South Carolina State University

South Carolina Governor's Nuclear Advisory Council Meeting

(April 13, 2026)

By:

Dr. H. Bryan Riley

Email: hriley@scsu.edu

About SC State

As South Carolina's only public, historically black college and university (HBCU), we pride ourselves on providing an exceptional educational experience to all of our students. Since our establishment in 1896, we have helped to educate generations of scholars and leaders.

We are more than just our history, though. Today, we serve diverse students from our state, across the U.S. and around the world, with more than 30,000 active alumni and more than 2,900 current students.

SCSU is South Carolina's only **Research 2 (R2) university** as classified by the Carnegie Classification of Institutions of Higher Education. The R2 status signifies a university with "high research activity," meaning it spends at least $5 million on research and awards at least 20 research doctorates annually. SC State exceeds both criteria.

Outline of Presentation

1. Center for Energy and Environmental Solutions (CEES)

1.1. Establishment of CEES
1.2. Organizational Structure
1.3. Meet the CEES Team and Partnerships
1.3. Summer 2025 Internships
1.4. CEES Scholars and Scholarships
1.5. Summer BRIDGE Program – Incoming STEM Freshmen
1.6. Summer Science Institute – Middle School and High School Teachers
1.7. Cohort I & II- CEES Scholars
1.8. Science Outreach Program: Impact & Future Directions

2. Accomplishments, Research, and Resources

2.1. CEES's Scientific Productivity
2.2. SCSU CSTEM-T and SRNL Joint Activities (USC and Clemson's Research Posters)
2.3. Overview of the E2 Center (Nuclear Engineering)
2.4. Cybersecurity

3. Overall Impact of $8M State of SC Funding

3.1. How SCSU Achieved Carnegie R2 Research Status
3.2. Overall Impact of $8 State funding
3.3. Outcomes and Impacts

4. Q & A

Establishment of the Center for Energy and Environmental Solutions

Proviso 11.24. (CHE: Battelle Alliance at Savannah River National Lab). Of the funds appropriated for the Battelle Alliance, twenty percent shall be allocated to South Carolina State University, forty percent to the University of South Carolina, and forty percent to Clemson University. The funds must be expended collaboratively to conduct research partnerships and develop workforce training programs designed to fill engineering, science, research, and management positions. The three universities shall provide the Battelle Alliance with accredited academic personnel, intellectual capital, and resources necessary to build out research capabilities and programs.

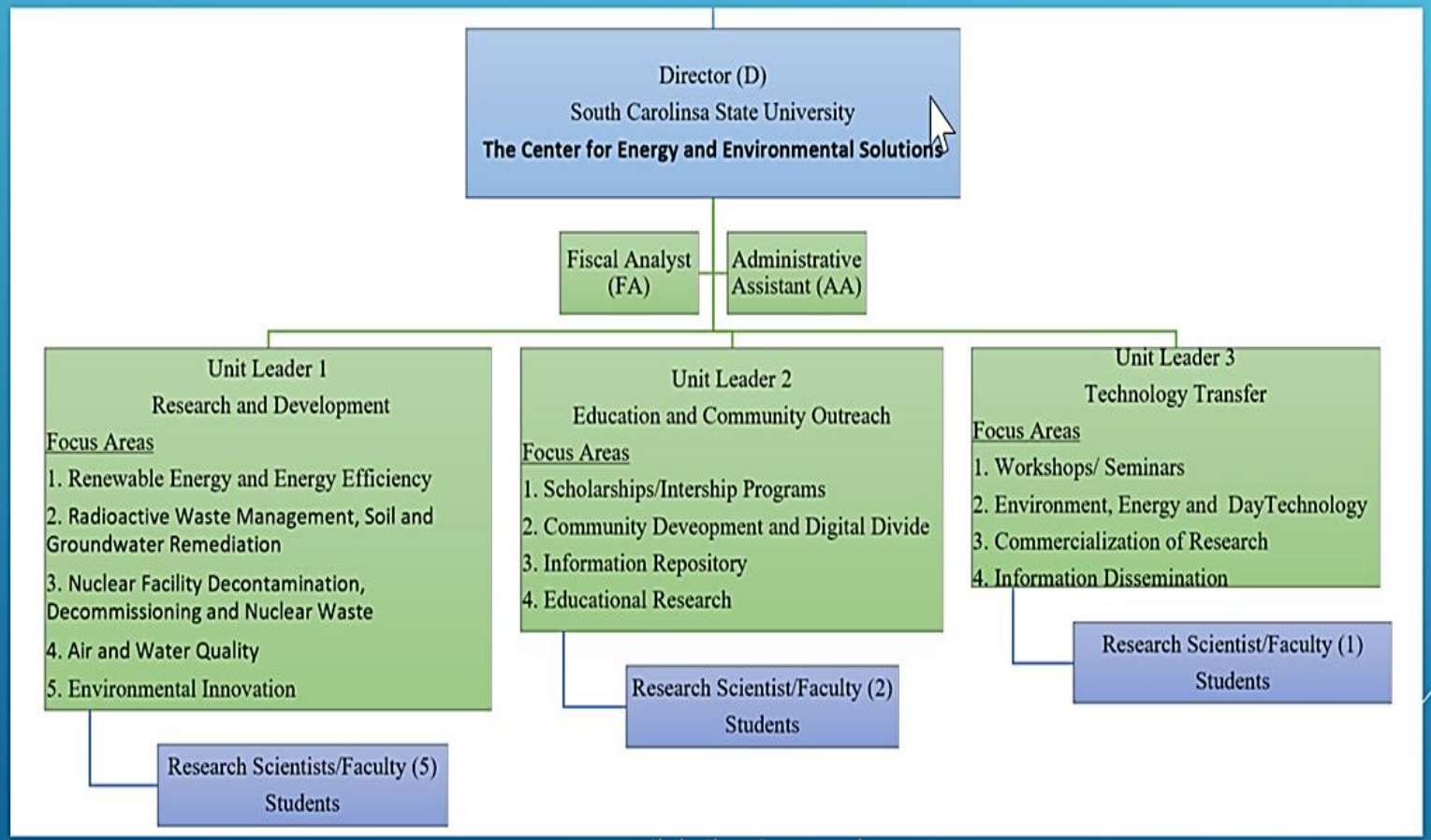
Collaborations between Savannah River National Laboratory (SRNL) and South Carolina State University (SCSU) College of Science, Technology, Engineering, Mathematics, and Transportation (STEM-T) will focus on the **nine key priorities** to maximize its impact on STEM research and workforce development.

The South Carolina General Assembly's FY 2025-2026 General Appropriation Act includes Proviso 93.24 which transfers the responsibility of reporting on Battelle Alliance expenditures, outcomes and progress from the South Carolina CHE to the South Carolina Department of Administration's Executive Budget Office (EBO). **Quarterly Financial Report Due Dates are Published.**

Organizational Structure

Dr. Stanley N. Ihekweazu, Dean, CSTEM-T

Mr. Elbert Malone. Associate Provost for Sponsored Programs and Research



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Meet the CEES Team and Partnerships

Summer 2025 Internships

CEES Sponsored Summer Internship Program (CEES-SSIP)

- CEES provides undergraduate students at South Carolina State University with hands-on research experiences in STEM fields
- CEES-sponsored interns receive up to **$20,000** in funding to support their participation in cutting-edge projects at universities, national labs, and/or industry partners.
- This program fosters meaningful collaborations between students and researchers to drive innovation in energy and environmental sciences.

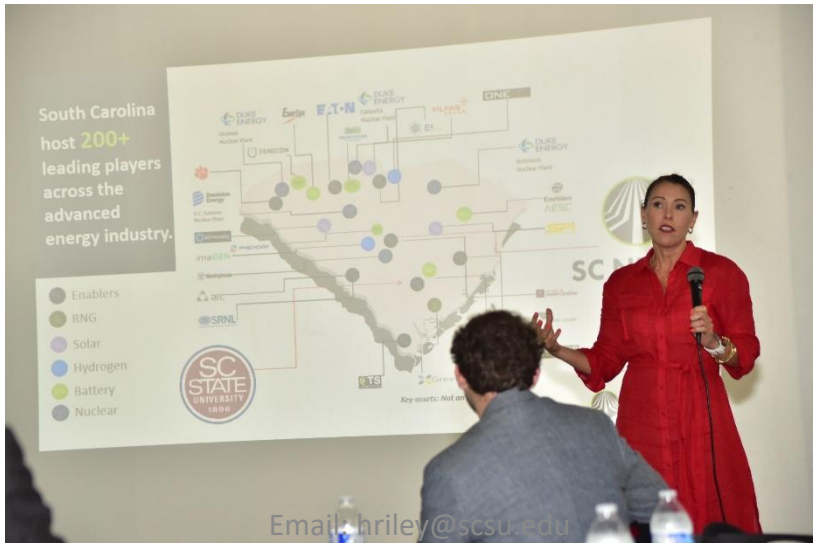
Funding Category	Amount Per Student	Details
Stipend	Sophomore: $900/wk Junior: $1000/wk Senior: $1200/wk	Based on classification. Internship must last at least 2 weeks, max allowed time frame is 10 weeks.
Travel Allowance	Up to $3,000	Covers airfare, mileage, or local transportation
Housing	Up to $4,000	Can be paid directly to the institution or reimbursed
Miscellaneous	$1,000 - $3,000	Covers training, conference fees, health insurance, etc.
Supplies/Equipment	Up to $1,000	Must be justified by the PI

Summer 2025 Internships (continued)

Student Intern Majors

- 1- Nuclear Engineering
- 1- Physics
- 1- Industrial Engineering
- 2 - Civil Engineering
- 1 – Mechanical Eng. Tech
- 1 – Electrical Engineering Tech
- 1 – Cybersecurity
- 1 – Transportation
- 5 – Chemistry
- 6 – Biology

Locations	# Of Interns	# Of PIs
South Carolina State University	14	8
Clemson University	3	2
University of South Carolina	2	2
The Medical University of South Carolina	1	1
Total	20	13



Summer 2025 Internships (continued)

Summer BRIDGE Program

BRIDGE 2025

MAJOR	SUMMER 2025
Biology	15
Chemistry	3
Civil Engineering	6
Computer Science	11
Cyber Security	2
Electrical Engineering (Technology)	2
Industrial Engineering	1
Mechanical Engineering (Technology)	3
Mechatronics Engineering	3
Nuclear Engineering	1
Total	47

All 47 students are currently enrolled and doing well in their academic studies.

Here is a breakdown by majors of the 47 students that attended the inaugural BRIDGE program.

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Summer Science Institute

Summer Science Institute - One-week on-campus program was held in June for (12) middle to high school teachers who engaged in STEM projects and activities to enhance their teaching strategies. They participated in hands on activities, peer to peer networking to promote the career opportunity in science, technology, engineering and mathematics to their students.

The Summer Science Institute allows us to partner with middle and high school STEM educators who play a critical role in shaping the pipeline. By supporting both students and teachers, we extend our impact across generations and help transform lives through greater opportunity and success.

Cohort I & II

MAJOR	COHORT I	COHORT II
Biology	11	12
Chemistry	3	5
Civil Engineering	6	4
Computer Science	9	13
Cyber Security	11	7
Electrical Engineering (Technology)	2	
Industrial Engineering	4	1
Mechanical Engineering (Technology)	3	
Mechatronics Engineering		4
Nuclear Engineering	3	7
Physics		2
Total	51	55

Eligibility Requirements

As of today, these are the CEES scholarships awarded to scholars majoring in Science, Technology, Engineering & Mathematics.

Maintain a minimum 3.0 GPA
10 hours of community service
5 hours of tutoring weekly
Attend CEES sponsored meetings and/or trainings.

Science Outreach Program: Impact & Future Directions

- Our initiative bridges the gap between university research and K-12 education, fostering scientific curiosity and building pathways to STEM careers.
- This presentation highlights our achievements, challenges, and strategic next steps.

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CEES's Scientific Productivity (April 2025-Present)

Peer-reviewed Journal Papers

		Publisher	Impact Factor Range
Published Papers	**7**	**Elsevier, Springer, MDPI, Wiley, Royal Society of Chemistry (RSC)**	**5 - 40**
Submitted Papers	**9**		**10.9 - 40**

Developing New Courses

1	Introduction to Polymer Science and Engineering
2	Polymer Science Laboratory: Characterization and Fundamentals
3	Advanced Materials Science and Processing
4	Hydrogen: Electrochemistry and Applications

Proposals

		Organization	Funding Amount
Submitted Proposals	**7**	**SC EPSCoR, NSF, DOD, AFRL**	$13,710,000
Ongoing Proposals	**2**	**NSF SBIR, DOE**	$800,000

SCSU CSTEM-T and SRNL Joint Activities (Feb 3, 2026)

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Energy Exploration (E2) Center at SCSU

Using state-of-the-art computer modeling within a 12-module NuScale SMR control room simulator, the E2 Center allows users to assume the role of control room operator. Each workstation can view the status of any of the 12 units within the model. The center's innovative features include:

1. A library of digital procedures and automations.
2. A tiered notification system that informs operators of abnormal conditions.
3. Integrated emergency procedures.
4. Fully automated sequences for changing output and controlling equipment.

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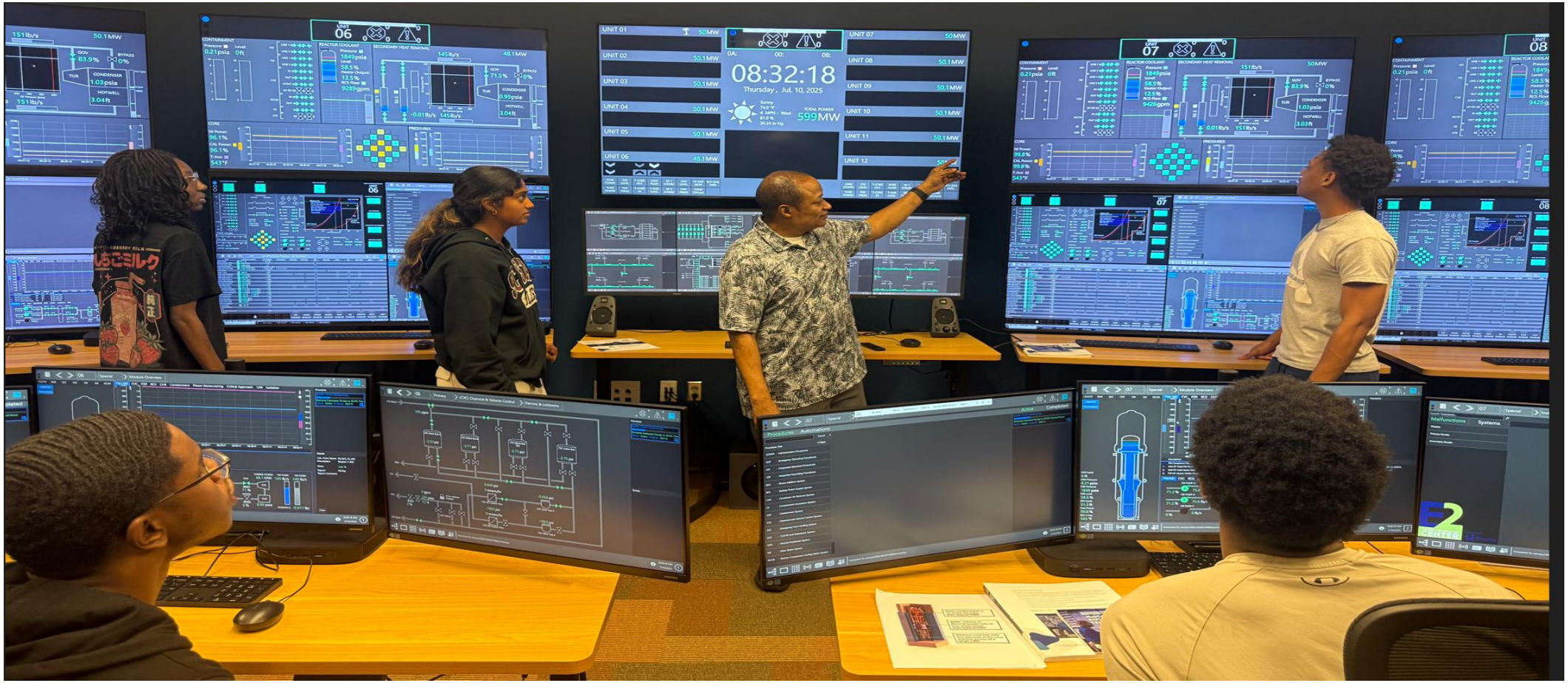
Energy Exploration (E2) Center at SCSU



Beyond classroom applications, the E2 Center also promotes collaborative research and builds bridges with industry leaders, academic partners and government entities — giving students a valuable network as they enter the field.

Energy Exploration (E2) Center at SCSU

Junior-Level Skill Development

- Use of simulator in reactor operations and safety courses
- Development of decision-making and system monitoring skills
- Team-based exercises to simulate real-world plant scenarios
- Reinforces theoretical concepts with practical application

Why the E2 Center Matters?

- Strengthens SC State's position as a leader in nuclear education
- Builds bridges with industry partners like SRNL and NuScale
- Supports professional development
- Inspires the next generation of nuclear scientists and engineers

Cybersecurity

Program Designations

- NSA Designation as a National Center of Academic Excellence in Cyber Defense Education (NCAE-C).
- NSA Validation of BS in Computer Science with Cybersecurity concentration.
- Lead Sponsor, SC HBCU Consortium on Employer Degree Apprenticeship Program.
- Member of IBM Global University Program.

Program Enrollment and Graduation Data

Program Enrollment	Degree	Fall 2020	Fall 2021	Fall 2022	Fall 2023	Fall 2024	Fall 2025	Total	Average
Computer Science	BS	79	89	109	154	153	152	736	122.7
Cybersecurity	BS	-	-	-	10	51	90	151	50.3

MS in Cybersecurity	**5 (Spring 2026)**
This number is expected to double during Fall 2026.	

Cybersecurity

Faculty Hires

Dr. Nyteisha Bookert, Assistant Professor of Cybersecurity (Spring 2025)

- Contributions
  - Course Instructions: Undergraduate and graduate course instruction in cybersecurity/AI
  - Research: Submitted a proposal to NSF titled "Research Initiation Award: Privacy Threat Detection in the Internet of Medical Things. NSF, 2026 – 2029.
  - Participation in Summer Research
- CS/Cyber/AI Hire – Completed review of Application and Interview. (Fall 2026)
- AI/Data Science Hire – Ongoing. (Fall 2026)

Laboratory Facilities of Cybersecurity

- **Physical laboratory stations**:
  - Application security, Industrial and IoT security,
  - Enterprise security, Network security and ethical hacking.
  - Computer Forensics
- **Virtual labs** include experiments on NISGTC Security+, NISGTC Network Security, NISGTC Forensics, NISGTC Ethical Hacking, CSSIA CompTIA Security+.
- Ongoing upgrades using funds from BSRA funds (Spring/Summer 2026):
  - **Cybersecurity for Drones**
  - NetLab

How SCSU Achieved Carnegie R2 Research Status

- **Research Expenditure Exceeding $5M (Minimum Threshold)**
SC State devoted **$7.8 million** to research in 2023, surpassing the required $5M minimum for R2 designation.

- **Doctoral Degree Graduation in Excess of 20 (Minimum Threshold)**
SC State awarded **25 doctoral degrees** in 2023, exceeding the required minimum of 20 research doctorates annually.

- **Exclusive National Standing**
SC State is one of only **139 institutions** selected from more than **3,000 colleges and universities** across the country evaluated for this designation.

- **Only R2 Institution in South Carolina** (with only **7% of universities in the nation**)

- **One of Only ~13 HBCUs Nationwide with R2 Status**

- **Key Research Areas Include Nuclear Engineering and Cybersecurity**

- **Pathway to R1 Status**
The next level — Carnegie R1 — is currently held by **180 schools nationwide**, including the University of South Carolina, Clemson University, and MUSC.

Overall Impact of $8M Funding To Date for SCSU CSTEM-T

- **Strategic Foundation Established**

  The CEES has successfully built a robust organizational structure, fostered high-impact partnerships, and launched transformative programs -internships, scholarships, and STEM pipeline initiatives (BRIDGE, Summer Science Institute, Outreach).

- **Talent Development & Workforce Pipeline**

  Through CEES Scholars, Cohorts I & II, and immersive summer programs, CEES is cultivating a diverse, highly skilled workforce aligned with national priorities in energy, environment, and cybersecurity.

- **Research Expansion & Collaboration**

  Significant growth in scientific productivity, strengthened collaborations with SRNL and regional R1 institutions (USC, Clemson), and expansion into critical areas such as Nuclear Engineering (E2 Center) and Cybersecurity.

- **Catalyst for Carnegie R2 Achievement**

  CEES played a pivotal role in advancing SCSU's research enterprise—contributing directly to achieving Carnegie R2 status

- **Maximizing State Investment ($8M Impact)**

  Strategic deployment of state funding has yielded measurable ROI:
  - Enhanced research infrastructure and capacity
  - Increased student access and success in STEM-T fields
  - Strengthened institutional competitiveness and visibility

- **Sustained Outcomes & Future Trajectory**

  CEES is positioned as a regional and national leader, driving innovation, workforce development, and interdisciplinary

Thank you for your attention

Q & A

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Supporting Information

Proposals

NSF: 3 proposals
Total: 13,410,000 $

DOD: 1 proposals
Total: 1,000,000 $

AFRL: 2 proposals
Total: 300,000 $

No.	Proposal Title	Submitted to	Funding Amount	Submission Timeline
1	Enhancing Teaching and Research Capabilities at SCSU with a High-Performance GC-MS	SC EPSCoR (Solicitation 1-MEP2025)	$77,790	April 7, 2025
2	EPSCoR Research Infrastructure Improvement Program: E-RISE	NSF 25-522	$8,000,000 + $4,500,000	August 12 2025
3	NCIrS Integrated Radiation Detection Lab: Advancing Education and Research	DOD, AFOSR, ARL	$1,000,000	April 28, 2025
4	EcoPower-SCSU: Advancing STEM Research and Workforce Development	NSF 25-523	$632,184	July 15, 2025
5	NSF 24-590 Engineering Research Initiation (ERI)	NSF 24-590	$200,000	September 16, 2025
6	Composite Functional Catalysts for Efficient Hydrogen-Powered C4I Systems	Air Force Research Laboratory (AFRL)	$150,000	
7	Solid-State Hybrid Materials for High-Capacity Battery Systems	Air Force Research Laboratory (AFRL)	$150,000	

CEES Organization

CEES's Hydrogen Strategy: Near Term Plan

Phase 1. Development of a **laboratory for hydrogen generation**.

Phase 2. Production of a **broad range of materials for hydrogen generation**.

Phase 3. Design and development of **hydrogen fuel cell laboratory**.

Phase 4. Development of **hydrogen simulation laboratory**.

Phase 5. Advancing hydrogen research **through innovation and training students**.

CEES's Advantages and Potentials in Hydrogen

Build Expert Teams → **Develop Advanced Hydrogen Technologies** → **Enhanced Community Engagement** → **Develop Trained Workforce** → **Solve Key Challenges**

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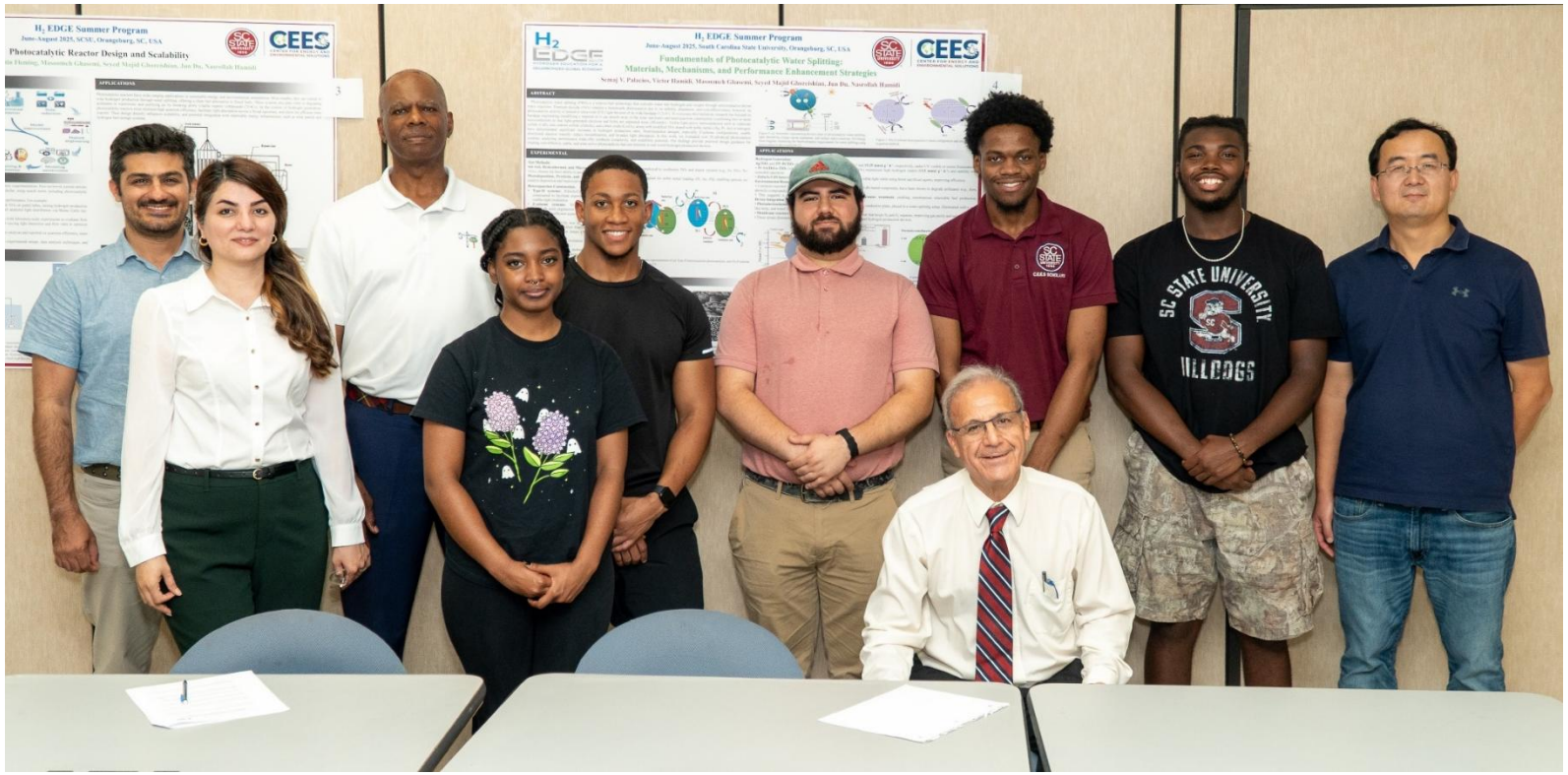
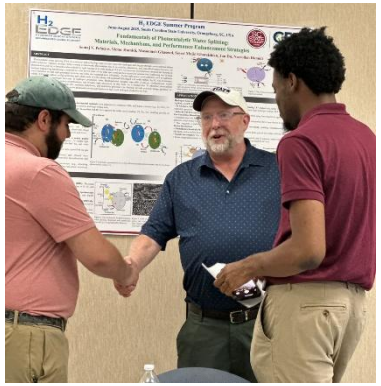
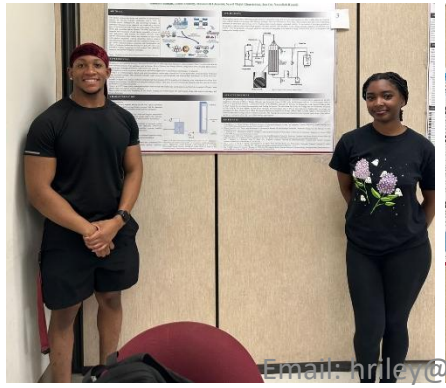
H2 EDGE Summer Program (Supported by CEES)

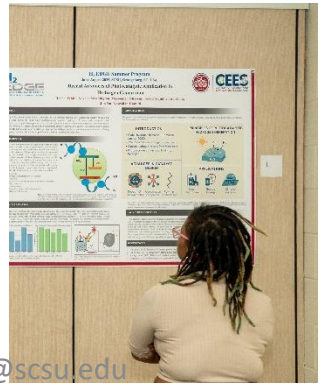
CEES proudly participated in the H2EDGE initiative, supported by the Department of Energy's Hydrogen and Fuel Cell Technology Office and the Low-Carbon Resources Initiative. This summer, eight students completed a 30-hour course on hydrogen fundamentals, including production, storage, and clean energy applications. Students conducted in-depth research, summarized scientific articles, and presented four group posters during the Final Celebration on August 25. Under faculty guidance, the team also co-authored a paper in the *International Journal of Hydrogen Energy* (Impact Factor 8.3). SCSU's contribution to H2EDGE highlights our commitment to developing the next generation of professionals in the emerging hydrogen industry.

H2 EDGE Summer Program (Supported by CEES)









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Recent advances in rational design of defect-engineered photocatalysts toward sustainable NH_3 synthesis as H_2 carrier: From fundamental and development to machine-learning

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Renewable energy
Nitrogen reduction
Hydrogen energy
Defect engineering

ABSTRACT

The Haber–Bosch process remains a pivotal technology in the synthesis of ammonia (NH_3). It has fundamentally transformed agriculture and the chemical industry; however, this method accounts for approximately 1 % of global annual energy consumption for nitrogen-based fertilizer production. This results in significant energy demands and substantial carbon dioxide emissions. As global efforts intensify to mitigate environmental impact, photocatalytic NH_3 synthesis has emerged as a promising, sustainable alternative. It produces nitrogen-containing compounds with lower energy requirements. This approach leverages sunlight as a renewable energy source and water as a reducing agent. Despite its potential, the efficiency of photocatalytic NH_3 synthesis is currently limited mainly due to the scarcity of highly active catalytic sites. Recent research has shown that engineering surface defects on photocatalysts can improve their performance. These defects enhance light absorption, weaken the N≡N bond of adsorbed nitrogen (N_2), promote charge separation, and facilitate charge transfer to adsorbed reactants. Nevertheless, achieving a comprehensive understanding of how modifications to the catalyst's microstructure influence N_2 binding, activation, and hydrogenation remains a significant challenge. These knowledge gaps hinder the development of photocatalysts suitable for industrial use. In this review, we provide a detailed overview of the fundamental mechanisms underpinning photocatalytic N_2 reduction. We also discuss advances in catalyst design for the synthesis of NH_3. Particular emphasis is placed on the role of surface defect engineering, which includes the creation of surface defects to enhance the performance of semiconducting photocatalysts for efficient N_2 reduction. In addition, the application of a machine learning-based computational modeling approach is discussed as an important driving force for predicting and regulating NH_3 synthesis efficiency based on catalyst features and reaction conditions. Finally, existing challenges and future perspectives for improving the performance of defect-engineered photocatalysts are outlined to contribute to the ongoing discourse on sustainable ammonia generation. This review aims to clarify recent progress in the rational design of defect-containing photocatalysts for the synthesis of NH_3 and encourages innovative approaches to catalyst optimization rather than solely focusing on new materials.

1. Introduction

Energy poverty has a profound negative impact on economic growth, productivity, social welfare, and overall quality of life. In this context, ensuring access to affordable, reliable, sustainable, and modern energy is enshrined as the seventh Sustainable Development Goal of the United Nations [1]. According to the Energy Institute's Statistical Review of World Energy 2023, fossil fuels—comprising coal, oil, and natural

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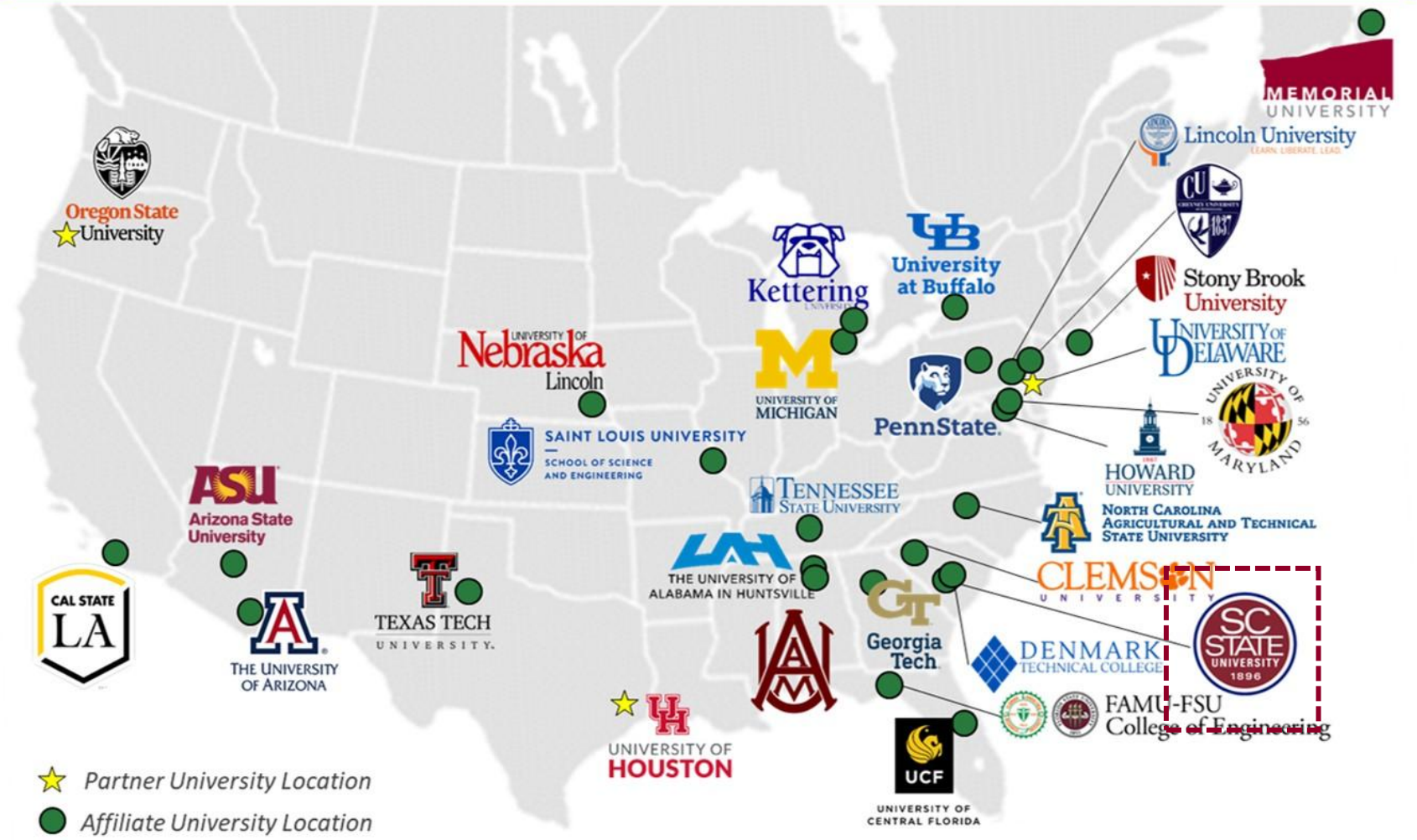
H2 EDGE Summer Program (Supported by CEES)

University Network



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Hydrogen Technology Expo 2026, Texas

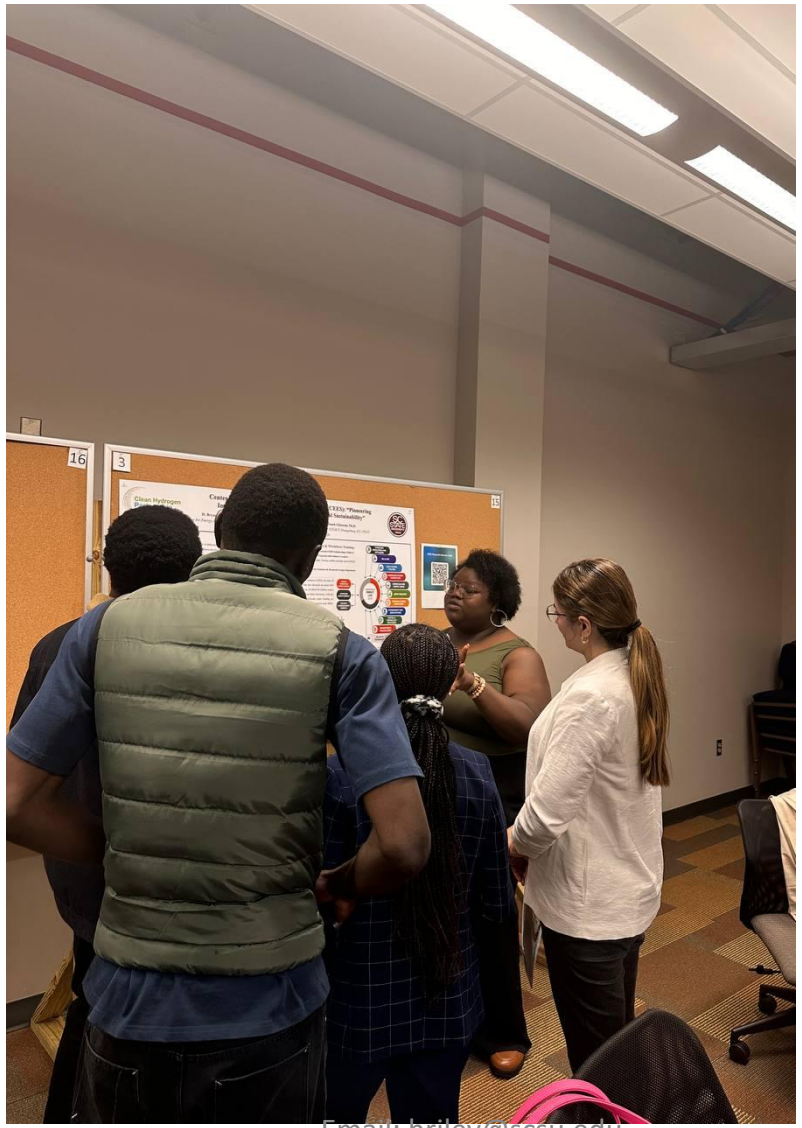
Hydrogen Technology Expo 2026, Texas

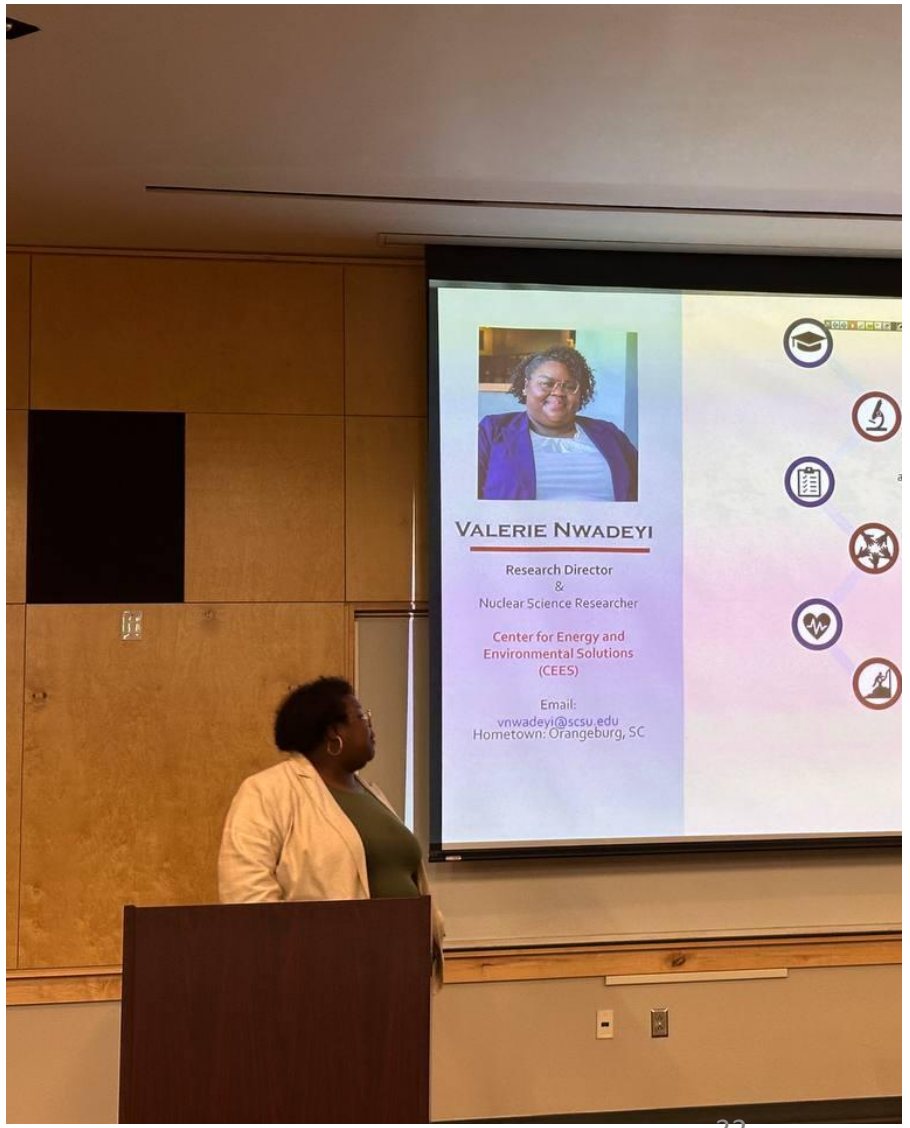
10,000 attendees

500 exhibitors

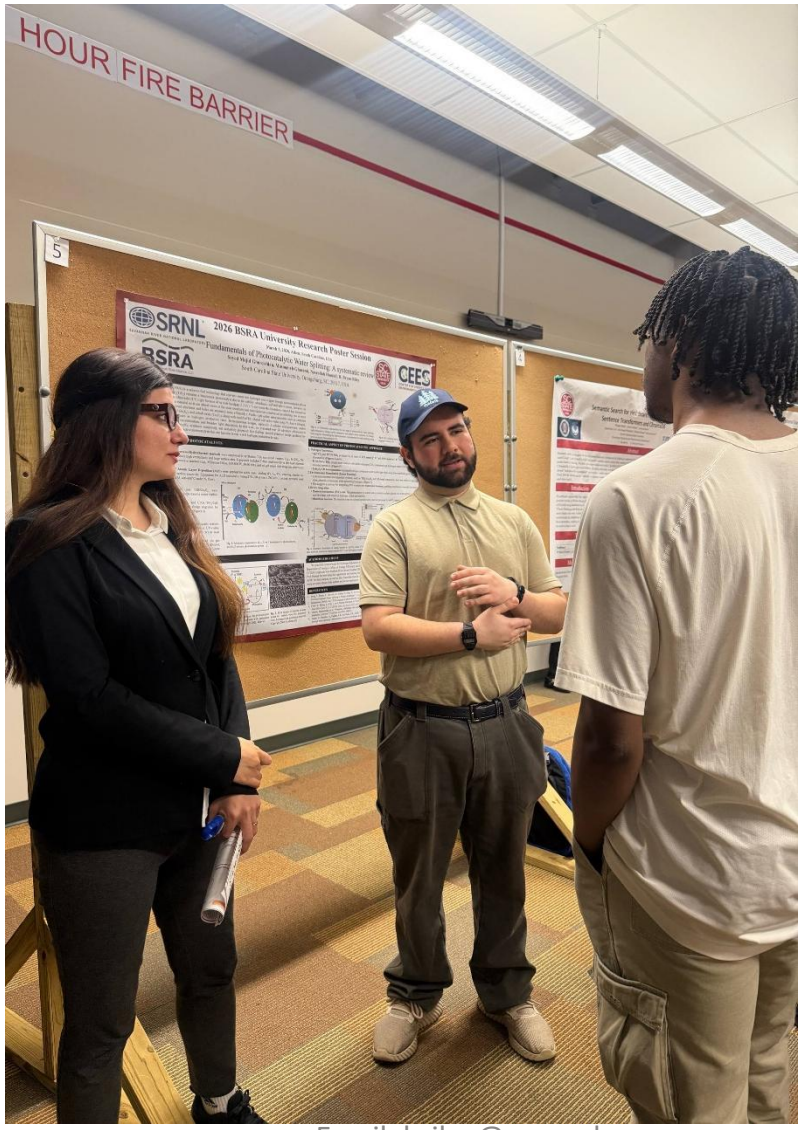
200 speakers

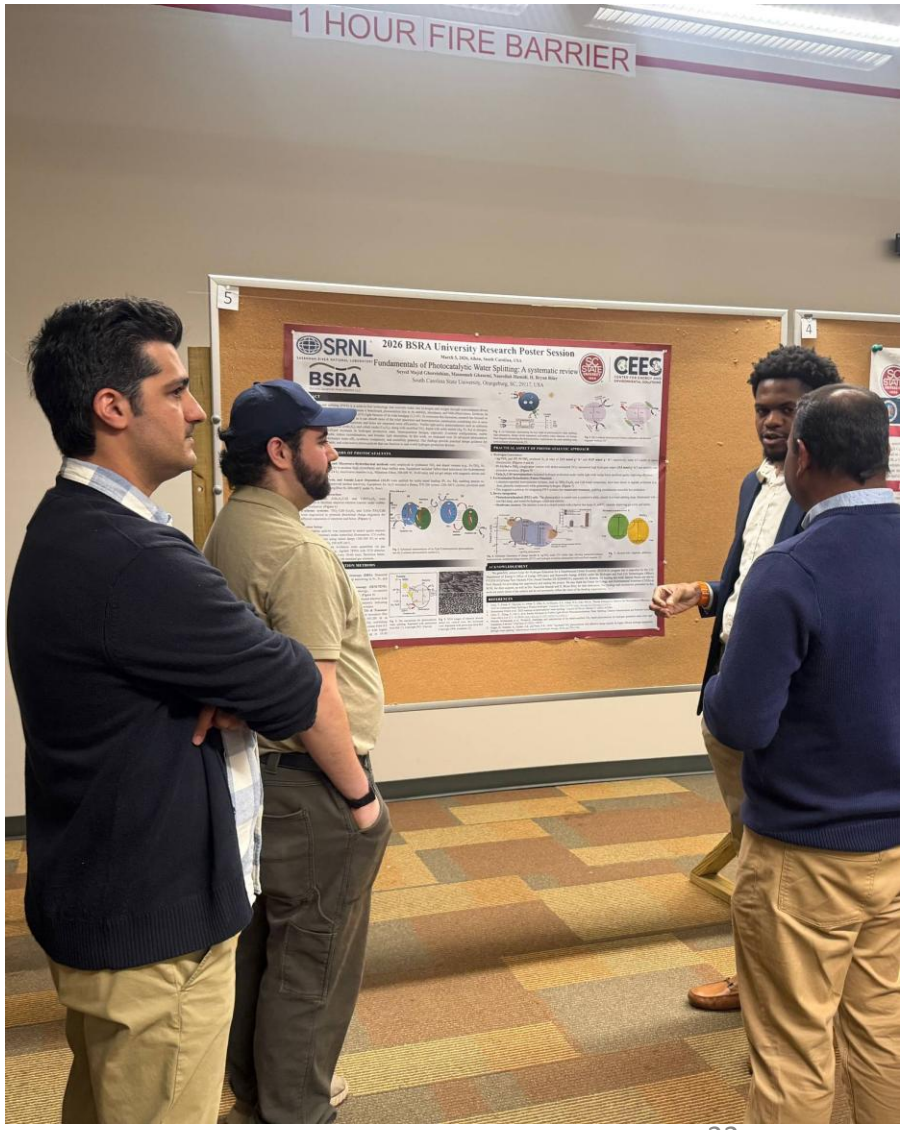
SCSU's STEM-T Showcase (March 26, 2025)





SCSU's STEM-T Showcase (March 18, 2026)





CEES's Domestic and International Collaborators

SC STATE UNIVERSITY 1896 | CEES CENTER FOR ENERGY AND ENVIRONMENTAL SOLUTIONS

UNIVERSITY OF SOUTH CAROLINA

UC DAVIS
UNIVERSITY OF CALIFORNIA

동국대학교 DONGGUK UNIVERSITY 1906

CHUNGNAM NATIONAL UNIVERSITY 충남대학교

SRNL®
SAVANNAH RIVER NATIONAL LABORATORY

UNIVERSITY OF WYOMING

CLEMSON UNIVERSITY EST. 1889

한국지질자원연구원 KIGAM Korea Institute of Geoscience and Mineral Resources

세명대학교 SEMYUNG UNIVERSITY

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Challenges & Opportunities for Growth

Resource Constraints

The HVAC system in Hodge Hall makes day to day operations very challenging with high temperatures.

1

2

Recruitment Challenges

The absence of a Scholarship Committee to select recipients by mid July and mid November.

There were 47 BRIDGE participants of which 13 have received scholarships for Fall 25.

3

Coordination Gaps

A Master calendar to guide the planning of events especially summer programs to not overlap.