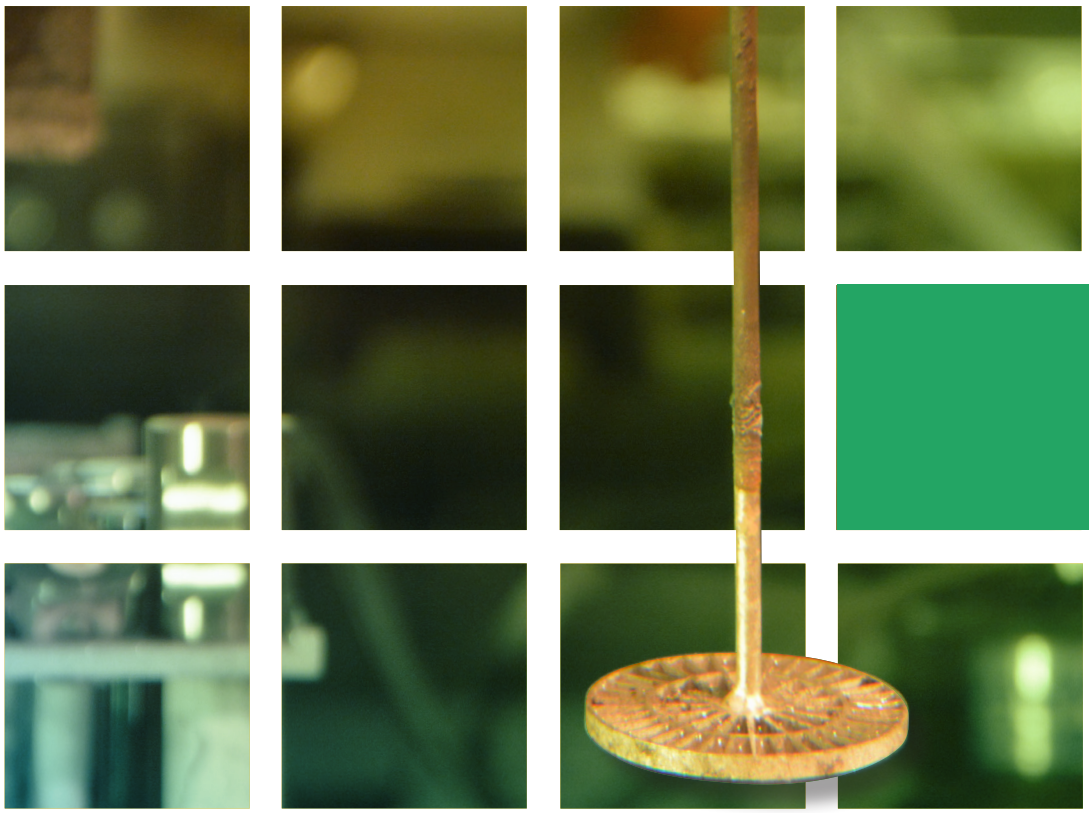
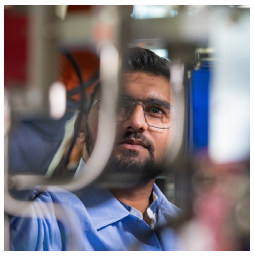


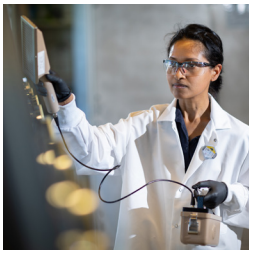
CAES
Center for Advanced Energy Studies

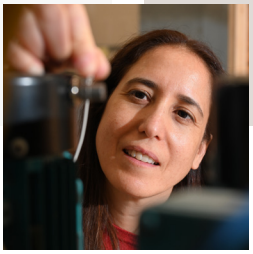
CENTER FOR ADVANCED ENERGY STUDIES

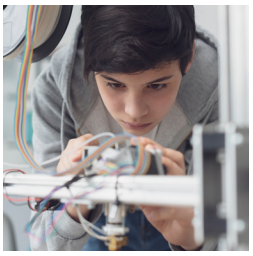
2023 ANNUAL REPORT

This report provides an overview of the main accomplishments of the CAES community in 2023.









On the cover, the photo is of iridium anode after testing. Part of the Robust Anode for Electrochemical in Extreme Environments project, which was a finalist in the 2022 R&D 100 award competition.

DIRECTOR'S LETTER

IF I HAD TO CHOOSE ONE WORD TO SUMMARIZE 2023, IT IS COLLABORATION. Working together, university, INL, governmental and industry partners brought another successful year of growth to CAES. We emphasized our new focus areas, expanded our efforts in industry engagement, enhanced student programs and promoted a sense of community among CAES' partners. We launched three new focus areas in CAES this year: advanced manufacturing, geoenergy research/critical minerals and energy storage/transfer. We leveraged our funds to maximize growth in advanced manufacturing. Similar investments will follow in geoenergy research/critical minerals and energy storage/transfer.

The addition of two new pieces of equipment, a ThermoFisher Spectra 300 scanning transmission electron microscope and a Panda Open Additive 3D laser powder bed fusing metal printer, launched new opportunities for research and collaboration at CAES. Throughout the year, successful startup testing made the new equipment available for researchers across the consortium institutions.

CAES also proudly hosted the first intertribal engagement meeting in September exploring how Indigenous knowledge can be recognized and supported in collaborative research. Participants included representatives from the Shoshone-Bannock Tribes, the Nez Perce Tribe and the Shoshone-Paiute Tribes, as well as the University of Idaho and Boise State University. We're excited to explore the partnership opportunities the relationship provides.

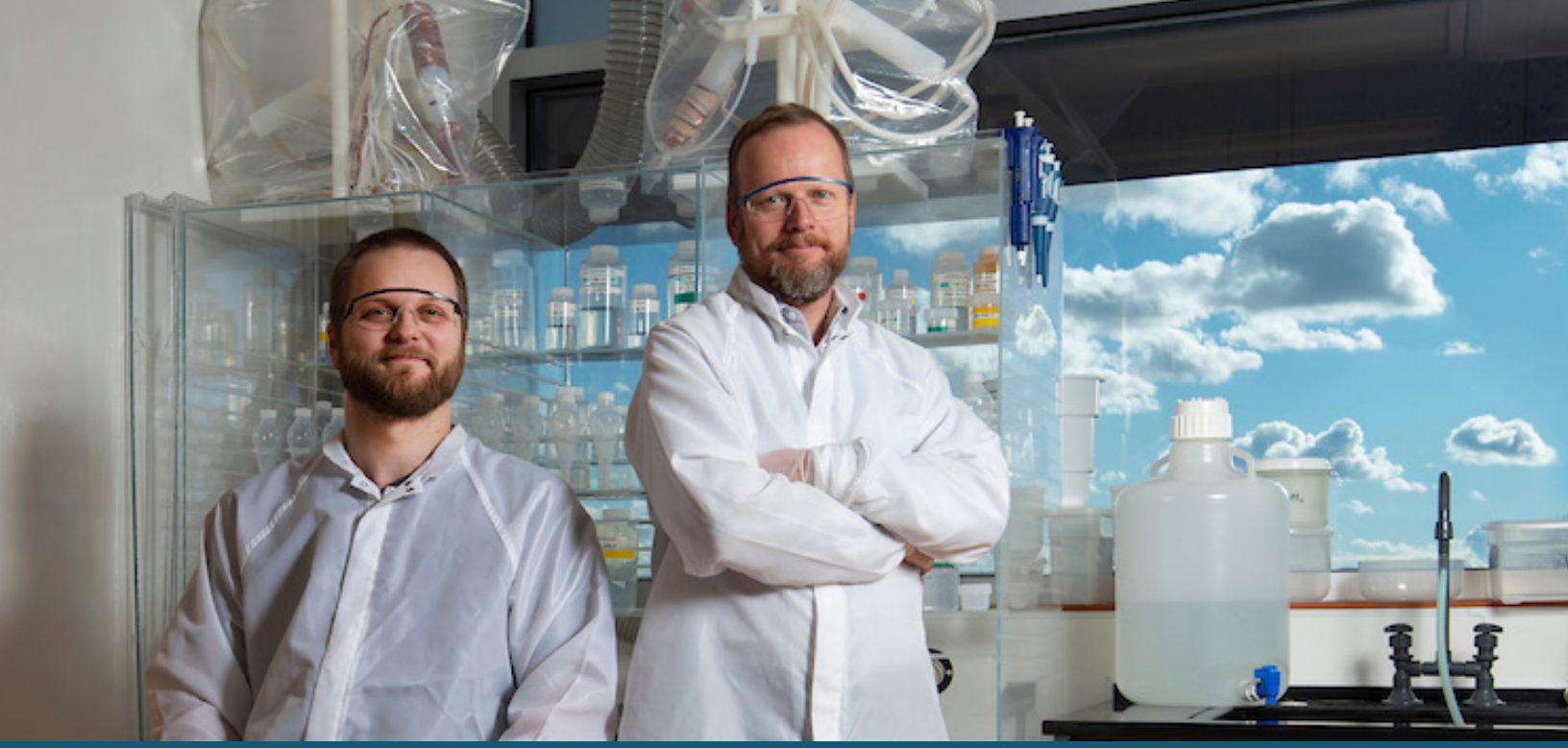
Philip Reppert
Center for Advanced Energy Studies director

As we look to the future, we will double down on our efforts to work with industry partners by looking at the best ways to connect Idaho businesses with the work being done in CAES. In 2024, we will continue to seek new ways to engage with industries and professionals including attending trade shows and collaborative discussions.

We were proud to participate in several programs and events that supported students at CAES. One such program is the National Science Foundation Research Experience for Undergraduates. In its second year, we welcomed 10 students from around the country who spent their summer working alongside CAES university faculty members and INL researchers. The goal is to develop their science, technology, engineering and math identity and literacy, while providing professional development opportunities for careers in the energy sector.

Developing a strong sense of connection and community among CAES occupants and partners in 2023 was important to strengthen our relationships. Over the summer, three food trucks set up regularly providing an opportunity for students and researchers to interact, congregate and share ideas. We were pleased to see the food offerings attracting employees from surrounding INL buildings as well. It was a simple but effective way to encourage networking among students, researchers and staff members. CAES leadership also hosted several potlucks to further connection and interaction among partners and supporters.

In 2024, CAES' goals will remain consistent: enhance the focus areas, expand the presence of industry, support student programs and strengthen relationships within the CAES community. As we drive toward excellence, I welcome your ideas for improving CAES as we make it a valued asset to our partners and to the state of Idaho.



CONTENTS

1 Highlights: Research, Education, Innovation

8 Accomplishments: Researcher, Staff, Student, Faculty

12 Meetings, Open Houses, Seminars, Workshops and Speeches

16 New Staff

18 By the Numbers

20 Publications and Proceedings

HIGHLIGHTS: RESEARCH, EDUCATION, INNOVATION

Computational Engineering and Data Science (CEADS) Program

CEADS is a summer computer science program between INL and Idaho State University (ISU) where faculty-student teams interact with industrial or nonprofit members to investigate ways to improve data analysis and security. ISU hosted 23 CEADS summer interns at CAES.

There were three main projects involving 23 students collaborating with INL's Chris Spirito on: 1) cyber nuclear machine learning, 2) cyber data science with software bills of materials, and 3) quantum chemistry machine learning.

CAES lab collaborates with Boise State to showcase ATR

CAES sponsored a collaborative effort between its Applied Visualization Laboratory (AVL) and Boise State University (BSU) to provide digital-visual art displays focused on nuclear energy research at INL. The displays included an interactive, three-dimensional display of the Advanced Test Reactor (ATR) that describes its components and three videos explaining technical aspects of the reactor, including heat flux in the reactor core. The digital content assembled by the AVL team, which is led by researcher John Koudelka from INL's Nuclear Science and Technology directorate, was initially to be featured at a mid-November meeting of the Center for Atomically Thin Multifunctional Coatings' Industry Advisory Board and could become a long-term exhibit at the Boise State School of Arts' Keith and Catherine Stein Luminary.

CAES Hosts Statewide Talent Pipeline Management Initiative

INL/CAES officially partnered with the Idaho Workforce Development Council on the Talent Pipeline Management (TPM) initiative in February. TPM specialists Jolie Turek and Jodi Johnson, were hired in the fall 2023 to lead this effort. Launched in Idaho in 2022, the program addresses skills gaps in industries throughout the state. It offers an employer-led approach that generates value and a return on investment for employers, potential employees as well as schools, colleges and universities and communities. The development council, a division within the Idaho Office of the Governor, was awarded $50 million from the state via the American Rescue Plan Act to launch the TPM initiative.

In December, the TPM specialists hosted two talent pipeline workshops — one at CAES and one at Idaho State University — that brought together about 20 representatives from local and regional industries.

Center for Space Nuclear Research (CSNR) Summer Fellowship Program hosted at CAES

CSNR is an INL fellowship alliance between undergraduate and graduate student research and development activities from national and international academic institutions. The program provides opportunities for students and visiting researchers to explore innovative solutions to the nation's space nuclear power and propulsion needs. The 2023 summer fellowship program was sponsored by NASA's Marshall Space Flight Center and supported 11 students on research teams that explored the possibilities of ultra-high-performance nuclear thermal propulsion systems that can leverage liquid nuclear fuels beyond 3,000 kelvins. These systems could one day be used for human and robotic exploration of the solar system and beyond.

The fellows designed and analyzed a nuclear thermal rocket featuring molten uranium fuel held on the inside of rotating porous tubes by centrifugal force. The hydrogen propellant, which is stored as a cryogenic liquid, first cools the structural components, flows radially inward through the porous tubes and then through the molten uranium. Molten uranium produces a higher temperature/velocity and some dissociation in the exiting propellant. Thus, the rocket "engine" produces more thrust per unit propellant and can markedly shorten the time for a spacecraft carrying astronauts to reach Mars or the planets in the outer solar system.

2023 Participants:

Kendall Adams
College of Western Idaho

Ana Clecia Alves-Almeida
University of Akron

Zyed M. Ansary*
University of Denver / University of Idaho

Pramatha Bhat
Texas A&M University

Aanchal Gupta*
University of Illinois Urbana-Champaign

Hui-Yu (Joanne) Hsieh
Texas A&M University

Kasturi Khatun*
University of Southern California

Nicole Wendolyn Ortega
Idaho State University

Manikandan Pandiyan*
University of Michigan - Ann Arbor

Zachary Sakata
University of Idaho

Teyen Widdicombe*
University of Idaho

*Indicates fellows who've participated in multiple years

CAES hosts NSF Research Experience for Undergraduate (REU) program for second year

During summer 2023, 10 students participated in the second year of the REU Program. The program gives students hands-on research experiences and networking opportunities to work alongside CAES university faculty members and INL researchers to develop their science, technology, engineering and math identity and literacy, while providing professional development opportunities for careers in the energy sector.

Francis Akwuba-Charles
Auburn University

PROJECT: Corrosion Performance of Additively Manufactured Structured Materials

MENTORS: Mike Hurley, Boise State University; Donna Guillen, INL

Alex Anta
College of Southern Idaho/ Boise State University

PROJECT: Visualization of Material Collection

MENTOR: John Koudelka, INL

Keegan Flaherty
Pennsylvania State University

PROJECT: 3D Li-ion Batteries through Advanced Manufacturing

MENTORS: Claire Xiong, Boise State University; Bin Li, INL

Mkari McDougall
Colorado School of Mines

PROJECT: Novel Alloy Development for Nuclear Applications

MENTORS: Brian Jaques, Boise State University; Boone Beausoleil, INL; Ching-Heng Shiau, Boise State University

Leonardo Ohata
Washington State University

PROJECT: Classical Molecular Dynamics Simulations of Nuclear Materials

MENTOR: John Russell, University of Idaho

Jose Policarpio
Washington State University

PROJECT: Aerosol Jet Printing for Devices in Nuclear Environments

MENTORS: Dave Estrada, Boise State University; Kiyo Fujimoto, INL

Carlos Rivas
Montana State University

PROJECT: Automatic Tool Changing Mechanism for Industrial Robotics Arms

MENTORS: Taher Deemyad, Idaho State University; Steve Egan, INL

Sadie Schenk
Southern Utah University

PROJECT: Development of High-Temperature Resistant Permanent Magnets Using Advanced Manufacturing

MENTORS: Daniel LaBrier, Idaho State University; Bryce Kelly, INL

Haiden Studer
South Dakota School of Mines and Technology

PROJECT: Multiphysics Modeling and Experimental Characterization of Printed Magnetostrictive Acoustic Sensors

MENTORS: Zhangxian (Dan) Deng, Boise State University; Joshua Daw, INL

Tera Swaby
University of Wyoming

PROJECT: Simulating Sintering Structural Reconfigurations

MENTOR: Eric Jankowski, Boise State University

CAES Collaboration Fund

In its sixth year, the CAES Collaborative Fund awarded 15 projects in April involving INL researchers and their counterparts at the CAES universities, out of a record 27 submissions. CAES Collaboration Funds are awarded once a year to projects led by INL researchers in collaboration with faculty members from the CAES universities. The goal is to advance promising research and build strategic relationships that enhance the vision and mission of INL and CAES. Awards typically range from $30,000 to $40,000.

Fifteen projects were awarded funding in 2023.

- 60 projects have been awarded a total of $1,555,824 in CAES funding since the program's inception.
- Four proposals have been submitted, four white papers produced and several seminars held from fiscal year 2023's Collaboration Fund Program.
- The largest awards are $1.1 million through the Idaho Global Entrepreneurial Mission (IGEM) for an ISU/INL project and $430,000 from the Office of Nuclear Safety, also for an INL/ISU project.
- Since FY-20, 32 graduate students, five Ph.D. students and three interns have been involved on these projects.

INL Principal Investigator (PI)	University Co-PI	INL Directorate	Research Focus Area
Boise State University			
Joshua Daw	Dan Deng	NS&T	Advanced Manufacturing, NS&T
Gabriel Ilevbare	Brian Jaques	EES&T	Advanced Materials (Discovery and Manufacturing)
Meng Li	Yu Lu	EES&T	Nuclear power plant safeguards and security. Robotics. Sensors and Instrumentation.
Takanori Kajihara	Ching-Heng Shiau	NS&T	Nuclear Energy, Computing, Data and Visualization, NS&T, MFC
S M Shafiul Alam	Eklas Hossain	EES&T	Nuclear Energy
Idaho State University			
Donna Guillen	Amir Ali	EES&T	Advanced Manufacturing
Jackson Harter	Minhaz Zibran	NS&T	Nuclear Energy
University of Idaho			
Elmar Eidelpes	Ahmed Ibrahim	NS&T	Material Science, Spent Nuclear Fuel Management
Cheng Sun	n/a	MFC	Advanced Characterization and Materials
Krzysztof Gofryk	John Russell	NS&T	Critical Materials
Xinchang Zhang	Aleksandar Vakanski	EES&T	Advanced Manufacturing, Critical Materials
Wencheng Jin	Audrey Fu	EES&T	Critical Materials/Geothermal and Energy Storage/Transfer
Mukesh Bachhav	Krishnan S Raja	MFC	Materials and Chemistry
Nathan Woods	Haiyan Zhao	NS&T	Energy Storage/Transfer
Tiankai Yao	Indrajit Charit	MFC	Advanced Manufacturing

NS&T=Nuclear Science and Technology; EES&T=Energy and Environment Science and Technology; N&HS=National and Homeland Security; MFC=Materials and Fuels Complex

NSUF-funded projects in MaCS

In FY-23, 15 Rapid Turnaround Experiment (RTE) proposals (across three calls) requested CAES usage. Of those 15 requests, nine were awarded and are identified below.

FY-23 Awarded NSUF MaCS RTE Projects	Award Institution
1. Evolution of Dispersoid in Austenitic Fe-Cr-Ni Oxide Dispersion Strengthened Alloy in Ion Irradiation	Center for Advanced Energy Studies
2. Deconvoluting Void and Bubble Effects on Deformation-Induced Martensitic Transformations in Austenitic Stainless Steel Using 4D STEM Strain Mapping	Florida State University
3. Investigation of Simultaneous Irradiation and Creep Behavior of Cr Thin Films	Texas A&M University
4. Dual Ion Beam Irradiation and Post-Irradiation-Examinations of Alumina Coating on Stainless Steel	Idaho National Laboratory
5. Atom Probe Characterization of HT-9 as a Function of Neutron Irradiation Temperature	Pacific Northwest National Laboratory
6. Investigation of Void Swelling and Chemical Segregation in Heavy Ion Irradiated Compositionally Complex Alloys	Sandia National Laboratories
7. Understanding the Origin of Irradiation-Induced Yield Drop Phenomena in Grade 91	Idaho National Laboratory
8. Effect of Ion Irradiation and Dose Rates on 316LY Oxide-Dispersion-Strengthened Steel Additively Manufactured by Laser-Directed Energy Deposition	Oregon State University
9. Defect Evolution in Irradiated Superior Heat Conductors	Idaho National Laboratory

Seed Grants

ISU Seed Grants

Eleven ISU researchers received $242 000 in seed grants for collaborative research projects involving partners from Idaho National Laboratory and the other CAES universities.

Funding for the projects helps researchers develop proposals with the potential to garner additional funding and comes from the portion of ISU's annual state funding that is allocated for CAES activities.

The grants are awarded each year to collaborative research projects led by ISU researchers in collaboration with their peers from Idaho National Laboratory and the other CAES universities.

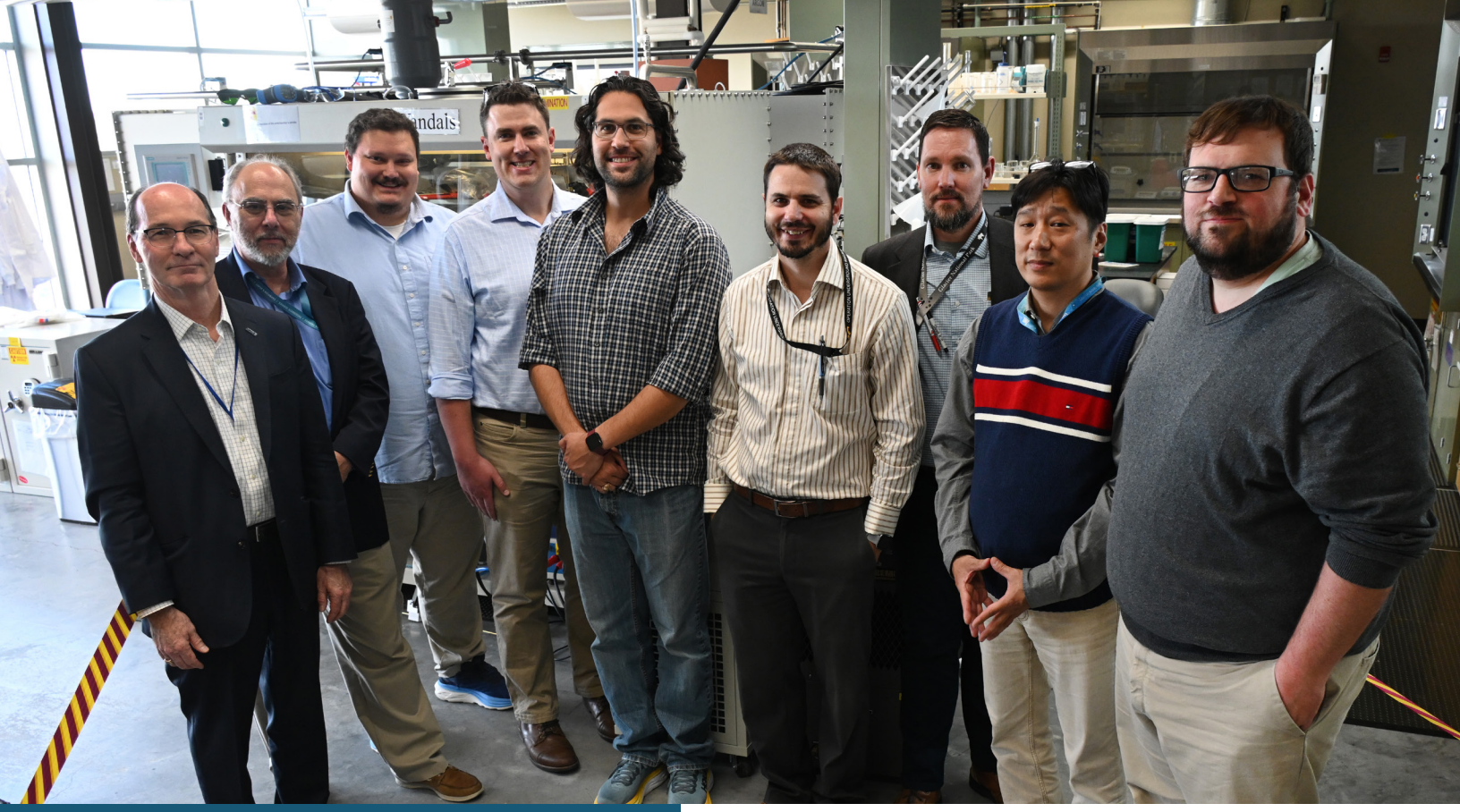
Recipients:

- **Amir Ali,** assistant professor in ISU's nuclear engineering department, is collaborating with INL researcher Ahmed Hamed on a project titled, "Validation Experiments of CAES Developed Advanced Heat Exchanger Technology for Integrated Energy and Storage System Applications."
- **Mostafa Fouda,** assistant professor in the electrical and computer engineering department, has partnered with INL's Mohammad Abdo on a project titled, "Effective Load and Generation Forecasts in Power Grids."
- **Dan LaBrier,** assistant professor in ISU's nuclear engineering department, is collaborating with fellow ISU researcher Chad Pope and INL researcher Bryce Kelly on a project titled, "Developing an Experiential Training Program for Use of Alkali Metals."
- **Mustafa Mashal,** associate professor in the civil and environmental engineering department, is collaborating with fellow ISU researchers Jared Cantrell and Uma Shankar Medasetti and INL researcher Vaibhav Yadav on a project titled, "Methodology for Assessment of Performance Effectiveness of Mobile Robots for Nuclear Power Plant Security Applications."
- **Rene Rodriguez,** professor in the chemistry department, is collaborating with INL researcher Kiyo Fujimoto on a project titled, "Plasma Methods for Novel Advanced Manufacturing Feedstock Development."
- **Chikashi Sato,** professor in the civil and environmental engineering department, is collaborating with ISU's John Dudgeon and INL researcher Kunal Mondal on a project titled, "Integrating Microbial Fuel Cell Into Algae Cultivator for the Development of Sustainable Energy-Water-Food System."
- **Marco Schoen,** professor in the mechanical engineering department, is collaborating with INL researchers Andrew Gorman and Jorgen Rufner on a project titled, "Preliminary Reinforcement Learning Control for Continuous Spark Plasma Sintering."
- **Glenn Thackray**, professor in the geosciences department, is partnering with Boise State University's Jennifer Pierce on a project titled, "Reliable Small-Hydropower Generation and the Consistency of Water Supply from Central Idaho Mountain Streams."
- **Danny Xu**, associate professor in the biomedical and pharmaceutical sciences department, is collaborating with INL researcher Eric Whiting on a project titled, "Hearing Loss Prevention Through Integrative High-Performance Computing and Data Science."
- **Minhaz Zibran**, associate professor in the computer science department, is partnering with ISU's Farjana Eishita and INL researcher Rajiv Khadka on a project titled, "VizSoft: Interactive Visualization of Software Aspects in IDE."
- **Rajib Mahamud**, assistant professor in ISU's mechanical engineering department, is collaborating with INL researcher Ahmed Hamed on a project titled, "Development of Combustion and Flame Propagation Models Within the MOOSE Multiphysics Computational Framework"

UI Seed Grants

In February, UI-CAES hosted its first Seed Grant Competition. Seven projects were awarded a total of $64,000 in state funding to help connect UI-led projects with additional external funders.

- **Amin Mirkouei**, "Collaborative Research: CyberTraining: Implementation: Medium: CyberTraining of Construction (CyCon) Research Workforce Through an Educational and Community Engagement Platform," $10,000
- **Indrajit Charit**, "Microstructural and Nanomechanical Characterization of Ion Irradiated Molybdenum Based Materials Joined via Pressure Resistance Welding," $9,999
- **Krishnan Raja**, "Additive Manufacturing of Self-healing and Irradiation Resistant Components by High Pressure Cold Spray Technology," $10,000
- **Min Xian**, "Building Capabilities in Uncertainty Quantification (UQ) for Computational Models in Nuclear Materials Characterization," $10,000
- **Min Xian**, "Summer Projects on AI-Enhanced Materials Characterization for Recruiting Graduate Students," $4,000
- **Aleksandar Vakanski**, "Active Learning Method for Predicting Creep-Fatigue Behavior of Nuclear Structural Materials," $10,000
- **Haiyan Zhao**, "Enhancing Advanced Materials and Chemistry Characterization via Acquisition of Mass Spectrometer," $10,000



BSU/MaCS Seed Grant Program

CAES launched the MaCS Seed Grant Program in 2022 to boost opportunities for members of the CAES community to conduct research in the Microscopy and Characterization Suite (MaCS). Supported by BSU and ISU, the program covers the costs of instrument time and MaCS staff time for selected proposals. The goal is to seed opportunities that advance the vision and mission of CAES, promote research in all science fields and increase the MaCS user base. In FY-23, the grant provided $12,500 in support.

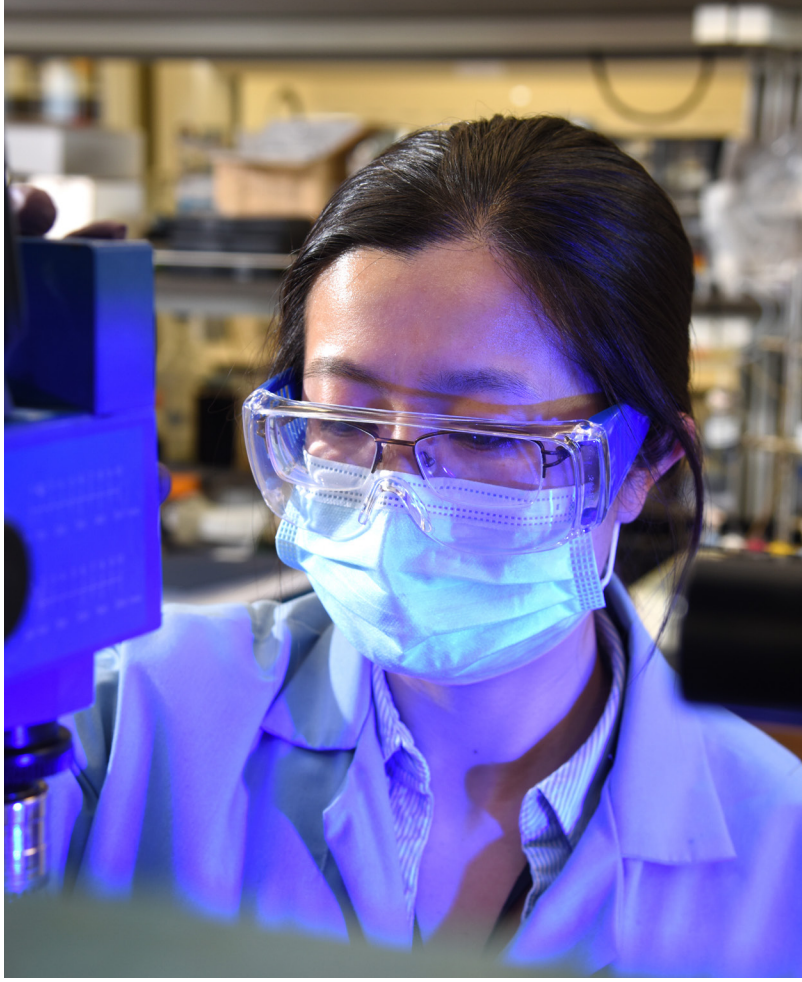
CAES Hosts DOE Advanced Research Projects Agency

In October, CAES hosted a delegation from the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). The group looked at how their funding was meeting a goal to enhance the nation's economic and energy security through the development of advanced energy technologies.

The innovative Traveling Molten Zone Refining Process Development for Innovative Fuel Cycle Solutions project is a collaboration between INL, ISU and University of Utah that is housed at CAES. Researchers are investigating how materials in the fuel rods of sodium cooled fast reactors could be recovered and reused, reducing byproducts and increasing efficiency.

According to Tae-Sic Yoo, an INL researcher and the project's principal investigator, the visit allowed ARPA-E representatives to see firsthand the progress that's been made. "We were very excited to demonstrate the positive results we're seeing on the project and the potential it opens to future research," Yoo said.

ACCOMPLISHMENTS: RESEARCHER, STAFF, STUDENT, FACULTY



CAES University of Idaho Alum Wins R&D 100 award for EC Leach project

Meng Shi, (pictured right) a postdoctoral researcher at INL and former CAES resident who earned her Ph.D. in chemical engineering from University of Idaho in 2020, is part of a research team that won a 2022 R&D 100 award for creating a cost-effective, efficient, safe and carbon-free process to recycle lithium-ion batteries. The team's project, Electrochemical Leach, is led by co-principal investigators Tedd Lister and Luis Diaz Aldana, along with INL researchers John Klaehn, Joshua McNally, Daniel Molina Montes de Oca and Shi. The technology developed "unlocks the green energy potential of these batteries at the end of their lives by allowing extraction and recovery of critical materials," according to an INL news release. The relatively simple process requires no expensive or hazardous materials, has a low operational cost and is compatible with any lithium-ion battery chemistry. The technology is one of three that originated at INL to receive a 2022 R&D 100 award.

CAES UI Alum a Finalist for R&D 100 Award

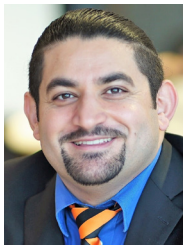
Steven Herrmann is a co-principal investigator on a research team whose project, Robust Anode for Electrochemical in Extreme Environments, was a finalist for a 2022 R&D 100 award. The technology demonstrated long-lasting, highly efficient performance to support consumer products recycling and spent nuclear fuel reprocessing, according to an INL news release.

Kristi Moser-McIntire named ISU's CAES Deputy Associate Director

Kristi Moser-McIntire obtained her masters and bachelor's in physics from ISU with an emphasis in applied health physics. Her background includes more than 20 years of teaching, safety and health physics experience working for the state of Idaho's Oversight Program, Naval Reactors Facility and ISU. She is also the CAES lead safety officer, serves on ISU's Radiation Safety

Committee and College of Eastern Idaho's Radiation Safety Technical Advisory Committee. Moser-McIntire has received several awards and recognitions, including the CAES Outstanding Contributor Award.

Mustafa Mashal Named CAES Associate Director for ISU and Structural Engineering Institute Fellow



Idaho State University faculty member **Mustafa Mashal** was named the CAES associate director for ISU in January. Mashal replaced Dave Rodgers, who retired in December after more than three years in the role. Mashal is an associate professor and director of the Disaster Response Complex and Structural Laboratories in ISU's civil and environmental engineering department. He is also a CAES fellow and frequent collaborator with INL researchers.

He recently completed a Fulbright in the civil and architectural engineering department at Qatar University in Doha, Qatar.

Mashal obtained his doctorate, master's and bachelor's in civil engineering from the University of Canterbury in New Zealand, the State University of New York at Buffalo in the United States, and Kabul University in Afghanistan, respectively. He has more than a decade of consulting and academic experience in the United States, New Zealand and Afghanistan and has received several awards and recognitions such as the 2020 Alfred Noble Prize from the American Society of Civil Engineers (ASCE), the 2018 ASCE Southern Idaho Section Outstanding Civil Engineer of the Year Award, Idaho Business Review Accomplished Under 40, and University of Canterbury's Visiting Erskine Fellowship.

Mashal was a member of the 2021 cohort of the CAES Summer Visiting Faculty Program. He has collaborated often with INL researchers on projects such as the Disaster Response Complex, an outdoor site that accommodates research, curriculum development and training/exercises for emergency responders from across the region, and a current project studying the use of robots for nuclear power plant security applications that received CAES Collaboration Funds and an ISU-CAES seed grant in 2022.

The Structural Engineering Institute of the American Society of Civil Engineers (SEI) recently named Mashal a 2023 SEI Fellow.

CAES Energy Policy Institute

The Energy Policy Institute, the policy arm for CAES, continued its applied research and training with multi-institutional awards, the launch of a first-of-a-kind nuclear security certificate and a field school in sustainability. It did this while building partnerships and bringing visibility to EPI and CAES in new venues, including the Arctic Circle Assembly in Iceland (photo on right). EPI also continued its popular Power Talks series.

Among major research awards, EPI secured $2 million to establish one of 12 national consortia that will provide recommendations to the U.S. Department of Energy on better practices in consent-based siting processes for spent nuclear fuel/nuclear waste. EPI Director Kathy Araujo also led Boise State's team in a statewide Established Program to Stimulate Competitive Research (EPSCoR) proposal to the National Science Foundation (NSF) on energy-water system resilience that was awarded $24 million (NSF and state funds). EPI also partnered with UI, ISU and CAES to launch a new online certificate in nuclear safeguards and security. EPI Senior Researcher Stephanie Lenhard also led the launch of a multidisciplinary field school in sustainability at Zena Creek Ranch.

CAES Universities collaborate on National Science Foundation Project

The CAES universities are collaborating with the Coeur d'Alene Tribe and the Shoshone-Bannock Tribes on a project that received a $20 million, five-year award from the NSF EPSCoR. The project, titled "Idaho Community-Engaged Resilience for Energy-Water Systems (I-CREWS)," allows university researchers, in collaboration with utility companies, state and federal government agencies, and Idaho cities and counties, to study the impacts of changes in climate, population, and technology on energy and water use in Idaho. Researchers will work to identify energy and water use strategies that will be resilient to Idaho's changing needs, based on ongoing feedback from communities. I-CREWS will involve more than 35 university and college faculty, plus eight new early-career hires, 10 postdoctoral researchers, 20 graduate students and more than 120 undergraduate researchers, with supporting projects reaching more than 500 students and community members. Students will refine the technical skills necessary to fill energy and water systems workforce needs.

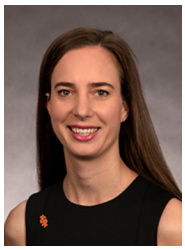
"This project is necessary right now because the intersection of water and energy issues is critical to Idaho's people, industries and livelihoods," said Idaho EPSCoR Director Andrew Kliskey, who is the research project principal investigator and a University of Idaho professor. "It demonstrates big-picture, use-inspired, science-informed approaches."

"...Intersection of water and energy issues is critical to Idaho's people, industries and livelihoods."

ANDREW KLISKEY

Update:

CAES-Funded Project Studying Perceptions of Nuclear Energy Featured in Publication



A CAES-funded project stemming from the 2020 Summer Visiting Faculty Program examined the perceptions of nuclear energy. The article, "Political ideology and nuclear energy: Perception, proximity, and trust," was written by **Irene van Woerden**, assistant professor at ISU and the public health department. She and INL's **Rae Moss** received $20,000 to complete the project through the ISU-CAES Seed Grant Program. They also published "Peoples' perception towards Nuclear Energy" in April 2022 in Energies with ISU graduate student Meesha Iqbal.

"Nuclear energy, in terms of an overall safety record, is better than other energy." **BILL GATES**

Notable University Publications, Programs, Recognitions and Awards

Boise State University

- 2D/3D Heterogeneous and Monolithic Integration via MOCVD of 2TMDs on 3D Semiconductors
- Direct Carbon Capture from Seawater by Leveraging Flowing Electrode Capacitive Deionization Strategy based on Two-Dimensional Materials
- Solar Powered Rocket with Impulsive Thermal Engine

Idaho State University

- Cyber Attack and Defense for Autonomous or Remote Operations of Nuclear Reactors
- University of Wyoming Course: Fundamentals of Nuclear Energy

University of Idaho

- International Atomic Energy Agency (IAEA) recognizes the UI's master's programs in: "nuclear engineering plus certificate in nuclear technology management" and "technology management plus certificate in nuclear technology management" as International Nuclear Management Academy endorsed.
- Matthew Swenson received Dean Larry & Nicole Stauffer Early Career Faculty Award, UI's College of Engineering.
- Mike McKellar received an INL Lifetime Achievement Award in 2022 for Inventorship: 15 patents.
- Min Xian: MIDA Lab's graduate students attended the UI's 2022 Data Science Competition. Two students ranked first and one student ranked second among 50 participants.

MEETINGS, OPEN HOUSES, SEMINARS, WORKSHOPS AND SPEECHES

CAES Hosts Future Net-Zero Innovators Student Symposium

Students led a symposium in March to discuss topics covering energy saving solutions. Boise State University, Idaho State University and University of Idaho teamed up with INL to host this event. Undergraduate and graduate students from throughout the Mountain West showcased their topics including energy storage, renewable sources and nuclear energy.

Kaelee Novich, a graduate student at Boise State University who also interned with INL's Net-Zero Program, chaired the symposium.

Students mentioned childhood inspirations and internships have been the biggest things pushing them through their journeys in energy efficiency and nuclear power.

European TV Crews Visit SMR Laboratory

A crew from Romanian TV, a public news outlet in Romania, visited CAES in early April to visit the Small Modular Reactor (SMR) Laboratory. The stop was part of an INL visit to gather information for their program, which will provide an in-depth report on the nuclear energy industry in the U.S., from the highest policy levels to engineering and design experts.

In December, a reporter from the German and French public television station ARTE also visited the SMR laboratory to learn more about SMRs and their potential in Europe's transition to clean energy. The segment, filmed at CAES, will air during an episode of ATRE Journal, the station's news program.

CAES Hosts Family Day

In August, over 100 affiliates of CAES — staff, faculty, INL researchers and their families — attended a family day in the facility. Games, food and tours of the facility offered a lighthearted opportunity to see the work being done in CAES. The open house offered a chance for the affiliates to bring their families and network with other members of the CAES community.

NRC visit in May

In May, CAES hosted about 20 guests from the NRC licensing department as well as guests from the Carbon Free Power Project doing a tour of INL facilities and the proposed NuScale site on the desert. A portion of the group stayed for an extended demonstration of the E2 lab with the NuScale control room simulator. They discussed the design changes in the plant and the impact of staffing and licensing new operators. They asked about how the universities fit into the CAES facility and INL.

IAEA Representative Visits CAES as Part of University of Idaho's Nuclear Technology Management Program

In June, a representative from the International Atomic Energy Agency, hosted by UI during a visit to their Idaho Falls campus, visited to evaluate UI's nuclear technology management certificate for a potential endorsement by the IAEA. The visit also featured a lunch meeting with the CAES director and student researchers to learn about the IAEA.

Winter collaboration Event with National University Consortium

CAES collaborated with INL's National University Consortium to host the Winter Collaboration Event at INL's Engineering and Research Office Building in late January. The two-day event featured presentations by Deputy Laboratory Director for Science and Technology and Chief Research Officer Marianne Walck and CAES Director Philip Reppert, as well as breakout sessions led by INL researchers on topics including:

- Advanced materials for manufacturing for extreme environments
- Net-zero carbon emissions
- The Chemical and Molecular Sciences Initiative at INL
- Fission battery
- Secure and resilient cyber-physical systems
- Plasma and fusion energy sciences
- More than 30 researchers from the CAES universities registered for the event, which was also offered virtually via Teams, while more than two dozen faculty members from the NUC universities registered. This marks the first year the event has been held in person since January 2020.

CAES Hosts Intertribal Collaborative Meeting

BEA and CAES held an intertribal engagement meeting in September to launch a conceptual conversation exploring how Indigenous knowledge can be recognized and supported in collaborative research. Participants included representatives from the Shoshone-Bannock Tribes, the Nez Perce Tribe and the Shoshone-Paiute Tribes, as well as the University of Idaho and Boise State University. The meeting deepened the relationship between INL and tribal communities, broadened knowledge of issues that impact tribal communities, and initiated conversations that may lead to collaboration.

ANS President Presents at CAES

ANS President Steven Arndt gave a presentation on the state of nuclear energy in the CAES Auditorium in early May. Arndt also met with CAES Director Philip Reppert and toured the CAES facility while visiting INL.

Idaho State Board of Education Representatives Visit CAES and INL

In October, TJ Bliss and John Thomas with the Idaho State Board of Education, along with University of Idaho CEO for the Idaho Falls campus Marc Skinner, visited CAES and INL to learn more about impact on the state of Idaho. Their visit included tours of CAES, the Cybercore Integration Center, the Collaborative Computing Center, the Advanced Test Reactor, and the Materials and Fuels Complex.

Codebreaker

This monthly webinar provides a forum for students and researchers to address their work, communicate opportunities and challenges to a receptive audience, and increase dialogue among CAES affiliates. Presenters in 2023 were:

Jorgen Rufner
INL advanced manufacturing lead, addressed the challenges, capabilities, and opportunities of developing new materials and methods for successful advanced manufacturing in extreme environments.

Trevor Atkinson
INL researcher, discussed how his group is working to better understand thermal energy and using Earth as a thermal battery could help achieve net-zero emissions.

Dave Estrada
CAES associate director for BSU, presented on how additive electronics manufacturing has applications in energy, space, water purification and medical sciences.

Xingyue Yang
INL researcher, showed how 3D visualization can be applied to a variety of applications, including training students and performing radiation surveys remotely.

Rajiv Mishra
Professor at the University of North Texas, discussed the fundamentals of the friction-stir process to build stainless-steel reactor vessels.

Debbie Senesky
Associate professor at Stanford, spoke on the viability of nanoelectronics for extreme environments.

Joe Campbell
INL communications liaison for ATR, shared a history of reactors developed at INL and a look at future reactor technology.

Kortny Rolston-Duce
Director of marketing communications at Atom Computing, presented on "Quantum Computers: Yes, they are real and why you should care."

Bin Liu
Kansas State University researcher, presented on boron-based semiconductor crystal growth and its relevance to energy conversions.

Dakota Roberson
University of Idaho researcher, presented on how to use experiential learning to cultivate a diverse and inclusive workforce equipped with the essential abilities and resources necessary to navigate the potential technological challenges in the future.

NEW STAFF

New Communications Liaison supporting CAES

Sunny Katseanes joined INL in late September 2023 as the communications liaison for CAES.

Katseanes' professional experience has spanned the nonprofit, local government, private and government contractor worlds. After graduating from Idaho State University in 1999 with a bachelor's in zoology, Katseanes became the first year-round education coordinator at the Idaho Falls Zoo and developed the zoo's foundational educational programming. She then served as Bechtel BWXT Idaho's communication specialist on the Advanced Mixed Waste Treatment Project, followed by director of education at the Museum of Idaho, and nine more years at the Idaho Falls Zoo serving as both education curator and public engagement curator overseeing the zoo's education, volunteers, marketing, development, public outreach and guest services departments.

Katseanes is a native of Idaho Falls who married her high school sweetheart nearly 30 years ago and they share two amazing daughters.

New CAES Project Coordinators

Levander (Van) Davis is a project coordinator for CAES responsible for executing projects and programmatic strategies in conjunction with INL and the consortium of Idaho universities.

Davis is an 18-year veteran of business and education from University of Idaho. After graduating in 2005, he joined Melaleuca Inc. and quickly worked his way up the corporate training ladder. He spent years honing his skills with adult training techniques and designing seminars, classes and programs for the professional world. In 2018, Davis joined the College of Eastern Idaho, where he implemented world-class community programs for eastern Idaho. He helped increased the number of business offerings for the community, started new programs like floral arranging and real estate licensing, and doubled the attendance of the annual Summer Science Youth Camp.

Davis has two lovely kids and a wife; but, unfortunately, also lives with four bossy chickens and three scaredy cats.

Jessica Ward is a project coordinator at CAES. She is responsible for executing CAES projects in conjunction with the consortium of Idaho universities and INL, as well as the strategic direction and management of caes.org.

Ward has over 18 years of experience with digital marketing and project management. Prior to joining CAES, Ward worked at BambooHR as a senior demand marketer specializing in website optimization. Ward holds a bachelor's degree in business administration from Eastern Michigan University.

Ward enjoys exploring the outdoors with her husband and two children and reading fantasy fiction.

Talent Pipeline Management Gains Two Workforce Development Specialists

Jodi Stuart Johnson is one of two workforce development specialists focusing on talent pipeline management for eastern Idaho covering 16 counties. Johnson joined the CAES team in August 2023. She is collaborating with employers, educators and job seekers to meet their talent needs and create clear paths into high quality careers.

Johnson worked at Idaho State University in the Energy Systems Technology and Education Center, where she was the program coordinator for the Providing Opportunities for Women in Energy Related Careers grant project. She increased the number of women entering these programs by 400% and maintained a 90% retention rate in the three-year grant period. Due to the success of the program, it was expanded across several more programs in the College of Technology. She has over 15 years working with educational programs and industries to identify and support workers' needs and providing accessible and valuable career pathways.

Johnson keeps herself busy outside of work by traveling, doing DIY or crafting projects and spending time with family and friends.

Jolie Turek is one of two workforce development specialists focusing on talent pipeline management for eastern Idaho, covering 16 counties. Turek joined CAES in late September 2023. She is collaborating with employers, educators, and job seekers to meet their talent needs and create clear paths into high quality careers.

Turek brings 15 years of extensive economic and workforce development experience to this position. Skilled in nonprofit board management, facilitating conferences, meetings, career fairs, and community and regional discussions. She has experience in public speaking and building collaboratives. Her work experience is diverse and includes 34 years in project facilitation and management, hospitality, mining, medical, photography, ranch management, equestrian, cattle and agricultural industries.

She enjoys networking and collaborating with people and is passionate about helping our future workforce and employers connect the dots to better our region and state.

Turek is an Idaho native who lives in and loves rural Idaho. She and her husband are new empty nesters who enjoy the outdoors and spending time with family and friends. Her hobbies include training and riding horses, ranching, skiing, kayaking, soaking up the sun on a warm beach and spending time with her critters (large and small).

BY THE NUMBERS

30
Ongoing projects

7
Projects started

FROM CAES UNIVERSITIES

19
Faculty members awarded INL joint appointments

10
INL interns transferred to INL after their internship

6
Projects completed

FROM CAES UNIVERSITIES

292
INL employees participated in Employee Education programs

13
Students began postdoctoral appointments at INL

FROM CAES UNIVERSITIES

3
Students received graduate fellowships at INL

103
Students interned at INL

CAES participated in the INL's Earth Day Event in April 2023

CAES building was the first LEED-certified building for a state agency or university in Idaho when it opened in 2009. It was designed with climate-responsive design strategies and spatial organization that considered internal loads, daylighting and visual and thermal comfort criteria.

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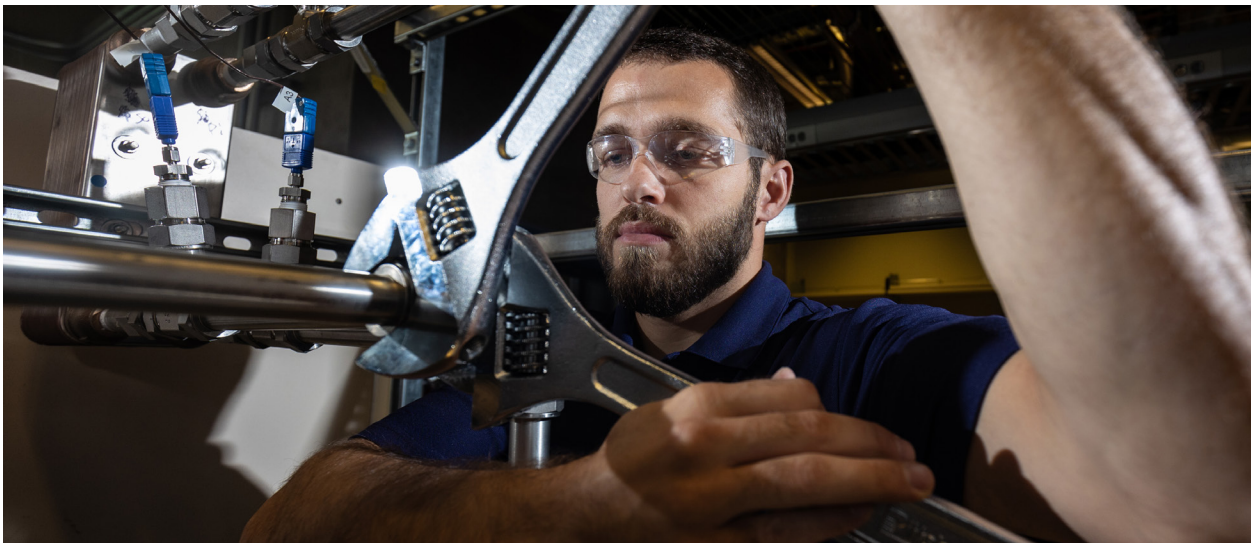

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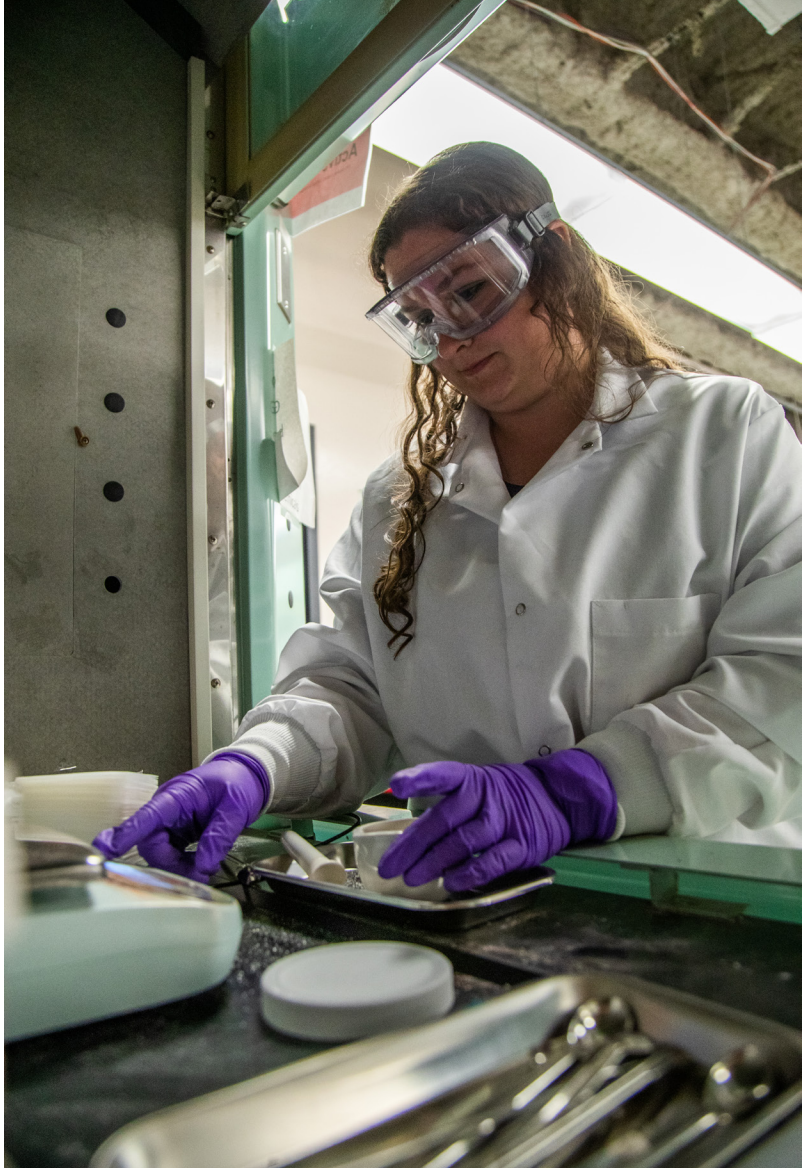

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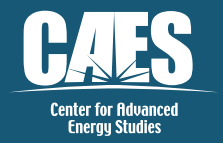
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