOM), Black & Veatch, and Tennessee Tech University. Before moving to the U.S., he spent a decade working with CESC and WBPDCL, two major utilities in eastern India.

Dr. Manna earned his Ph.D. in Electrical Engineering from Tennessee Tech University in 2006. His expertise and interests include power system, high-voltage (HV) and extra-high-voltage (EHV) power apparatus, HVDC and FACTS, 765kV systems, grounding, lightning transients, geomagnetic disturbances (GMD), harmonics, and electromagnetic pulse (EMP). He has delivered over 50 technical presentations on T&D applications.

A licensed Professional Engineer (PE), Project Management Professional (PMP), Chartered Engineer, and Senior IEEE Member, Dr. Manna has actively contributed to more than 20 IEEE-PES and CIGRE working groups and has authored numerous technical papers, articles, and standards. His contributions at Burns & McDonnell have been recognized with several prestigious honors, including the 2019 Keith W. Jeffers Technical Excellence Award and the 2023 Blue Quill Hall of Fame Award.

Dr. Manna is passionate about advancing the power industry and collaborating with fellow professionals to drive meaningful impact.

MASTERS

Joseph Himes

"Leveraging Surplus Energy from Nuclear Power Generation for Seawater Desalination: A Process Modeling Investigation"

Summer 2024
Dr. Jonathan (Robby) Sanders
Chemical Engineering

Shushanta Chakraborty

"Curing Behavior and Undrained Shear Strength of Clay Stabilized with Type IL Cement"

Summer 2024
Dr. Daniel VandenBerge
Civil Engineering

S M Mostaq Hossain

"SoftPUF: a Software-Based Blockchain Framework using PUF and Machine Learning"

Summer 2024
Dr. Sheikh Ghafoor
Computer Science

Tyler Marcrum

Summer 2024
Dr. Charles Van Neste
Electrical and Computer Engineering

Michael Tidwell

"Development of Communication Utilizing Through-the-Soil Wireless Power Transfer"

Summer 2024
Dr. Charles Van Neste
Electrical and Computer Engineering

Yang Zheng

"Cooperative and Resilient Energy Compensation in the Smart Grid using Mobile-Aware Electric Vehicles"

Summer 2024
Dr. Nan Chen
Electrical and Computer Engineering

Taiye Owu

"Modelling and Optimization of a Cross Double-D Electromagnetic Coupler for Enhanced Misalignment Performance in Wireless Charging Applications"

Summer 2024
Dr. Satish M. Mahajan
Electrical and Computer Engineering

Trevor Kramer

Summer 2024
Dr. Rory Roberts
Mechanical Engineering

Landon Davis

"The Effect of High Initial Curing Temperatures on Compressive Strength of Some Common Tennessee Concrete Mixtures"

Fall 2024
Dr. Lewis Crouch
Civil Engineering

Samuel Asare-Duah

"A Temporal Analysis of Travel by the Urban and Rural Elderly and Their Implications for Transportation Planning"

Fall 2024
Dr. Daniel Badoe
Civil Engineering

Caleb Dunlap

Fall 2024
Dr. Charles Van Neste
Mechanical Engineering

David Schafer

Fall 2024
Dr. Rory Roberts
Mechanical Engineering

Kundan Rathod

Fall 2024
Dr. Timothy Huff
Civil Engineering

Sohag Kumar Saha

Fall 2024
Dr. Satish Mahajan
Electrical and Computer Engineering

Thomas Hines

Spring 2025
Dr. Sheikh Ghafoor
Computer Science

Christopher Storm Johnson

Spring 2025
Dr Charles Van Neste
Electrical and Computer Engineering

Brett Harden

"Grid-Induced Ground Current Fault Detection and Triangulation Through Non-Contact Methods"

Spring 2025
Dr. Charles Van Neste
Electrical and Computer Engineering

Grace Dadzie

"Scalable IOT and Edge AI for Real-Time Flood Monitoring and Prediction"

Spring 2025
Dr. J. W. Bruce
Electrical and Computer Engineering

Number of MS Students: 18

PhD

Elmahedi Mahalal

"AI-Assisted Physical Layer Security in Next Generation Wireless Networks"

Summer 2024

Dr. Muhammad Ismail

Engineering

Umair Mughal

"AI-Assisted Intrusion Detection System for Swarms of Unmanned Aerial Vehicles"

Summer 2024

Dr. Muhammad Ismail

Engineering

Josiah Haruna

"High Density Symmetrical Two-Phase Induction Machine Drive"

Summer 2024

Dr. Mohamed Mahmoud

Engineering

Ahmed Ahmed

"Investigating Robust Reinforcement Learning Models for Securing Smart Grids"

Summer 2024

Dr. Mohamed Mahmoud

Engineering

Atef Bondok

"Towards Secure Federated Learning Against Adversarial Attacks in Smart Grids"

Summer 2024

Dr. Mohamed Mahmoud

Engineering

Abayomi Adeleke

"Exploring Nanoscale Interactions and Magnetic Field Effects in Polyacrylamide Gel Nanocomposite Structures"

Fall 2024

Dr. Pedro Arce

Engineering

Tyler Marcrum

"Quasi-Wireless Power Transfer Utilizing Quarter Wave Resonators with a Focus in Aerospace Robotics"

Fall 2024

Dr. Charles Van Neste

Engineering

Ty Hagan

"Thermocavitation over an Ice Interface"

Fall 2024

Dr. Rory Roberts

Engineering

Trevor Kramer

"Effects of SOFC Pressurization and Investigation of SOFC Gas Turbine Hybrids for Aerospace Applications"

Fall 2024

Dr. Rory Roberts

Engineering

Ebrahim Nasr Esfahani

"Simulation and Experimental Analysis of a Double-Sided Lattice-Compensated Wireless Power Transfer System for Electric Vehicles"

Spring 2025

Dr. Indranil Bhattacharya

Engineering

Carey Ann Wilson

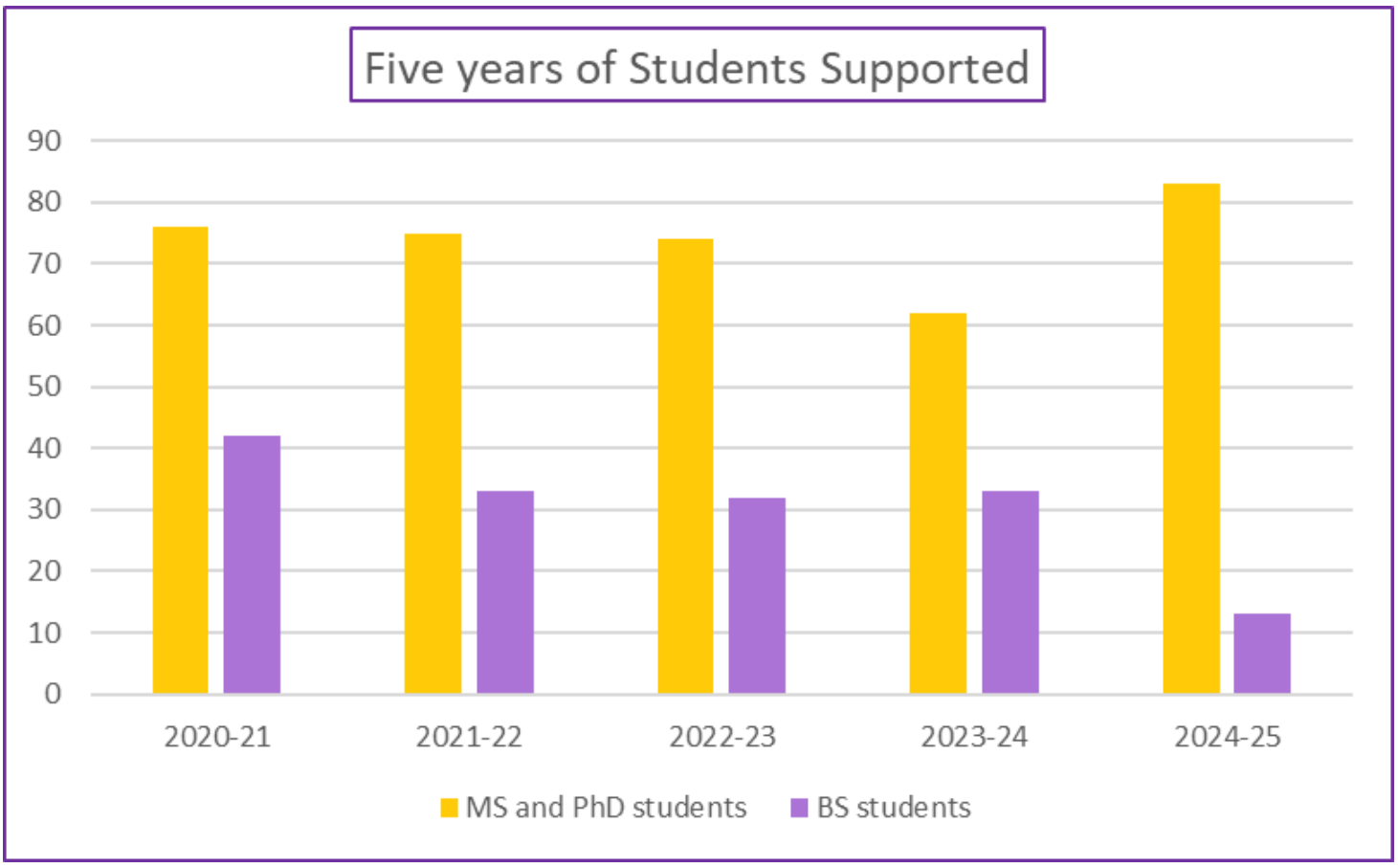
"Got STEM Education? A Content Analysis of Four STEM Education Journals"

Spring 2025

Dr. Pedro Arce/Dr. Holly Anthony

STEM Education

Number of PhD Students: 11



Number of Students Supported Financially

PH.D. STUDENTS SM-9

Name	Dept.	Source of Support	Advisor
Ifeoluwa Adeloye	ECE	CESR	Bhattacharya
Ejikeme Amako	ECE	ARC ARISE	Arzani/Mahajan
Mary Vinolisha Antony Dhason	ECE	CESR	Bhattacharya
Junaid Anwar	ECE	NIST & CESR	Rizvi
Brendan Atarigiya	CEE	CESR	VandenBerge
Shampa Banik	CSC	CESR Match CS & CESR	Rogers
Trapa Banik	ECE	TVA & NSF RET & CESR	Bhattacharya
Rajat Bhattarai	CSC	NASA UNC	Ghafoor
Jessica Baugh	CSC	CESR Match CS & NSF Shield	Ismail
Atef Bondok	ECE	CESR	Mahmoud
Caleb Dunlap	ECE	CESR	Van Neste
Nathan Duran-Ledezma	CHE	IUSE & NSF RET & CESR	Biernacki
Marwan Elawady	CSC	NSF G6	Ismail
Abdelrham Elsayed	ECE	ARC ARISE & CESR	Arzani/Mahajan
Mariam Gado	CSC	NSF Shield	Ismail
Eslam Hasan	CSC	NSF ERI	Ismail
Shafieh Karami	CHE	CESR	Arce
Sina Kazemipour	ME	LUNA & CESR	Zhang
Srijan Khadka	ECE	ARC ARISE	Arzani/Mahajan
Priyanka Mahajan	CHE	CESR	Arce
Elmahedi Mahalal	CSC	TEES Next Gen & NSF ERI	Ismail
Mohamed Mansour	ECE	CESR	Bhattacharya
Tyler Marcrum	ECE	SitS	Van Neste
Mohamed Shaban Mohamed	CSC	NSF G6	Ismail
Umair Mughal	CSC	TEES Next Gen	Ismail
Grace Nansamba	CSC	CESR	Skjellum
Jennifer Nwafor	CHE	CESR	Arce
Seyed A. Osia	CEE	CESR	VandenBerge
Mohsen Pourfallah	ME	CESR	Languri
Ashwini Rathod	ECE	CESR	Van Neste/Mahajan
Kundan Rathod	CEE	CESR	Huff
Sohag Kumar Saha	ECE	CESR Match CS	Mahajan/Arzani
Nabil B. S. Shuva	ECE	CESR	Mahajan
Humaira Tasnim	ME	CESR	Yoon
Robert John Thomas	ECE	TVA	Van Neste

M.S. STUDENTS SM-9

Name	Dept.	Source of Support	Advisor
Henry Asamany	CEE	TDOT & CESR & NIBS	VandenBerge
Jesse Akowauh	CEE	TDOT UTAP	Badoe
Samuel Asare-Duah	CEE	TDOT	Badoe
Shushanta Chakraborty	CEE	TDOT	VandenBerge
Ryan Cunningham	CEE	TDOT UTAP #2	Huff
Grace Dadzie	ECE	CESR	Kalyanapu/Bruce
Md Saeid Ebna Maleque	CEE	TDOT & CESR	Mohr
Christopher Elson	CHE	SitS	Stretz
Abbie Ferguson	CEE	TDOT UTAP	Huff
Anna Gore	CEE	NIBS	VandenBerge
Brett Harden	ECE	TVA & SitS	Van Neste
Dylan Hazard	MBA	ARC ARISE TCRI CS	Aikens
Megan Hendrickson	CSC	NASA UNC & CESR	Ghafoor
Thushitha Jayasekara Mudiyanselage Wa Gedara	Chem	ACS PRF	Gurusinghe
Randi Kalahe Padikoralage	Chem	ACS PRF	Gurusinghe
Pramashis Kar	CEE	TDOT & CESR	Mohr
Bishal KC	CSC	ARC ARISE	Hussein
Charles Ofori	ECE	ARC ARISE	Aikens
Conor Orr	ECE	SitS	Van Neste
Taiye Owu	ECE	CESR	Mahajan
Carson Pope	ECE	SitS & CESR	Van Neste
Babatunde Soyoye	ECE	CESR	Bhattacharya
Gabriel Tardy	CEE	CESR	Liu
Yang Zheng	ECE	CESR	N. Chen
Joel Wallace	CEE	CESR	Morrell
Mitchel Watson	MBA	ARC ARISE TCRI CS	Aikens

HOURLY STUDENT PERSONNEL SM-10

Undergraduate Students		Degrees and Major
Gabriel R. Adams		Bachelor of Science- Computer Science
Lewis F. Bates		Bachelor of Science- Computer Engineering
Branson M. Blaylock		Bachelor of Science- Mechanical Engineering
Asher Britt		Bachelor of Science- Physics
Israel Cansino		Bachelor of Science- Civil Engineering
Easton T. Cash		Bachelor of Science- Chemical Engineering
Yaran Hassan		Bachelor of Science- Business/IT
Megan Hendrickson		Bachelor of Science- Computer Engineering
Micah D. Owens		Bachelor of Science- Civil Engineering
Bane Shafer		Bachelor of Science- Mechanical Engineering
Nikolas Vassilev		Bachelor of Science- Chemistry
Ezekiel Vespie		Bachelor of Science- Physics
Ethan White		Bachelor of Science- Physics

Masters Graduate Students		Degrees and Major
Henry Asamany		M.S.- Civil and Environmental Engineering
Landon Davis		M.S.- Civil and Environmental Engineering
Christopher Elson		M.S.- Chemical Engineering
Charles Ofori		M.S. - Electrical and Computer Engineering

Ph.D. Graduate Students		Degrees and Major
Trapa Banik		Ph.D. - Electrical and Computer Engineering
Nathan Duran-Ledezma		Ph.D. - Chemical Engineering
Marwan Elawady		Ph.D. - Computer Science
Abdelrham Elsayed		Ph.D. - Electrical and Computer Engineering
Jacob Foster		Ph.D. - Mechanical Engineering
Mariam Gado		Ph.D. - Computer Science
Eslam Hasan		Ph.D. - Computer Science
Brandon Hines		Ph.D. - Mechanical Engineering
Christopher Johnson		Ph.D. - Electrical and Computer Engineering
Chloe (Cadence) Miller		Ph.D. - Chemistry
Bradley Northern		Ph.D. - Computer Science
Owen O'Connor		Ph.D. - Electrical and Computer Engineering
Ashwini Rathod		Ph.D. - Electrical and Computer Engineering
Nabil B. S. Shuva		Ph.D. - Electrical and Computer Engineering
Nicholas Skjellum		Ph.D. - Computer Science
Robert John Thomas		Ph.D. - Electrical and Computer Engineering

UNDERGRADUATE RESEARCH PROJECTS SM-11

Student	Sponsor	Research Project Name	Faculty Advisor
Gabriel Adams	Appalachian Regional Commission	Smart Grid Development Consortium and HILLTOP Platform Expansion	Robert Craven
Lewis Bates	Appalachian Regional Commission	Smart Grid Development Consortium and HILLTOP Platform Expansion	Robert Craven
Branson Blaylock	Luna Innovations Incorporated	Multi-Input Strength Loss Sensing for Webbing Structures	Peng Zhang
Asher Britt	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali
Israel Cansino	Tennessee Department of Transportation	TDOT Federal Project, Guidance for Chemical Stabilization of Pavement Subgrade Soils in Tennessee	Daniel VandenBerge
Israel Cansino	Tennessee Department of Transportation	TDOT Federal-Early Age Concrete Acceptance	Benjamin Mohr
Israel Cansino	Tennessee Department of Transportation	TDOT State: Development of Tennessee UHPC for Bridge Applications	Benjamin Mohr
Israel Cansino	Tennessee Department of Transportation	TDOT Federal: Development of Tennessee UHPC for Bridge Applications	Benjamin Mohr
Easton Cash	National Science Foundation	NSF: Collaborative Research: SitS: Collaborative: Long Range Wirelessly Powered Multi-variable Sensor Network for Continuous Monitoring of the Soil Health	Holly Stretz
Easton Cash	National Science Foundation	NSF: Collaborative Research: SitS: Collaborative: Long Range Wirelessly Powered Multi-variable Sensor Network for Continuous Monitoring of the Soil Health	Holly Stretz

Student	Sponsor	Research Project Name	Faculty Advisor
Yaran Hassan	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali
Megan Hendrickson	University of North Carolina via National Aeronautics & Space Administration	UNC via NASA: Lake Observations from Citizen Scientists and Satellites	Sheikh Ghafoor
Micah Owens	Tennessee Department of Transportation	TDOT Federal Project, Guidance for Chemical Stabilization of Pavement Subgrade Soils in Tennessee	Daniel VandenBerge
Micah Owens	Tennessee Department of Transportation	TDOT Federal-Early Age Concrete Acceptance	Benjamin Mohr
Bane Shafer	Tennessee Department of Transportation	TDOT Federal-Early Age Concrete Acceptance	Benjamin Mohr
Nikolas Vassilev	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali
Ezekiel Vespie	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali
Ethan White	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Mustafa Rajabali

Creek Anderson	MS	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Ronnie Dunn	PhD	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Jessee Griffith	MS	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Michael Miner	PhD	ECE	Mahajan	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Katie Pabody	MS	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Catherine Philips	PhD	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Carey Wilson	PhD	ES	Arce	08/01/2024 to 07/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Dipendra Wagle	PhD	CE	Arce	8/20/2024 to 7/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Daphni Wetzlich-Engle	MS	ES	Allen	8/20/2024 to 7/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Claire Myers	MS	CE	Sanders	8/20/2024 to 7/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Olivia Campbell	PhD	ES	Buer	8/20/2024 to 7/31/2025	NSF NRT Engendering the Spirit of Gadugi at the FEW Nexus Program
Garrett Armstrong	MS	ECE	Bhattacharya	01/16/2025 to 12/31/2025	NSF NRT-GCR and AI: Immersive Research Traineeship in the Convergence of Artificial Intelligence, Energy, and Cyber Security.
Terry Hines	MS	ME	Anton	5/19/2025 to 12/31/2025	NSF NRT-GCR and AI: Immersive Research Traineeship in the Convergence of Artificial Intelligence, Energy, and Cyber Security.

ACRONYMS

ACS	American Chemical Society
ARC UCDD	Appalachian Regional Commission via Upper Cumberland Development District
ARPA-E	Advanced Research Projects Agency-Energy via Department of Energy
ASCE	American Society of Civil Engineers
CEE	Civil & Environmental Engineering
CESR	Center for Energy Systems Research (Tennessee Technological University)
CHE	Chemical Engineering
CSC	Computer Science
ECE	Electrical & Computer Engineering
DOD	Department of Defense
DOE	Department of Energy
EPRI Distribution Energy Resource	Electric Power Research Institute
FES	Fusion Energy Student
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
IGNITE	Initiatives to Grow New Innovate Talent to Enable
IUSE	Improved Undergraduate Success through Effective Critical Thinking via National Science Foundation
MBA	Master's of Business Administration
ME	Mechanical Engineering
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Systems Command
NIBS	National Institute of Building Sciences
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
ORED	Office of Research & Economic Development
ORNL	Oak Ridge National Laboratory
QNRF	Qatar NRF
Qatar via TAMU	Qatar via Texas A&M University
R&D	Research and Development
RENEW	Researching a New Energy Sciences Workforce
RET	Research Experiences for Teachers
SPS	Special Power Sources

TBR	Tennessee Board of Regents
TBR SERS Project	Tennessee Board of Regents via Student Engagement, Retention, and Success Grant
TDOT	Tennessee Department of Transportation
TREEDC	Tennessee Renewable Energy Economic Development Council
TVA	Tennessee Valley Authority
TVA Endowment	Tennessee Valley Authority Endowment
TVA-Sequoyah Nuclear	Tennessee Valley Authority-Sequoyah Nuclear

SCHEDULE 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET[3]

Institution: Tennessee Technological University

Center: Center for Energy Systems Research

	FY 2024-25 Actual			FY 2025-26 Proposed			FY 2026-27 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries									
Faculty	$905,109	$337,394	**$1,242,503**	$888,852	$510,778	**$1,399,630**	$890,000	$450,000	**$1,340,000**
Other Professional	$441,910	$317,236	**$759,146**	$448,698	$268,460	**$717,158**	$450,000	$240,000	**$690,000**
Clerical/ Supporting	$1,072	$24,676	**$25,748**	$0	$63,576	**$63,576**	$0	$38,000	**$38,000**
Assistantships	$425,947	$309,016	**$734,964**	$367,600	$177,461	**$545,061**	$375,000	$235,000	**$610,000**
Hourly Students	$95,562	$9,327	**$104,889**	$86,462	$4,000	**$90,462**	$90,000	$5,000	**$95,000**
Total Salaries	**$1,869,600**	**$997,650**	**$2,867,250**	**$1,791,612**	**$1,024,275**	**$2,815,887**	**$1,805,000**	**$968,000**	**$2,773,000**
Fringe Benefits	$666,857	$407,981	**$1,074,838**	$656,205	$180,000	**$836,205**	$685,000	$314,715	**$999,715**
Total Personnel	**$2,536,457**	**$1,405,631**	**$3,942,088**	**$2,447,818**	**$1,204,275**	**$3,652,093**	**$2,490,000**	**$1,282,715**	**$3,772,715**
Non-Personnel									
Travel	$103,976	$25,898	**$129,874**	$96,200	$24,742	**$120,942**	$95,000	$20,000	**$115,000**
Software	$0	$5,077	**$5,077**	$0	$0	**$0**	$0	$0	**$0**
Books & Journals	$0	$0	**$0**	$0	$0	**$0**	$0	$0	**$0**
Other Supplies	$173,715	$44,827	**$218,543**	$162,340	$70,078	**$232,418**	$165,000	$80,000	**$245,000**
Equipment	$7,500	$9,390	**$16,890**	$75,000	$0	**$75,000**	$50,000	$0	**$50,000**
Maintenance	$0	$515	**$515**	$0	$0	**$0**	$0	$10,000	**$10,000**
Scholarships	$843,032	$0	**$843,032**	$1,000,000	$0	**$1,000,000**	$750,000	$0	**$750,000**
Consultants	$2,112,526	$6,847	**$2,119,372**	$2,000,000	$0	**$2,000,000**	$2,500,000	$0	**$2,500,000**
Renovation	$0	$0	**$0**	$0	$0	**$0**	$0	$0	**$0**
Other (Specify):			**$0**			**$0**			**$0**
Seminars /Workshops .Conf	$0	$3,460	**$3,460**	$0	$0	**$0**	$0	$0	**$0**
			$0			**$0**			**$0**
			$0			**$0**			**$0**
Total Non-Personnel	**$3,240,749**	**$96,015**	**$3,336,764**	**$3,333,540**	**$94,820**	**$3,428,360**	**$3,560,000**	**$110,000**	**$3,670,000**
GRAND TOTAL	**$5,777,206**	**$1,501,646**	**$7,278,852**	**$5,781,358**	**$1,299,095**	**$7,080,453**	**$6,050,000**	**$1,392,715**	**$7,442,715**
Revenue	**NOTE: Actual Matching Funds do not include Indirect Costs of $1,002,415.29 for FY 2024-2025.**								
New State Appropriation		$1,176,100	**$1,176,100**		$1,205,100	**$1,205,100**		$1,392,715	**$1,392,715**
Carryover State Appropriation		$606,422	**$606,422**		$280,875	**$280,875**			**$0**
New Matching Funds	$5,777,206		**$5,777,206**	$5,781,358		**$5,781,358**	$6,050,000		**$6,050,000**
Carryover from Previous Matching Funds		$260,057	**$260,057**		$171,342	**$171,342**			**$0**
Total Revenue	**$5,777,206**	**$2,042,579**	**$7,819,785**	**$5,781,358**	**$1,657,317**	**$7,438,675**	**$6,050,000**	**$1,392,715**	**$7,442,715**

[3] NOTE: Carryover funds of $280,875 are committed to: 1) beginning investigators and early-career faculty (to build a foundation of leadership in energy-related research); 2) graduate student support; 3) cost-sharing for external grants.

JUSTIFICATION FOR 2025-2026 APPROPRIATIONS REQUEST

The Center for Energy Systems Research (CESR) respectfully requests a 5% increase in our annual budget allocation to address unavoidable rising costs that directly impact the Center's ability to fulfill its mission.

1. Increased Student Support Costs
    - CESR relies heavily on graduate and undergraduate research assistants to conduct sponsored projects, support faculty-led research, and engage in applied energy systems innovation.
    - Competitive stipends and tuition support are necessary to recruit and retain high-caliber students. Over the past year, student compensation and tuition-related costs have risen significantly, reflecting broader trends across higher education. Without additional funding, the Center risks losing valuable student talent to competing institutions and programs.
2. Faculty and Staff Salary Adjustments
    - Salary increases mandated at the state and university level have raised personnel costs. While these adjustments are essential to retaining qualified faculty and staff, they also place additional strain on CESR's limited budget. A 5% increase will help offset these costs, ensuring continued delivery of high-quality research, instruction, and outreach activities.
3. Inflationary Pressures on Operations

General inflation has increased the cost of goods, services, travel, and materials critical to CESR's research and administrative functions. These operational increases, while modest individually, collectively represent a substantial budget impact.

A 5% increase is essential to maintaining CESR's current level of productivity and competitiveness. CESR is committed to advancing Tennessee's research capacity, supporting industry partnerships, and preparing the next generation of energy systems engineers and researchers. This modest budget adjustment is necessary to uphold that commitment.