ANNUAL REPORT

2012

CAES Center for Advanced Energy Studies

"Collaboration really is at the heart of the center's success."

Dear colleagues,

Fiscal year 2012 marked the seventh year of the Center for Advanced Energy Studies, a partnership between Idaho National Laboratory and Idaho's three public research universities – Boise State University, Idaho State University and University of Idaho.

Once again, we made significant progress toward fulfilling our dual missions of building a collaborative research portfolio while educating the next generation of scientists and engineers to benefit Idaho, the region and the nation.

The CAES partners have proven that a national laboratory can work collaboratively with universities and achieve results. CAES is now touted as a model across the U.S. Department of Energy complex.

Researchers from partner institutions are working side by side to assemble strong, innovative proposals that win funding from a variety of agencies and industries. And our virtual CAES model through which we pool resources and share equipment has allowed us to compete with much larger universities and win research dollars.

In addition, the university partners continue to build strong academic programs that are educating a new generation of scientists and engineers. Boise State recently introduced a doctoral program in materials science and engineering and University of Idaho and Idaho State University continue to build enrollment in nuclear-related fields.

The CAES partnership is flourishing because of the strong support of all involved.

Battelle Energy Alliance, the contractor that runs INL for the U.S. Department of Energy, continues to invest more than $5 million in the partnership. During the 2012 legislative session, the state of Idaho increased its funding for CAES to $2 million.

The state also created the Idaho Global Entrepreneurial Mission (IGEM), a new program modeled after CAES. IGEM will funnel another $2 million in research to the Idaho universities and $1 million to commercialize that work.

As the partnership enters its eighth year, we are taking steps to ensure the partnership succeeds well into the future.

Sincerely,
CAES Board of Directors

David Hill, Deputy Lab Director, Idaho National Laboratory

Richard Jacobsen, Vice President of Research, Idaho State University

Jack MacIver, Vice President of Research, University of Idaho

Mark Rudin, Vice President of Research, Boise State University

FY 2012 | By the Numbers

The Center for Advanced Energy Studies provided the state of Idaho, the U.S. Department of Energy and Battelle Energy Alliance a strong return on investment in federal FY 2012.

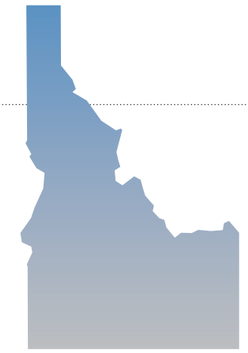
COMPETITIVE RESEARCH AND OTHER FUNDING CAES RESEARCHERS WON IN FY 2012.

9.07
$ MLLION

While much of $9.07 million came from DOE programs – traditional sources of funding – CAES also diversified its portfolio. Researchers won grants from the National Science Foundation and the U.S. Department of Agriculture – firsts for CAES – and funding from industrial partners like the Innovation Center for U.S. Dairy.

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

50.97
$ MILLION



THE STATE OF IDAHO'S INVESTMENT IN CAES DURING STATE FY 2012.

ONE.SIX
$ MILLION

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

TWO
$ MILLION

THE STATE'S RETURN ON ITS FY 2012 INVESTMENT IN THE CAES PARTNERSHIP.

5.6 : 1

Every $1.00 spent brings in $5.60

AMOUNT IDAHO NATIONAL LABORATORY INVESTED IN CAES IN FY 2012.

$5 MILLION-PLUS

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

583

This is nearly a 140% increase over 2010 enrollment in similar programs

NUMBER OF PUBLICATIONS, PRESENTATIONS AND PROCEEDINGS CAES RESEARCHERS PRODUCED IN FY 2012.

228

NUMBER OF CAES AFFILIATE RESEARCHERS

ONE HUNDRED TWENTY FIVE+

Research Capabilities

The Center for Advanced Energy Studies continues to build its research portfolio and strengthen partnerships through two major capabilities– the Microscopy and Characterization Suite (MaCS) and a computer assisted virtual environment (CAVE).

CAES operates both of these laboratories as user facilities so scientists, engineers and others outside the partnership can gain access to them. Use of the CAVE and MaCS by internal and external researchers and partners grew substantially in FY 2012.

RESEARCHERS FROM THE CAES PARTNER INSTITUTIONS, UNIVERSITY OF WYOMING AND OTHER COLLEGES ARE USING THE CAVE TO EXAMINE AND EXPLORE DATA.

THE WESTERN ENERGY POLICY RESEARCH CONFERENCE CONTINUED TO GROW IN 2012. THE 2012 CONFERENCE FEATURED 45 PRESENTATIONS, A 35 PERCENT INCREASE FROM 2011.

MaCS users included researchers from: Micron, Nanosteel, University of California –Santa Barbara, University of California – Berkeley, General Electric, Oxford University (United Kingdom), University of Florida, Texas A&M, Center for Space Nuclear Research, University of Wisconsin-Madison, Idaho National Laboratory and the Idaho universities.

CAVE users included several companies: Idaho Falls Power, the Idaho Cleanup Project, the Bonneville Power Administration, CRSA Architects and HDR Engineering.

Research Accomplishments

Exchanging research ideas

More than 80 people from industry, academia and government agencies converged in Boise to take part in the second annual Idaho Research Symposium. Launched by CAES in 2011, the symposium connects Idaho industry and companies with the state's researchers and spark potential collaborations. Twelve entities sponsored the event in FY 2012 and 58 companies participated, up from 22 the year before.

Discussing energy policy

The second annual Western Energy Policy Research Conference featured more than 45 presentations from 33 universities, national laboratories, and stakeholder groups throughout the United States, Canada and the United Kingdom. Sponsored by the CAES Energy Policy Institute, the conference is one of the few in the country that focuses on energy-related policy research.

Siting solar energy facilities

The CAES Energy Policy Institute leads a team of 12 researchers that is developing a computer-based Geographic Information System (GIS) tool to identify potential sites for large-scale solar energy facilities. The tool analyzes natural resource, physical characteristics as wells public acceptance/opinion of where such farms should be located. The $2.8 million project is being funded through the U.S. Department of Energy's Sunshot Initiative.

Researching nuclear energy

Researchers with the CAES nuclear science and engineering initiative won more than $2.5 million from the U.S. Department of Energy. The researchers, all from University of Idaho, won three of the 47 research projects funded by DOE's Nuclear Energy University Programs (NEUP) in FY 2012. Supathorn Phongikaroon, Akira Tokuhiro and Vivek Utgikar lead the various research projects (Utgikar and Milos Manic, a UI/CAES researcher also serve as collaborators on one.)

$109,524 POTENTIAL COST SAVINGS FROM ENERGY EFFICIENCY IMPROVEMENTS IDENTIFIED BY CEERI STUDENT TEAMS.

DR. DARRYL BUTT, A BOISE STATE UNIVERSITY PROFESSOR WHO LEADS THE CAES ADVANCED MATERIALS INITIATIVE, IS PART OF A NATIONAL TEAM RESEARCHING USED NUCLEAR FUEL STORAGE.

Improving energy efficiency

The CAES Energy Efficiency Research Institute (CEERI) launched a statewide industrial assessment center after receiving a U.S. Department of Energy 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.

Manure to fuel

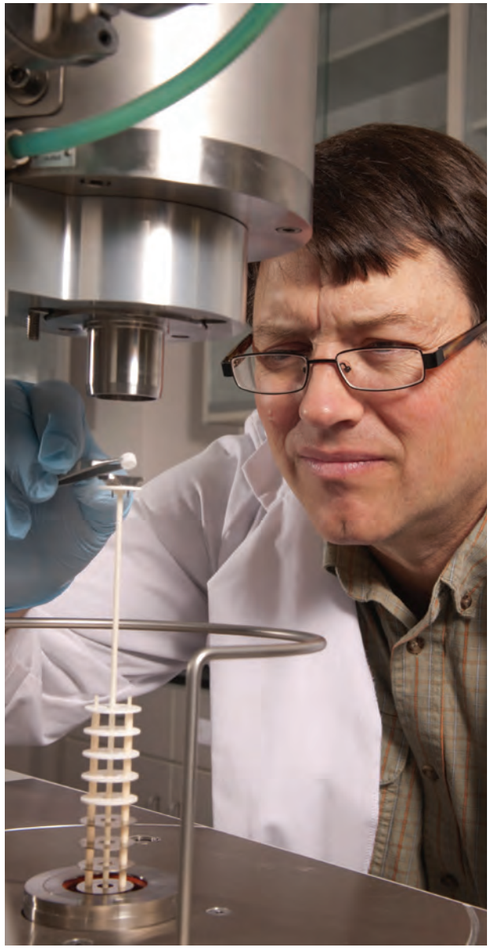
A CAES bioenergy research team won a $680,000 grant from the U.S. Department of Agriculture to investigate turning effluent, a liquid waste produced during the anaerobic digestion of dairy manure, into a biofuel. The project is a collaboration between CAES and the Innovation Center for U.S. Dairy, an industry group that is committed to reducing greenhouse gas emissions at the nation's dairy farms by 20 percent.

Testing for Geothermal

A CAES research team is working to improve the accuracy of geothermal reservoir temperature predictions, which could help lower geothermal exploration costs. The geofluids energy science team won a $1 million grant from the U.S. Department of Energy to conduct the research.

Building sensors to monitor used fuel

Boise State University/CAES researchers Darryl Butt, Sin Ming Loo and Mike Hurley are part of a multi-university team investigating whether or not used nuclear fuel can be stored safely in giant, stainless steel casks for 100 years or more. Boise State's portion is to develop a sensor array that detects any changes to the used fuel or cask from the inside out. Heat from used fuel could power the sensor, which would be placed inside or near casks and transmit information about temperature, corrosion, radiation, gas evolution, global position and other conditions so they could be monitored remotely for years to come.



MILOS MANIC, A UNIVERSITY OF IDAHO PROFESSOR AND CAES RESEARCHER, WON A $200,000 GRANT TO CREATE A REVERSE 911 SYSTEM THAT USES THE INTERNET – NOT TELEPHONE LINES – TO ISSUE ALERTS.

DID YOU KNOW? CAES/UNIVERSITY RESEARCHERS WON THREE NATIONAL SCIENCE FOUNDATION GRANTS IN FY 2012, A MAJOR ACCOMPLISHMENT BECAUSE NSF FUNDING IS EXTREMELY COMPETITIVE.

Photo courtesy of the Post Register

Educating the Energy Workforce

Student opportunities

CAES provide students opportunities to work in cutting-edge laboratories and on a variety of projects, from separating used nuclear fuel to researching new applications of nuclear energy in space. More than 50 students interned or conducted graduate-level research at CAES during FY 2012.

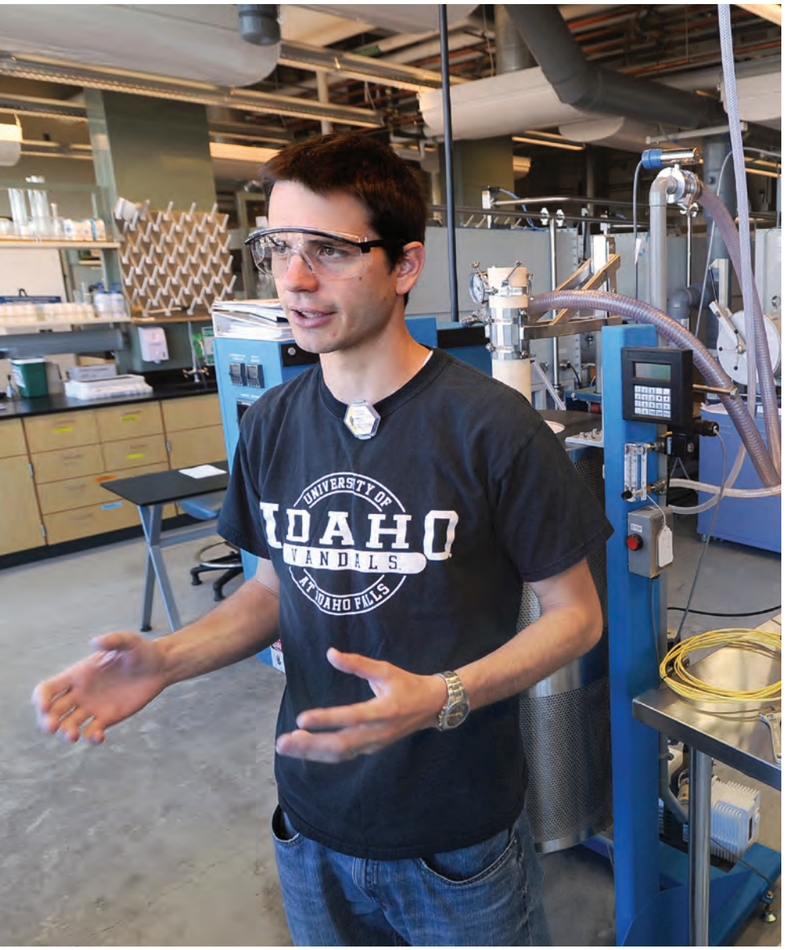


Photo courtesy of the Post Register

"I enjoy working at CAES because it allows me an opportunity to participate in cutting-edge research projects as well as providing an environment for international and domestic collaboration with scientist, engineers, and students."
-Ammon Williams, graduate student, nuclear engineering, University of Idaho

AMMON WILLIAMS, A UNIVERSITY OF IDAHO GRADUATE STUDENT, WORKS WITH DR. SUPATHORN PHONGIKAROON ON SEPARATING USED NUCLEAR FUEL THROUGH A TECHNIQUE CALLED PYROPROCESSING.

STUDENTS ENROLLED IN THE NUCLEAR OPERATIONS TECHNICIAN PROGRAM AT IDAHO STATE UNIVERSITY'S ENERGY SYSTEMS TECHNOLOGY AND EDUCATION CENTER (ESTEC)INTERNED AT IDAHO NATIONAL LABORATORY DURING FY 2012.

Funding scholarships

CAES awarded $2,250 in scholarships to three Idaho National Laboratory interns interested in energy careers. Winners were: Kenneth Peters, a geography student at University of Idaho; Callan McGriff, a civil engineering major at UI; and Dane Sterbenz, a nuclear engineering major at Idaho State University. CAES launched the program five years ago to help fulfill its mission of increasing the number of students entering the energy field.

DID YOU KNOW?

CAES INVESTED $1.4 MILLION IN INL-FUNDED SEED MONEY TO RESEARCHERS FOR EXPLORATORY PROJECTS IN FY 2012. THE GOAL IS TO INVEST IN PPROJECTS INCLUDED: IMPROVING DRIVER BEHAVIOR AND FUEL EFFICIENCY OF THE INL BUS FLEET, RESEARCHING AND IMPROVING A TWO-STAGE ANAEROBIC DIGESTION PROCESS, AND DESIGNING BETTER ALARM SYSTEMS FOR POWER PLANT CONTROL ROOMS.

Supporting STEM Education

More than 400 educators attended four hands-on workshops sponsored by the Idaho Science. Technology, Engineering and Mathematics initiative – or i-STEM - of which CAES is a member. CAES also provided tours to several student groups during FY 2012, including Idaho Science and Aerospace Scholars and My Amazing Future, a female-oriented, hands-on STEM workshop.

CAES AND ITS PARTNER INSTITUTIONS SUPPORT SEVERAL STEM EVENTS THROUGHOUT THE YEAR, INCLUDING HANDS-ON ACTIVITIES FOR K-12 STUDENTS.

$44,250 AMOUNT OF SCHOLARSHIP MONEY CAES HAS DISTRIBUTED SINCE FY 2009.

1,000-plus NUMBER OF IDAHO K-12 EDUCATORS WHO HAVE ATTENDED I-STEM TEACHER INSTITUTES SINCE 2009.

3,000+ NUMBER OF PEOPLE WHO TOURED CAES AND VISITED THE CENTER'S COMPUTER ASSISTED VIRTUAL ENVIRONMENT (CAVE) IN FY 2012.

Awards and Accomplishments

Idaho university students win geothermal competition

A student team from Idaho State University took first place and a Boise State University team placed second in the U.S. Department of Energy's National Geothermal Student Competition. All three Idaho public research universities – BSU, ISU and University of Idaho – had teams in the finals.The subject of this year's competition was the geothermal potential of Idaho's Snake River Plain.

Researcher recognized by international organization

An international organization honored University of Idaho/CAES researcher Milos Manic for his work in computational intelligence and industrial electronics. The Industrial Electronics Society, a division of the Institute of Electrical & Electronics Engineers, selected Manic to receive its first David Irwin Early Career Award. The award is given to a "young researcher who has made significant contributions to the advancement of the field of industrial electronics."

UI students win poster competition

University of Idaho graduate students, Ammon Williams and Robert Hoover, placed first and third at the 2012 American Nuclear Society Student Conference's poster conference. Williams and Hoover, both of whom are based at CAES, work with Dr. Supathorn Phongikaroon, a University of Idaho researcher in Idaho Falls. Williams and Hoover competed against students from universities across the country.

DID YOU KNOW? CAES HELPS PAY THE SALARY OF EIGHT RESEARCHERS/PROFESSORS AT THE IDAHO UNIVERSITIES THROUGH IDAHO NATIONAL LABORATORY'S JOINT APPOINTMENT PROGRAM, WHICH IS DESIGNED TO PROMOTE COLLABORATION BETWEEN THE LAB AND ACADEMIA.

Nuclear energy scholarships

Students from University of Idaho and Idaho State University won more than $300,000 in fellowships and scholarships from the U.S. Department of Energy's Nuclear Energy University Programs (NEUP). Richard Skifton, a UI student based at CAES, and Brycen Wendt of ISU received three-year, $155,000 fellowships to pursue graduate degrees and Jason Stock, an ISU student, got a $5,000 undergraduate scholarship.

ISU/CAES associate director honored

A national organization awarded Jason Harris, an Idaho State University professor and CAES Associate Director, for his work in the field of health physics. The Health Physics Society presented Harris with its Elda E. Anderson Award, which is given to a young member and recognizes excellence in research or development, discovery or invention, devotion to health physics and significant contributions to the field.

MORE THAN 50 STUDENTS INTERNED OR CONDUCTED GRADUATE LEVEL-RESEARCH AT CAES DURING FY 2012.

DR. JASON HARRIS, AN IDAHO STATE UNIVERSITY WHO LEADS THE CAES NUCLEAR SCIENCE AND ENGINEERING INITIATIVE, WAS HONORED BY THE HEALTH PHYSICS SOCIETY FOR HIS WORK IN THAT FIELD.

Three named outstanding CAES contributors

CAES honored employees from its partner institutions for their contributions to the partnership and its mission. Kevin Feris of Boise State University, Kristi Moser-McIntire of Idaho State University and Dennis Keiser of University of Idaho were named outstanding CAES contributors for 2012. This is the third year CAES has given out the awards.

International organization recognizes UI/CAES researcher

Dr. Donald M. McEligot, a distinguished visiting professor in mechanical engineering at University of Idaho and CAES scientists, received the International Network of Engineering Education and Research (iNEER)'s Leadership Award. The organization selected McEligot was for his "visionary leadership in innovative research, consistent scholarship through international collaborations and pioneering contributions to engineering."

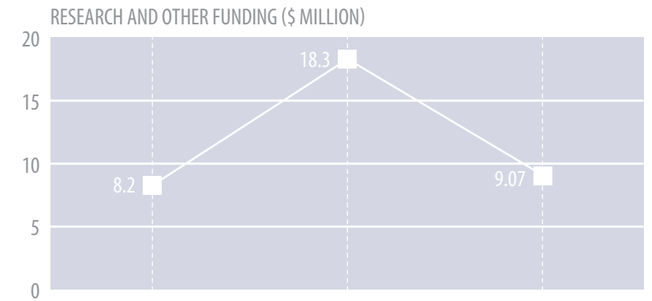
THREE NUMBER OF EMPLOYEES NAMED AS OUTSTANDING CAES CONTRIBUTORS

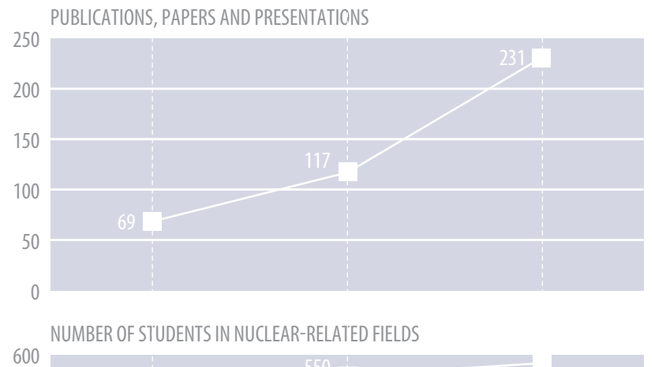
ELLEN RABENBURG, A BOISE STATE UNIVERSITY GRADUATE STUDENT, WORKS IN THE CAES MATERIALS LAB.

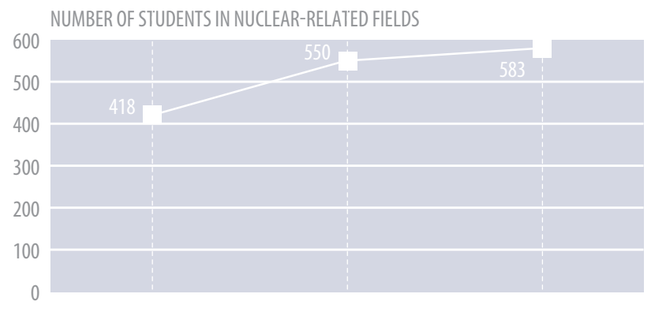
RIGHT - AN IDAHO STATE UNIVERSITY EMPLOYEE WORKS WITH THE SCHOOL'S RESEARCH REACTOR.

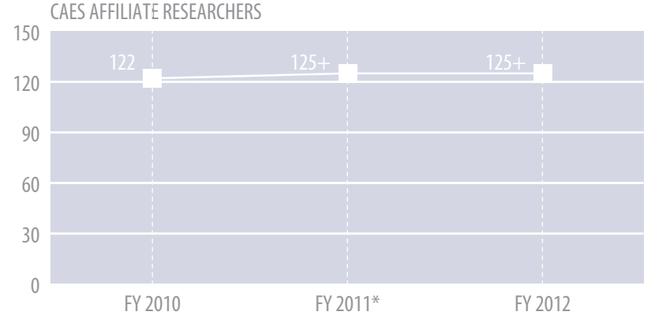
THE GRAPHS DEPICT CAES' PERFORMANCE OVER THE PAST THREE YEARS.

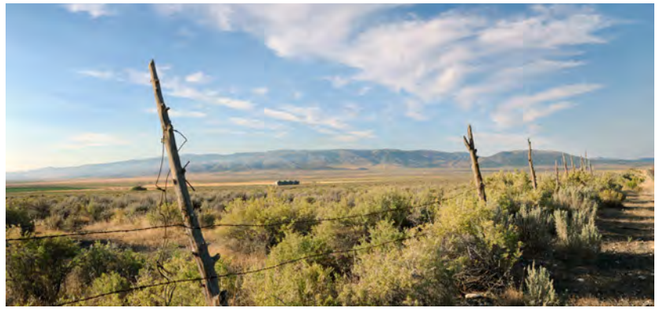
**DENOTES CHANGE IN REPORTING PERIOD FROM A STATE FISCAL YEAR TO A FEDERAL FISCAL YEAR..*











CAES ADDS CAPABILITIES AND EQUIPMENT THAT SUPPORTS RESEARCH AND PROVIDE A COMPETITIVE EDGE. THE IDAHO FALLS FACILITY IS HOME TO UNIQUE EQUIPMENT, INCLUDING A SPARK PLASMA SINTERING SYSTEM CONTAINED WITHIN A GLOVEBOX AND HIGH-END MICROSCOPY LAB.

RESEARCH AT CAES FOCUSES ON NUCLEAR SCIENCE AND ENGINEERING, ADVANCED MATERIALS, BIOENERGY, CARBON MANAGEMENT/GEOTHERMAL ENERGY, ENERGY EFFICIENCY, ENERGY POLICY, AND MODELING AND SIMULATION.

RIGHT: UNIVERSITY OF IDAHO'S INTEGRATED DESIGN LAB, WHICH IS BASED IN BOISE, PLAYS A MAJOR ROLE IN THE CAES ENERGY EFFICIENCY RESEARCH INITIATIVE (CEERI).

ABOVE: BIG SKY WEST DAIRY IN GOODING, IDAHO RECEIVED A CAES/ IDAHO NATIONAL LABORATORY ENERGY ACHIEVEMENT AWARD FOR ITS COMMITMENT TO CONVERTING MANURE INTO POWER AND OTHER USEFUL PRODUCTS.

CAES STUDENTS HAIL FROM ALL OVER THE WORLD - CHINA, NIGERIA, INDIA, KOREA AND THE CZECH REPUBLIC AND OTHER COUNTRIES.

12 DOZEN NUMBER OF DUMPLINGS MADE AND SERVED DURING A CHINESE NEW YEAR CELEBRATION AT CAES.

Publications, Presentations, and Proceedings

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2. Aldrich, E.L., &and C. Koerner, C., 2011, "Assessment of Carbon Capture and Sequestration Liability Regimes.," The Electricity Journal , 24 (7), 35-–48.
3. Aldrich, E.L., C. Koerner, C., J. C. Perkowski, J.C., &and T. McLing, T., March 2012, "Managing the Risks of Carbon Sequestration: Liability Concerns and Alternatives.," In J.A.F. Stoner &and C. Wankel (Eds.), Managing Climate Change Business Risks and Consequences: Leadership for Global Sustainability. New York City, NY: Palgrave Macmillan.
4. Aldrich, E., C. Koerner, C., &and D. Solan, D., December 2011, "Analysis of Liability Regimes for Carbon Capture and Sequestration: A Review for Policymakers.," Energy Policy Institute, December 2011.
5. Beazer, R., D.P. Ames, D.P.,J. Joe, J., D. Solan, D., D. Koehler, D., and J. Carlisle, J., 2011, "Integrating Social Attitudes and GIS The LineSiter Application.," Oral presentation, engineering seminar, Idaho State University, Idaho Falls, IdahoD, November 2011.
6. Beazer, R., D. P. Ames, D.P., J. Joe, J.,D. Solan, D.,D. Koehler, D., and J. Carlisle, J., 2011, "Stream Flow and Least Cost Path Analysis: An Algorithmic Comparison.," Oral presentation, Idaho Statewide Water Seminar, Idaho State University, Idaho Falls, IdahoD, November 2011.
7 Carlson, A. H., R. E. Hiromoto, R. B. Wells, "Breaking Block and Product Ciphers Applied Across byte Boundaries," IEEE Conference IDAACS 2011, September 15–17, 2011, Prague.
8. Poster presentation, Idaho State Board of Education, Idaho Falls, IdahoD, June 2012.
9. Black, G., 2012, "Estimating the Economic Impacts of Small Modular Reactors," Presented at the Platts 3rd Annual Small Modular Reactor Conference, Arlington, VirginiaA, May 21, 2012.
10. Black, G., 2012, "Economic and Employment Impacts of Small Modular Nuclear Reactors" Invited presentation at the Leadership in Nuclear Energy Commission, Boise, ID, June 2012.
11. Hall T., P. Wilson, P.,J. Newman, J., 2011, "Evaluating the Short- and Long-term Effects of a Modified Deliberative Poll on Idahoans' Attitudes and Civic Engagement Related to Energy Options.," Journal of Public Deliberation, 7 (1), 1-–30.
12. Hiromoto, R. E., "The Art and Science of GPU and Multi-Core Programming," International Journal of Computing, 2012, Vol. 11, Issue 1.
13. Koehler, D., and McCarthy, K., 2012, "Motivations and Support for Plug-in Electric Vehicles." Invited presentation at the Treasure Valley Clean Cities Coalition Stakeholders Meeting, Boise, Idaho, June 2012.
14. Louis, M., and D. Solan D., April 2012, "Idaho Investor-Owned Utility Transmission Siting Process.," Energy Policy Institute, April 2012.
15. O'Laughlin, J., D. Solan, D. & and L. Wennstrom, L., April 2012, "Identifying Barriers and Potential Solutions to Facilitate Woody Biomass to Energy Projects in Idaho: Roundtable Report.," Energy Policy Institute, April 2012.
16. Solan, D., &and L. Wennstrom, L., April 2012, "Identifying Barriers and Potential Solutions to Facilitate Anaerobic Digester Projects in Idaho: Roundtable Report.," Energy Policy Institute, April 2012.
17. Solan, D., &and L. Wennstrom, L., December 2011, "Identifying Barriers and Potential Solutions to Facilitate Combined Heat and Power Projects in Idaho: Report on December 1st Workshop.," Energy Policy Institute, December 2011.

NUMBER OF PUBLICATIONS, PRESENTATIONS AND PROCEEDINGS CAES RESEARCHERS PRODUCED IN FY 2012

228

18. Artri.p K.yle, D. Shrestha, D. Keiser., 2011. "Reducing Greenhouse Gas Emissions on Idaho Dairy Farms through the Use of Anaerobic Digestion Systems.," Poster presentation at the Bioenergy Research Collaboration Symposium, University of Idaho, Moscow, Idaho, 2011.
19. Pollyea, R., and J. P. Fairley, 2012. "Implications of Reservoir Uncertainty for CO2 Sequestration in Low-Volume Basalt,." Hydrogeology Journal, doi:10.1007/s10040-012-0847-1, 2012.
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22. Rissmann, C., A. Nicol, J. Cole, B. Kennedy, J. Fairley, B. Christenson, M. Leybourne, S. Milicich, U. Ring, and D. Gravley, 2011. Fluid Flow Associated with Silicic Lava Domes and Faults, Ohaaki Hydrothermal Field, New Zealand,." Journal of Volcanology and Geothermal Research, 204:12-26, 2011.
23. Gebrehiwet T. A., G. D. Redden, Y Fujita, MS Beig and RW Smith, (2012) "The Effect of the CO32- to Ca2+ Ion Activity Ratio on Calcite Precipitation Kinetics and Sr2+ Partitioning,". Geochemical Transactions, 13:1 doi:10.1186/1467-4866-13-1, 2012.
24. Wu Y., J. B. Ajo-Franklin, N. Spycher, S. S. Hubbard, G. Zhang, K. H. Williams, J. Taylor, Y. Fujita, and R. W. Smith, (2011) "Geophysical Monitoring and Reactive Transport Modeling of Ureolytically-Driven Calcium Carbonate Precipitation,". Geochemical Transactions, 12:7 doi:10.1186/1467-4866-12-7, 2011.
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27. Titiladunayo, I.F., McDonald, A.G., and Fapetu, O.P., (2012) Effect of temperature on biochar product yield from selected lignocellulosic biomass in a pyrolysis process. Waste and Biomass Valorization. 3(2)311-318, 2012.
28. Chakraborty, M., Miao, C., McDonald, A., and Chen, S., (2012) Concomitant extraction of bio-oil and value added polysaccharides from Chlorella sorokiniana using a unique sequential hydrothermal extraction technology. Fuel. 95:63-70, 2012.
29. Coats, E.rik R., *Ibrahim, Ibrahim, Briones, Aurelio, Brinkman, Cynthia K. Methane Production on Thickened, Pre-fermented Manure. Bioresource Technology 107, (2012), 205-–212, 2012.
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