



ANNUAL REPORT

2013



Dear colleagues,

Over the past eight years, the Center for Advanced Energy Studies has become a model of how universities and national labs can effectively and efficiently collaborate on research while educating a new generation of scientists and engineers.

The CAES partners – Boise State University, Idaho National Laboratory, Idaho State University and University of Idaho – took a significant step in FY 2013 to ensure the collaboration continues to flourish. They signed a new agreement formalizing many aspects of the collaboration, including roles and responsibilities of participants, rules governing intellectual property, and institutional responsibilities.

This agreement will provide a better foundation as we enter the next phase of the CAES partnership and build stronger relationships with industry throughout the state and region.

“As CAES moves forward, our goal is to become a resource for private industry and help companies solve critical technical issues.”

As CAES moves forward, we will focus on providing research capability to help Idaho businesses be more competitive; we will develop larger, sustainable research programs; and open more opportunities for Idaho students to develop into international research leaders.

These objectives will draw on the real power of CAES – the leverage the collaboration provides. Together, the capabilities of our collaborators are much more competitive than those of any single institution alone. Our goal is to expand and deploy the partners’ capabilities to help move Idaho forward.

We are already doing this in bioenergy. CAES researchers continue to work with state and national dairy industry organizations to convert waste into marketable products like bioplastics and electricity, while addressing environmental concerns of our dairymen. It’s a great example of the value of the partnership in assisting Idaho business.

In essence, CAES provides a “front door” for Idaho business to gain access to multidisciplinary capabilities and expertise that exist at the partner institutions.

We believe this approach has many benefits. It will enable CAES researchers to win more funding – an economic boon for the state – and our universities to attract more students all while helping grow Idaho’s competitive edge.

Sincerely,

A handwritten signature in black ink, appearing to read "Steven Aumeier". The signature is fluid and cursive.

Steven Aumeier
Director, Center for Advanced Energy Studies

FY 2013 | By the Numbers

CAES provided the state of Idaho, DOE and Battelle Energy Alliance a strong return on investment in FY 2013.

AMOUNT OF COMPETITIVE RESEARCH FUNDING WON BY CAES RESEARCHERS IN FY 2013.

\$4,437,182.00

AMOUNT OF INFRASTRUCTURE GRANTS CAES RESEARCHERS WON IN FY 2013.

475
\$ THOUSAND

421

NUMBER OF STUDENTS ENROLLED IN NUCLEAR-RELATED DEGREE AND CERTIFICATE PROGRAMS AT THE CAES PARTNER UNIVERSITIES.

TOTAL RESEARCH AND OTHER FUNDING WON BY CAES RESEARCHERS IN FY 2013.

5.49

\$ MILLION

TOTAL AMOUNT OF COMPETITIVE RESEARCH AND OTHER FUNDING CAES RESEARCHERS HAVE WON SINCE FY 2008.

56.63

THE STATE OF IDAHO'S INVESTMENT IN CAES IN FY 2013.

TWO



\$578,732.00

AMOUNT OF SCHOLARSHIP, FELLOWSHIP AND OTHER FUNDING AWARDED TO THE CAES PARTNER UNIVERSITIES IN FY 2013.

SIXTY-PLUS

NUMBER OF IDAHO UNIVERSITY STUDENTS WORKING ON CAES-RELATED (NON-NUCLEAR) RESEARCH PROJECTS IN FY 2013.

Research Highlights

Manufacturing crystals for research

A team led by Eric Burgett, an Idaho State University/CAES researcher, successfully created its first batch of pure, single uranium oxide crystals in the Research in Science and Engineering (RISE) facility in Pocatello. Researchers at Idaho National Laboratory and elsewhere are using the crystals to better understand uranium oxide – the primary fuel for the nation’s nuclear reactors – and design higher-performing fuels.

ERIC BURGETT, A CAES/IDAHO STATE UNIVERSITY RESEARCHER, AND HIS TEAM MANUFACTURE SINGLE CRYSTALS AT ISU’S RESEARCH IN SCIENCE AND ENGINEERING (RISE) BUILDING IN POCATELLO.





Powering electronics with wind

Boise State University engineering, business and debate students are developing a lightweight, portable wind turbine that can power a cell phone and other electronic devices as part of a national competition. Boise State was one of 10 schools selected by the U.S. Department of Energy to participate in the agency's inaugural Collegiate Wind Competition and was the only college chosen from Idaho, Montana, Wyoming, Utah, Washington and Oregon.

THE COLLEGIATE TEAMS COMPETING ARE:

BOISE STATE UNIVERSITY

CALIFORNIA MARITIME ACADEMY

COLORADO SCHOOL OF MINES

JAMES MADISON UNIVERSITY (VA)

KANSAS STATE UNIVERSITY

NORTHERN ARIZONA UNIVERSITY

PENNSYLVANIA STATE UNIVERSITY

UNIVERSITY OF ALASKA FAIRBANKS

UNIVERSITY OF KANSAS

UNIVERSITY OF MASSACHUSETTS-LOWELL

\$2,280,000

AMOUNT OF MONEY WON FROM THE U.S. DEPARTMENT OF ENERGY TO CONDUCT NUCLEAR ENERGY RESEARCH.



CAES HELPS SUPPORT THE UNIVERSITY
OF IDAHO'S INTEGRATED DESIGN
LAB AND ITS EFFORTS TO IMPROVE
ENERGY EFFICIENCY. KEVIN VAN DEN
WYMELLENBERG, THE LAB'S DIRECTOR,
LEADS A TEAM OF STUDENTS AND STAFF.

DID YOU KNOW?

IDAHO NATIONAL LABORATORY FUNDS 12 IDAHO UNIVERSITY RESEARCHERS AS PART OF ITS COMMITMENT TO THE CAES COLLABORATION. INL PAYS FOR UP TO HALF OF THEIR SALARIES THROUGH THE LAB'S JOINT APPOINTMENTS PROGRAM.

Integrating renewable energy through policy

The CAES Energy Policy Institute is leading a three-year, National Science Foundation-funded project to research renewable energy and electricity planning. The team will perform a comparative study of three Regional Transmission Organizations (RTOs) that coordinate delivery of electricity to more than two-thirds of households in the United States. Many states have mandated RTOs to use more wind, solar and other renewable energy sources, but the organizations struggle to integrate them and still provide reliable power.

Researching nuclear energy

University of Idaho/CAES researchers won more than \$2.28 million from the U.S. Department of Energy to conduct nuclear energy research. Vivek Utgikar, Chien Wai and Batric Pesic are leading three of the 61 projects funded by the department's Nuclear Energy University Programs (NEUP) in FY 2013. Supathorn Phongikaroon, a UI/CAES researcher, is collaborating on a fourth research project with Ohio State University.

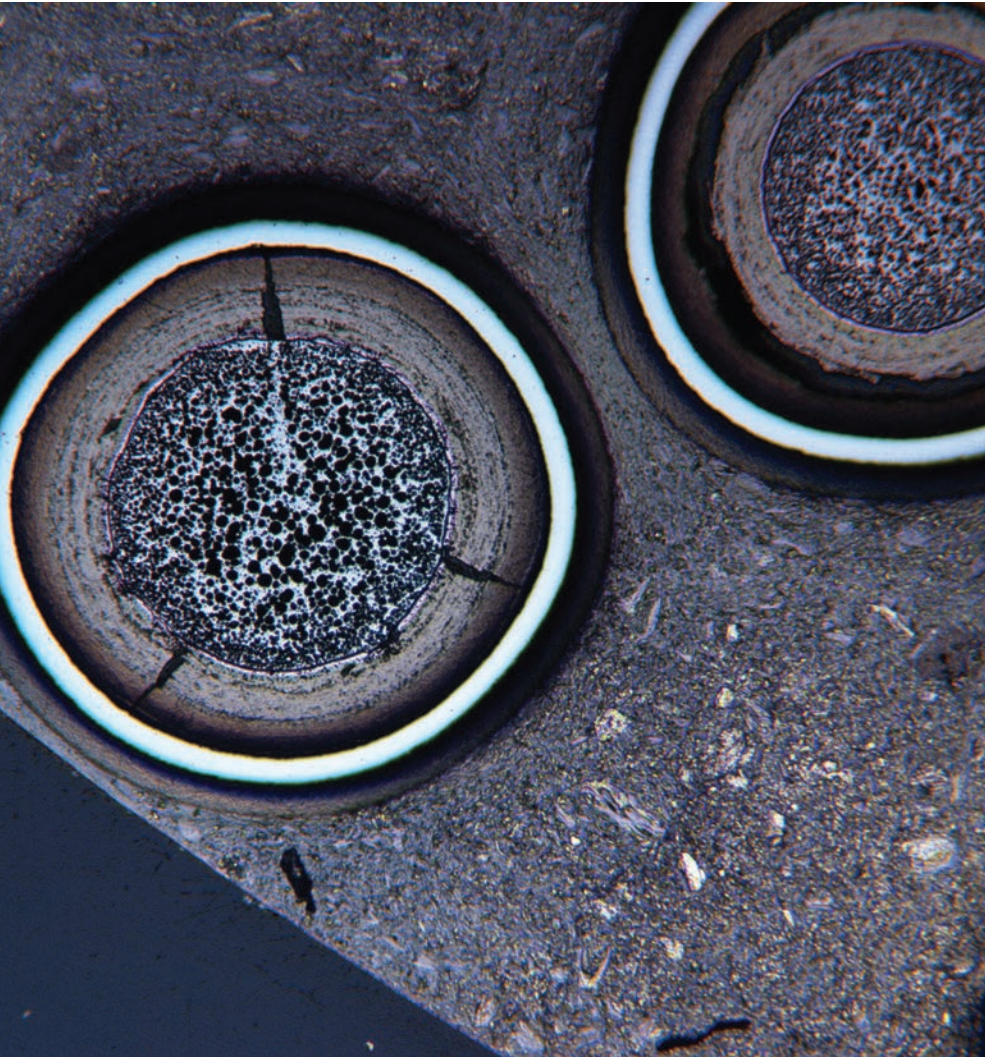
Energy-efficient construction and design

The University of Idaho Integrated Design Lab (IDL) is supporting Idaho Power Company's efforts to improve energy efficiency by providing professional education to the design and construction industry and technical assistance on new construction and renovations. IDL staff also are developing new commercial heat pump sizing calculation methods, researching the most effective commissioning practices to harvest daylight and reduce use of electric lighting, and studying the cost-effectiveness of energy-efficient multifamily residential design.



Finding the silver lining

Idaho National Laboratory scientists studying a new type of nuclear fuel discovered where silver fission products have been hiding with the help of Yaqiao Wu, a Boise State University student and an instrument lead for the CAES Microscopy and Characterization Suite (MaCS). The team used a powerful microscope to identify where silver fission products were amassing in a sample of tristructural isotropic (TRISO) fuel. The fuel could run the next generation of high-temperature gas-cooled reactors, which have built-in safety features. The discovery will help researchers understand how fission products move during irradiation and design better TRISO fuel.



“The (Microscopy and Characterization Suite) at CAES is set up for collaboration and to make discoveries like silver congregating in (tristructural isotropic) fuel.”

*-Yaqiao Wu,
Boise State University
researcher and instrument
lead for MaCS*

TRISTRUCTURAL ISOTROPIC (TRISO)
FUEL COULD RUN THE NEXT GENERATION
OF HIGH-TEMPERATURE GAS-COOLED
REACTORS, WHICH HAVE BUILT-IN
SAFETY FEATURES.

350

NUMBER OF HOURS THE CAES MICROSCOPY AND CHARACTERIZATION SUITE (MaCS) WAS BOOKED FOR USE IN JUNE 2012.

700

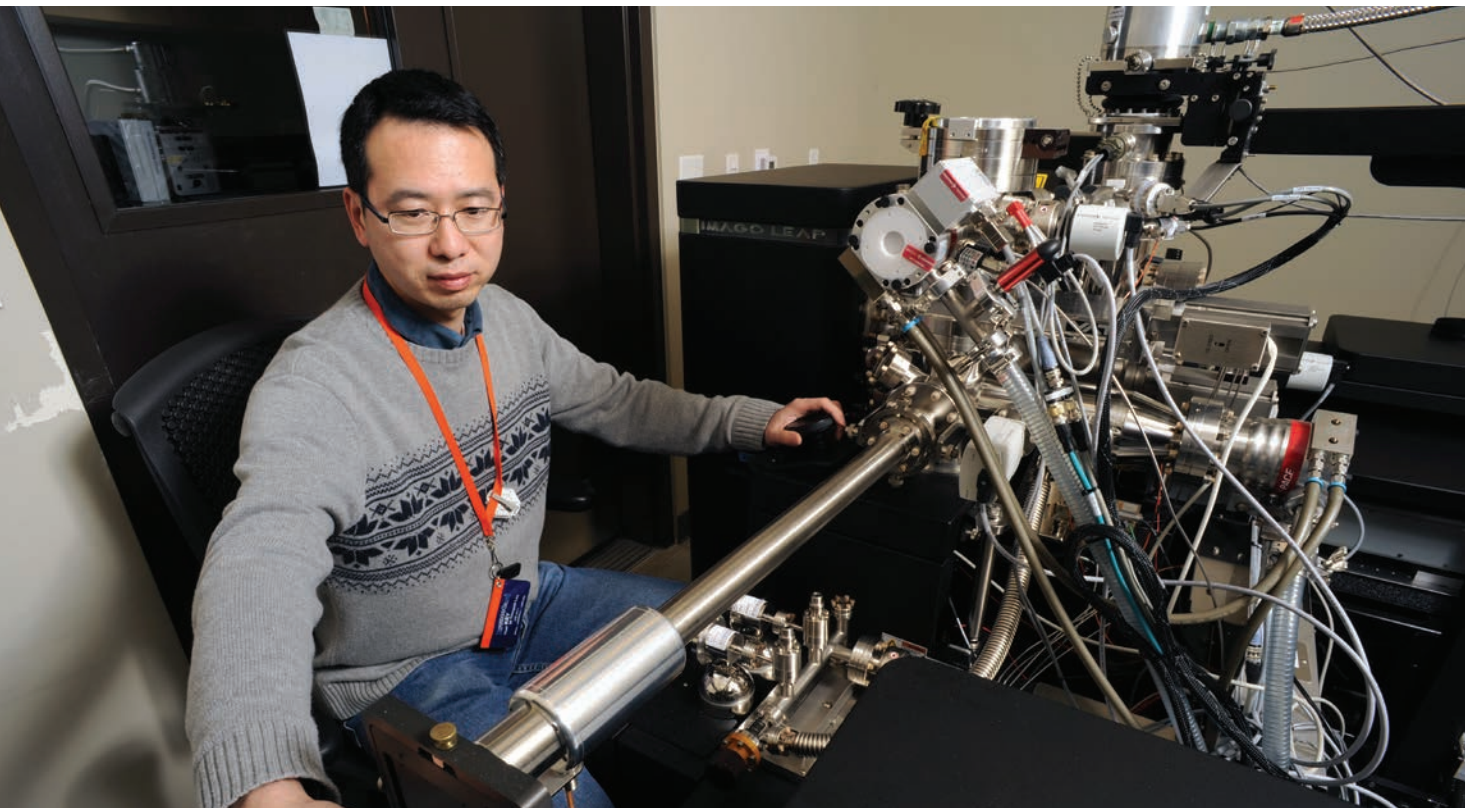
NUMBER OF HOURS MaCS WAS BOOKED IN JUNE 2013.

15

AVERAGE NUMBER OF HOURS MaCS IS BOOKED PER DAY.

MaCS-imizing Research

CAES operates its Microscopy and Characterization Suite (MaCS) as a user facility so researchers outside the partnership can gain access to the lab's powerful microscopes and localized electrode atom probe (LEAP).



DID YOU KNOW?

PV MAPPER, A NEW SOLAR-SITING TOOL DEVELOPED BY A CAES RESEARCH TEAM, IS ENTERING THE BETA TESTING PHASE. INDUSTRY PARTNERS ARE EXPECTED TO TEST THE GEOGRAPHIC INFORMATION SYSTEM-BASED SOFTWARE OVER THE NEXT YEAR. THE PROJECT IS LED BY THE CAES ENERGY POLICY INSTITUTE.

UNIVERSITY OF IDAHO RESEARCHERS
HAVE BUILT A PILOT-SCALE SYSTEM TO
TURN COW MANURE INTO PLASTIC.

Converting cow manure to bioplastics

A University of Idaho research team has developed a system to transform cow manure into polyhydroxyalkanoate – or PHA – a biodegradable plastic. A pilot-scale model of the manure-to-plastic system is operating at the UI dairy. The system also works with anaerobic digesters, which convert manure to electricity – a major CAES research initiative. Fermented manure can be split into solids that can be used for electricity and liquids for plastic production.



Presenting energy policy

The third annual Western Energy Policy Research Conference featured 42 presentations from students, university professors, and representatives from government and industry. More than 120 people from six countries attended the event. Sponsored by the CAES Energy Policy Institute, the conference is one of the few that focuses on energy-related policy research.

Helping industry save energy

The CAES Energy Efficiency Research Institute (CEERI) launched a statewide industrial assessment center after receiving a DOE grant. Student teams at the CAES partner universities conducted free energy efficiency assessments for regional companies and manufacturing plants. The teams conducted eight visits and submitted four reports during FY 2012. Total projected energy savings identified by the teams is 1,003,464 kilowatt hours, 83,022 therms, 1,255 kilowatts and a potential cost savings of \$109, 524.

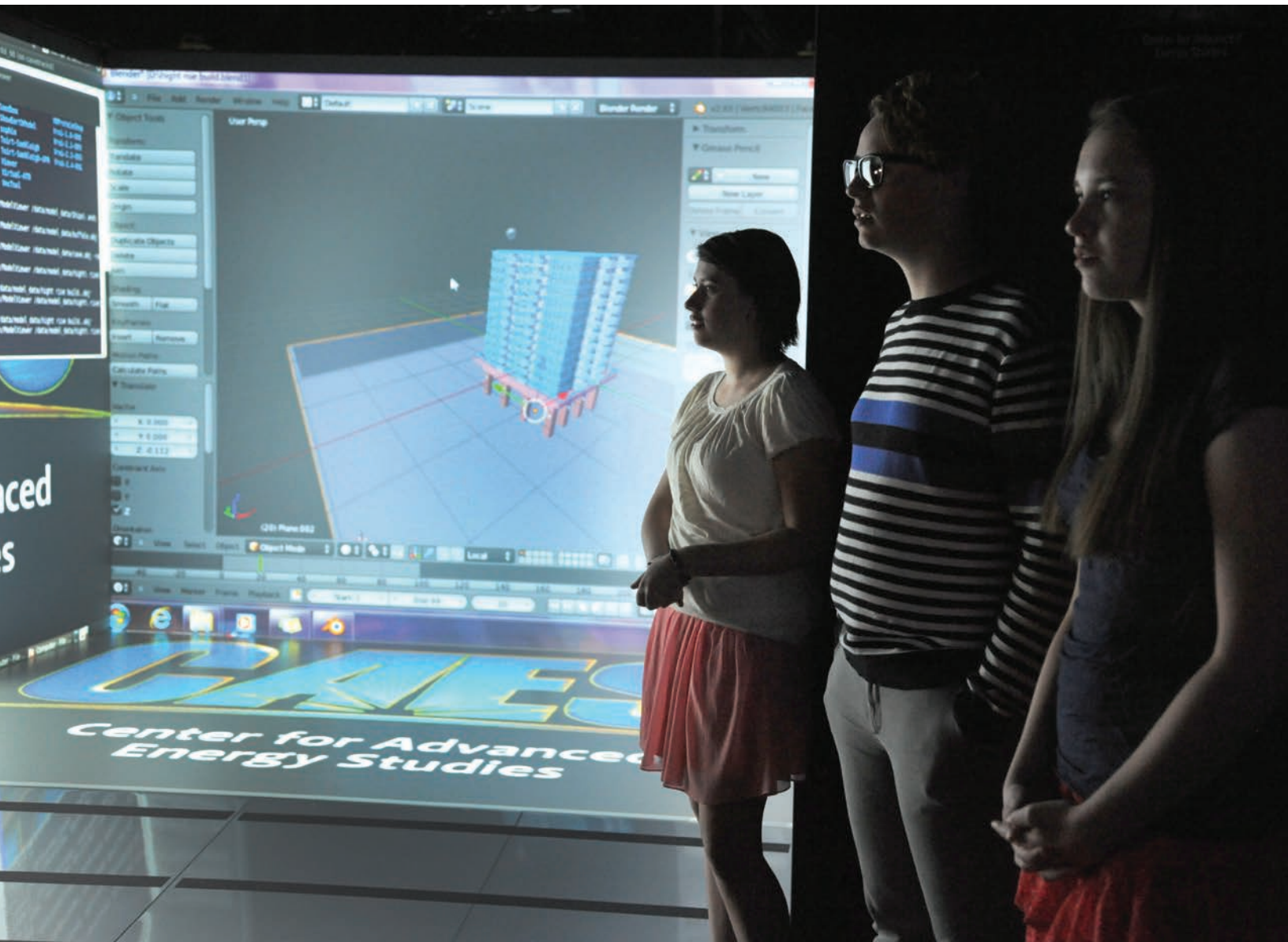


Education and Outreach

STUDENTS FROM IDAHO FALLS' COMPASS
ACADEMY HIGH SCHOOL PRESENTED ON
A 3-D MODEL THEY BUILT TO FUNCTION
IN THE CAVE.

Doing math in a CAVE

Algebra II students from an Idaho Falls high school used the computer-assisted virtual environment (CAVE) at CAES to learn about the quadratic function. The students created animated computer models that depicted a real-world use of a quadratic equation and displayed their work in the CAVE. They also presented their models and the math behind them to a panel of CAES students and researchers.





Science Fair

More than 70 students from Twin Falls to Idaho Falls participated in the Eastern Idaho Tournament of Innovation, which was held in March at the Center for Advanced Energy Studies (CAES). The event was sponsored by the Museum of Idaho, the Discovery Center of Idaho, CAES and Idaho National Laboratory.



50
 NUMBER OF K-12
 EDUCATORS WHO
 PARTICIPATED IN A
 WEEKLONG SCIENCE,
 TECHNOLOGY,
 ENGINEERING AND
 MATH TRAINING
 SESSION AT CAES
 AND EASTERN IDAHO
 TECHNICAL COLLEGE.



FEMALE JUNIOR HIGH SCHOOL STUDENTS PARTICIPATED IN HANDS-ON SCIENCE PROJECTS AND INTERACTED WITH PROFESSIONAL WOMEN DURING THE 2013 MY AMAZING FUTURE EVENT AT CAES.

My Amazing Future

More than 100 female junior high school students defended electronic tablets from cyberattacks, used chemistry and paper chromatography to solve crimes, and detected radiation during the sixth annual My Amazing Future workshop at CAES. Eighth-graders from Idaho Falls, Blackfoot, Fort Hall, Pocatello and Twin Falls participated in the daylong event organized by Idaho National Laboratory employees and members of Idaho Women in Nuclear (IWIN).

CAES Energy Scholars

CAES launched a new scholarship program for Idaho students interested in performing energy-related research. The CAES Energy Scholars program is a mentored internship focused on providing students from the center's partner universities with real-world experience in a variety of areas, including nuclear engineering, bioenergy, material science, modeling and simulation, and cybersecurity.



Awards and Accomplishments

Researcher selected for Fulbright scholarship

University of Idaho/CAES researcher Robert Hiromoto was named a Fulbright Scholar and is spending the 2013-2014 academic year teaching and conducting research at the American-Ukrainian School of Computer Science at Ternopil National Economic University. Hiromoto is the first UI-Idaho Falls professor to be named a Fulbright Scholar and the first CAES-based researcher to be selected for the prestigious program.

DID YOU KNOW?

JASON STOCK, A PHYSICS MAJOR AT IDAHO STATE UNIVERSITY, WAS ONE OF 37 UNDERGRADUATE STUDENTS IN THE COUNTRY TO RECEIVE A \$5,000 SCHOLARSHIP THROUGH THE U.S. DEPARTMENT OF ENERGY'S NUCLEAR ENERGY UNIVERSITY PROGRAMS (NEUP).

ROBERT HIROMOTO, A UNIVERSITY OF IDAHO/CAES RESEARCHER, IS SPENDING THE 2013-2014 ACADEMIC YEAR IN THE UKRAINE AS A FULBRIGHT SCHOLAR.



Student awarded fellowship from national organization

University of Idaho/CAES student Leslie Kerby received a \$32,000 M.H. Blewett Fellowship for Women from the American Physical Society. Kerby, who is earning her master's degree in nuclear engineering, also won a \$5,000 Post Foundation Award for her research.

CAES associate director named distinguished professor

Boise State University designated CAES Associate Director Darryl Butt as a distinguished professor for his teaching, research and public service achievements. Butt has mentored more than 34 graduate students, published 180 peer-reviewed journal articles and maintained an active research program since joining BSU in 2005. Butt also served as chair of BSU's Department of Materials Science and Engineering and leads the CAES materials research initiative.



CAES student/advisor win best paper

Dumidu Wijayasekara, a University of Idaho/CAES student, and his advisor, Milos Manic, won the best paper award at the 2013 IEEE Symposium Series on Computational Intelligence (SSCI 2013) in Singapore. Their paper is titled "Shadowed Type-2 Fuzzy Logic Systems." More than 1,000 articles were submitted to the conference.

Researcher recognized for energy efficiency work

The NW Energy Coalition honored the director of the CAES Energy Efficiency Research Institute with its highest award. CEERI director John Gardner, who also teaches mechanical engineering at Boise State University, received the coalition's Bob Olsen Memorial Conservation Eagle Award.



Researcher honored for energy education

The Idaho Falls-based Partnership for Science and Technology organization recognized Akira Tokuhiko, a University of Idaho/CAES researcher, for his contributions to energy education. Tokuhiko teaches and conducts nuclear energy research and also has served on the American Nuclear Society Special Committee on Fukushima.

Publications, Presentations, and Proceedings

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- Black, G., 2013, "A Decision Framework for Economic Impacts Deployment of Small Modular Reactors in Developing Countries," *Presentation for the 75th Annual International Atlantic Economic Conference*, Vienna, Austria, April 3–6, 2013.
- Black, G., 2013, "Wind Energy Development in the West: The Role of State Incentives," *Presentation for the 2013 Western Energy Policy Research Conference*, Portland, Oregon, USA, September 5–6, 2013.
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