

Annual Report

FY 2011





Dear Colleagues:

When I joined the Center for Advanced Energy Studies (CAES) in May 2011, it quickly became apparent that I was part of a world-class team with a meaningful purpose and vision.

In just a few years, the CAES partners—Boise State University, Idaho National Laboratory, Idaho State University, and University of Idaho – have proven the power of collaboration and that by working together, they can achieve more.

The evidence is in our accomplishments. In FY 2011 CAES:

- Won \$18.3 million in research, infrastructure and other funding.
- Launched a new statewide energy efficiency research initiative that has garnered strong support from the private sector as well as the endorsement of Idaho Gov. C.L. “Butch” Otter.
- Launched a partnership with the Innovation Center for U.S. Dairy to reduce greenhouse gas emissions at dairies across the country and solve environmental and energy challenges.
- Supported Idaho Falls Power on a smart grid demonstration project.
- Provided researchers from academia, industry and government access to unique advanced fabrication, characterization, modeling and simulation capabilities.

Our success is a direct result of the strong support provided by the state of Idaho, U.S. Department of Energy and industry. CAES success in turn supports the Idaho research universities in becoming first-tier, nationally recognized research leaders and sustains Idaho National Laboratory’s transformation into a world-class nuclear laboratory.

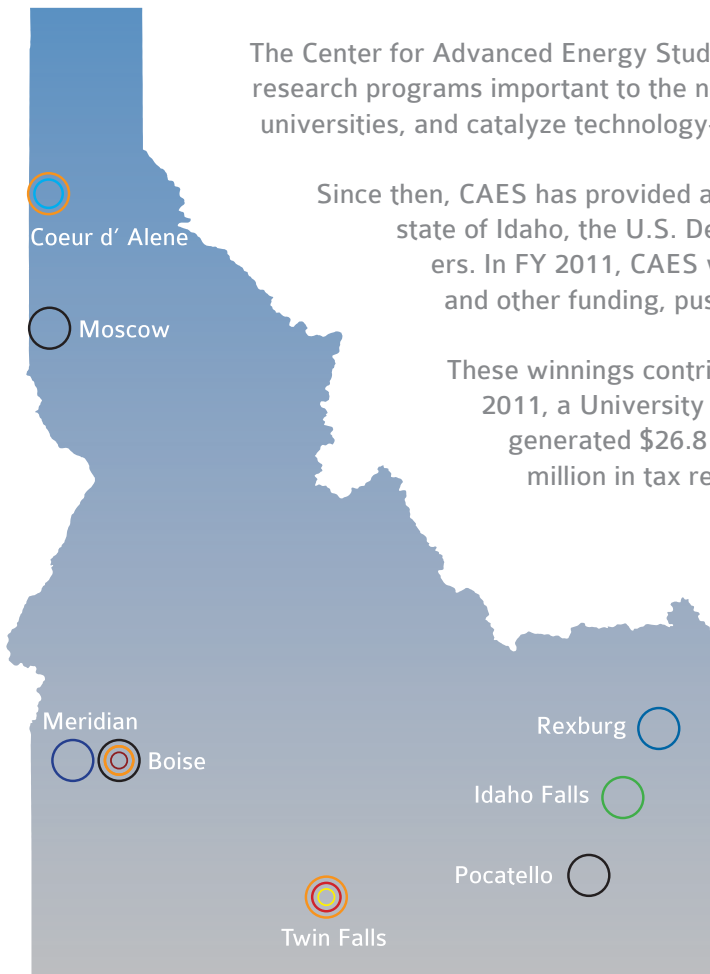
Sincerely,

Bill Rogers
CAES Director

*Collaboration
Inspiring
Innovation*



Executive Summary



The Center for Advanced Energy Studies (CAES) was created in 2005 to lead research programs important to the nation, attract students and faculty to Idaho universities, and catalyze technology-based economic development.

Since then, CAES has provided a significant return on investment for the state of Idaho, the U.S. Department of Energy and other stakeholders. In FY 2011, CAES won \$18.3 million in competitive research and other funding, pushing its total winnings to \$41.9 million.

These winnings contribute significantly to Idaho's economy. For 2011, a University of Idaho economist estimates that CAES generated \$26.8 million in regional sales, 366 jobs and \$0.62 million in tax revenue. Cumulatively (FY 2009-2011) CAES contributed \$64.3 million in regional sales, 889 jobs, and \$1.4 million in tax revenue.

CAES also continues to attract students to the Idaho universities' nuclear science and engineering programs. During the 2011 spring semester, more than 550 students were enrolled in nuclear-related degree or certificate programs.

11:1 Idaho's return on its FY 2011 \$1.6 million investment in CAES.

CAES Contributions to Idaho in FY 2011

- Boise, Pocatello, and Moscow** Idaho's research universities received portable 3D visualization systems known as IQ-Stations to build their modeling and simulation capabilities.
- Boise, Twin Falls, and Coeur d'Alene** Approximately 400 Idaho teachers attended three expense-paid science, technology, engineering, and math workshops, which CAES supported.
- Meridian** City officials are working with CAES to secure funding for a new anaerobic digestion pilot at the city's wastewater treatment plant.
- Twin Falls** The Innovation Center for U.S. Dairy is working with CAES to implement advanced anaerobic digestion technologies to reduce greenhouse gas emissions.
- Twin Falls** A CAES-sponsored policy roundtable examined issues surrounding community and cooperative anaerobic digesters for Magic Valley dairies.
- Coeur d'Alene** A CAES-sponsored policy roundtable examined issues surrounding, acquiring, and utilizing forest residues in the Pacific Northwest for bioenergy products.
- Idaho Falls** CAES is assisting Idaho Falls Power with its new smart grid demonstration project.
- Rexburg** Madison School District #321 won a grant to install solar panels on some of its schools and has asked CAES to help develop a related curriculum.
- Boise** A CAES team is evaluating data collected at the Banner Bank building, a certified "green" facility, to maximize energy efficiency.

Leveraging Infrastructure and Equipment

The CAES partners maximize research capabilities, expand the breadth of their research, and provide rich, hands-on experiences for students by sharing and leveraging laboratories, equipment, and other infrastructure. Through this “virtual CAES” model, stakeholders gain access to the unique infrastructure and equipment at the CAES facility in Idaho Falls, on the university campuses, and across the INL complex.



University of Idaho

Leads Geofluids Energy Science Initiative, biodiesel, and radiochemistry capabilities

Key Infrastructure:

- Agriculture Research and Extension Centers
- Integrated Design Laboratory
- Idaho Water Research Institute



Idaho State University

Leads Nuclear Science and Engineering Initiative

Key Infrastructure:

- Research Reactor/Health Physics
- Accelerator Center
- Nuclear Engineering Laboratory



Boise State University

Leads Advanced Materials, Energy Policy and Energy Efficiency Initiatives

Key Infrastructure:

- Advanced material fabrication and testing
- Center for Materials Characterization
- New Product Development Laboratory



CAES

Key Infrastructure:

- 55,000 sq. ft. LEED Gold
- 6 Labs (4 with radiological capabilities)
- 4-wall virtual reality CAVE
- Advanced visualization and computing
- Material fabrication and characterization



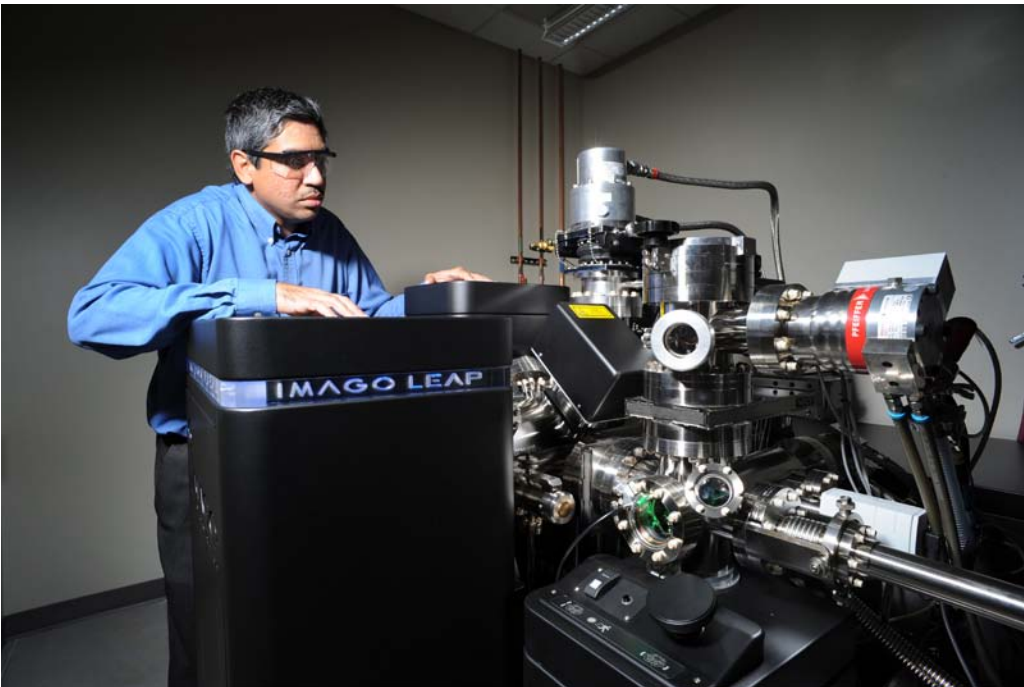
Idaho National Laboratory

Leads Bioenergy, and Modeling and Simulation Initiatives

Key Infrastructure:

- Advanced Test Reactor
- World-class energy research facilities
- One-of-a-kind radiological research facilities
- “Fission” Supercomputing facilities

In FY 2011, CAES began operating its Microscopy and Characterization Suite (MaCS), its computer assisted virtual environment (CAVE) and other high-end computing resources as user facilities. This strategy provides CAES researchers and other stakeholders access to unique research capabilities and also supports the partnership's fiscal viability.



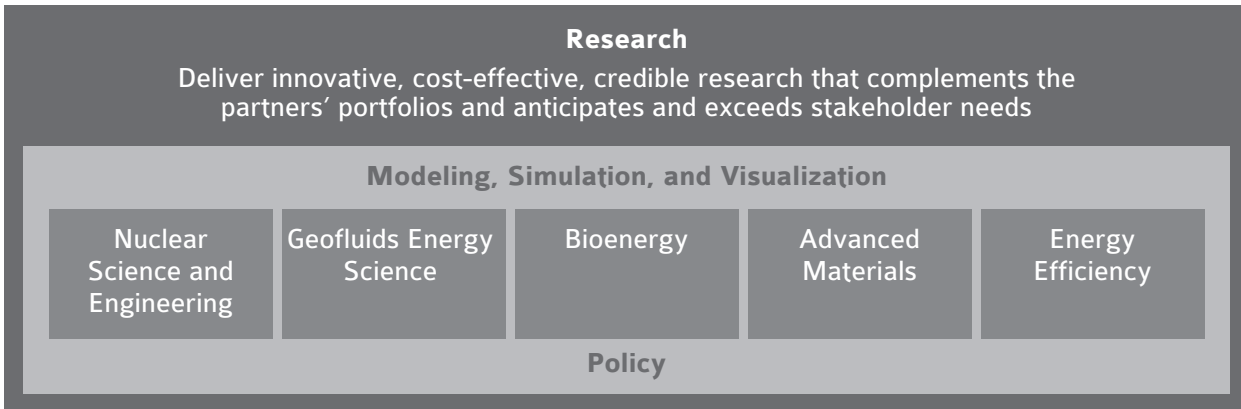
The **CAES Microscopy and Characterization Suite (MaCS)** houses state-of-the-art equipment used to analyze and characterize materials. MaCS represents an \$8 million investment in CAES by the Department of Energy and Battelle Energy Alliance, the contractor that runs INL. With MaCS, researchers can characterize materials on the atomic level.

The **high performance computing enclave at INL and computer assisted virtual environment (CAVE)** at CAES provide researchers with cutting-edge modeling and simulating resources. Through the new enclave, CAES researchers have access to "Fission," the new INL supercomputer installed in April 2011. Fission was ranked #99 on the June 2011 list of the fastest supercomputers in the world.



Research Accomplishments

During FY 2011, CAES continued to invest in and build its research portfolio based on the needs of industry and the strengths and capabilities of its partner institutions. The CAES research portfolio focuses on: nuclear science and engineering, advanced materials, bioenergy, geofluids energy science, energy efficiency, modeling and simulation, and energy policy.



Operating Safely and Efficiently

CAES is developing and implementing safe, compliant, and effective processes and procedures that facilitate productive research and ensure the safety of all researchers.

Accomplishments include:

- Implementation of a common set of environmental, safety, and health practices, including radiological controls
- Safe execution of research with no injuries for 2011.

125+ Number of affiliate researchers from the CAES partners.

CAES promotes a common environmental, safety and health (ES&H) culture across the partner institutions and continues to explore ways to improve its project planning processes and ensure researcher safety.

Investing in Research

Idaho National Laboratory provided \$1.4 million to fund exploratory research projects at CAES in FY 2011. This seed money is supporting a wide range of research projects, including one focused on improving the fuel efficiency of bus and truck fleets.

90+ Number of publications and proceedings CAES researchers produced during FY 2011.

“Greening” with U.S. Dairy Industry to Tackle Waste and Energy Issues

CAES is teaming with the U.S. dairy industry to turn cow manure into energy and reduce greenhouse gas emissions at the nation’s 90,000 dairy farms. CAES signed a memorandum of understanding with the Innovation Center for U.S. Dairy to help develop sustainable farm practices, better manure management techniques, and improve methods for turning waste into energy. The agreement is expected to result in a \$3 million investment in CAES’ bioenergy initiative.

“CAES has unique research capabilities and expertise to help meet the dairy industry’s sustainability goals.” – Jerry Bingold, the Innovation Center’s Director of Renewable Energy.

Creating an Energy Efficiency Research Initiative

Idaho Governor C.L. “Butch” Otter announced that CAES is leading a new statewide research program aimed at making buildings, homes, and industrial systems more energy efficient. The CAES Energy Efficiency Research Institute (CEERI) has garnered support from some of Idaho’s largest companies—Idaho Power, Micron Technology, and the J.R. Simplot Company—and other entities like the Boise Metro and the Chamber of Commerce.

“CAES is able to bring in all the players and get them to work together.” – Ric Gale, Idaho Power’s vice president for corporate responsibility, about CAES leading a statewide energy efficiency research program.

Exchanging Ideas between Researchers and Industry

CAES hosted the inaugural Idaho Research Symposium, with 53 participants, to improve the alignment between Universities research agendas and industry’s needs and cultivate collaboration between scientists, engineers, and the private sector. CAES researchers described the capabilities of their respective institutions in geothermal energy, energy efficiency, nuclear energy and bio-energy. Industry representatives presented some of their technical challenges and explained how relationships with Idaho’s research community would enhance their competitiveness.



Research Accomplishments

Turning Hot Water into Energy

CAES formed a geothermal energy research team to explore turning the abundance of hot water flowing beneath Idaho into an economical power source. The team is focusing on enhanced geothermal energy systems—a technology in which fluid is injected into hot, dry rock that has been fractured in order to extract heat and harness it to generate power. Idaho is consistently ranked as one of the top states for its geothermal energy potential.

Building a Smarter Grid

CAES is working with Idaho Falls Power to help test and deploy hundreds of new residential and commercial meters as part of the utility's participation in a national smart grid demonstration project. CAES is also helping to develop surveys to gauge how ratepayers feel about smart grid technology. Utilities are increasingly embracing smart grid technology as a way to improve energy efficiency.

Accelerating Transmission Line Siting Process

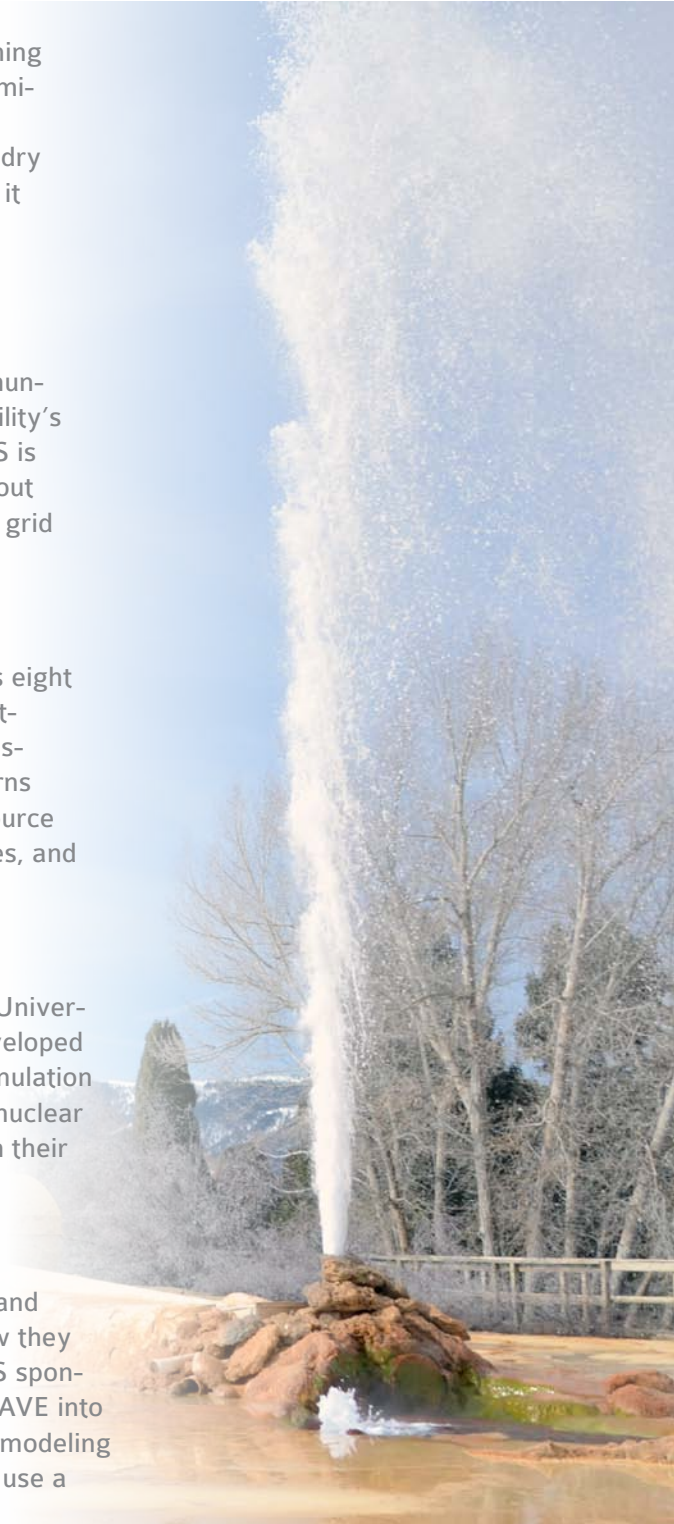
Siting and building new transmission lines isn't easy. It now takes eight to ten years to complete the process. CAES researchers are creating a software program that merges public opinion about transmission lines with GIS technology. With LineSiter, the public's concerns are addressed up front—before a route is proposed. The open-source program will be available for use by utilities, government agencies, and others.

Building "Model" Capabilities

CAES deployed portable 3D visualization stations to Boise State University, Idaho State University, and University of Idaho. The INL-developed systems, known as IQ-Stations, are building the modeling and simulation capabilities at each institution, aiding scientists and engineers in nuclear energy, materials, bioenergy, geothermal, and other disciplines in their research and fostering collaboration between the CAES partners.

Accessing Unique Capabilities

CAES sponsored several two-day workshops at which scientists and engineers from industry, academia, and national labs learned how they can use two new cutting-edge tools to aid in their research. CAES sponsored a 3D visualization course focused on how to integrate its CAVE into research such as transmission line siting, materials analysis, and modeling and simulation. The second workshop taught researchers how to use a high-end focused ion beam and atom probe in MaCS.

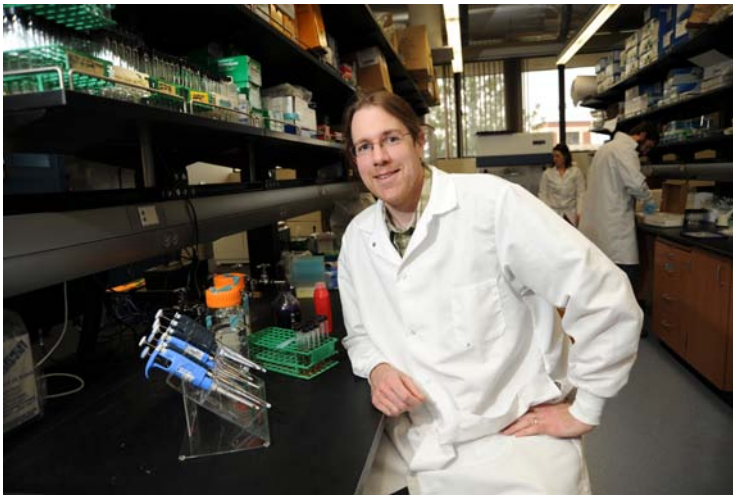


Educating the Energy Workforce

As part of its mission, CAES helps educate the next generation of energy researchers, technicians, and policymakers by investing in programs that support INL mission accomplishments.

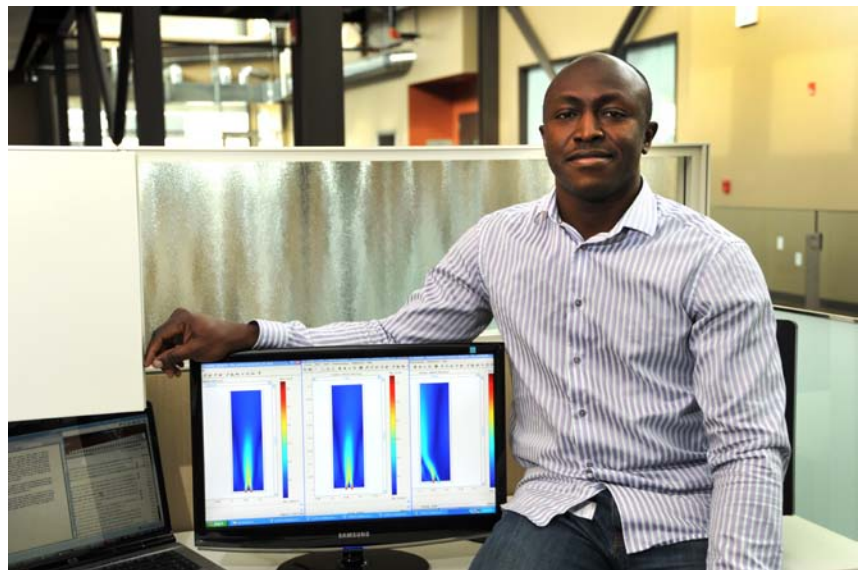
Over the last five years, CAES' university partners have developed degrees that will help build INL and the nation's workforce, including nuclear science and engineering undergraduate and graduate degree programs.

In addition, the CAES partners are involved in the Idaho science, technology, engineering, and mathematics initiative (i-STEM), a statewide effort by educators, government, and businesses to improve STEM education in the state.



“The research collaborations I’m involved in through the CAES bioenergy research initiative played a significant role in my receiving tenure at Boise State University. I look forward to expanding the bioenergy component of my research program as well as continuing to build upon the strong relationship I have with CAES and its research partners.” – Kevin Feris, a biology professor at Boise State University.

“As a student at CAES, I have experienced a new world of research and educational opportunities. I received scholarships to attend the 2010 World Nuclear University in Oxford, England and the 2011 Modeling Experimentation and Validation School at Argonne National Laboratory in Chicago.” – Olumuyiwa Omotowa, graduate student in nuclear engineering at University of Idaho-Idaho Falls.



Educating the Energy Workforce

Training New Technicians

The Energy Systems Technology and Education Center (ESTEC), a two-year technical school at Idaho State University, has steadily added new programs based on input from the energy industry. It introduced two new associate degrees in FY 2011—a renewable energy technician and a nuclear operations technology program. ESTEC's enrollment surpassed 140 in FY 2011, a record number for the technical school.

The Best of Both Worlds

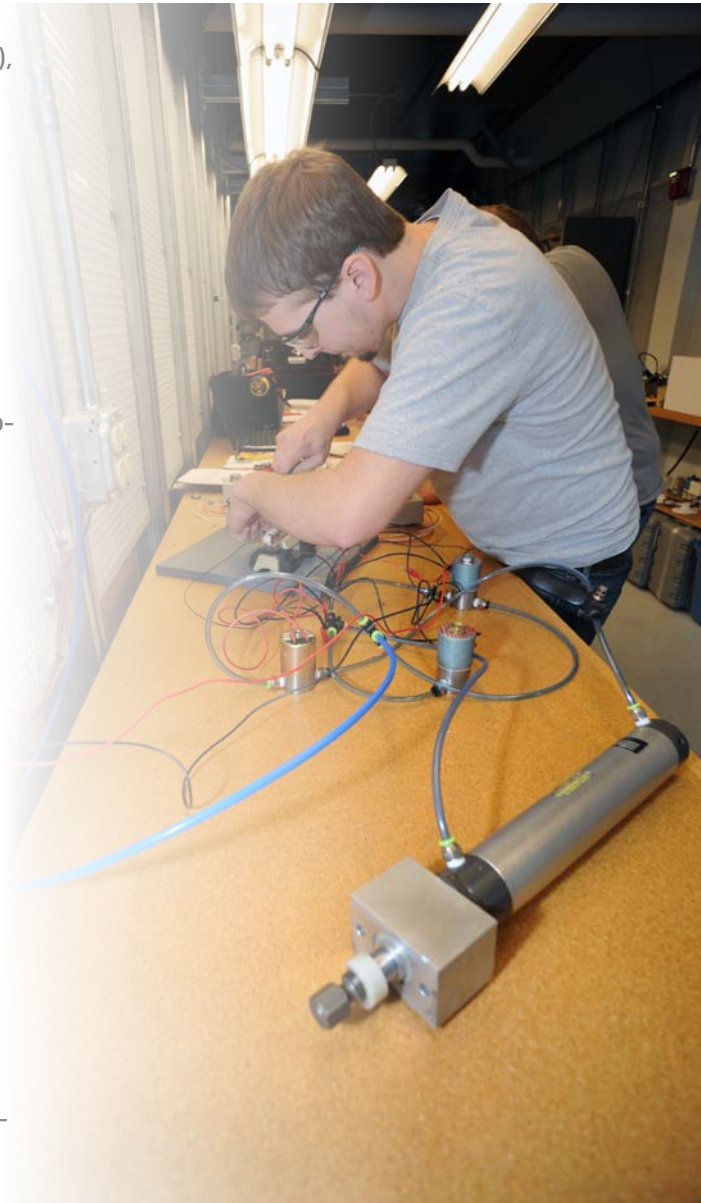
In FY 2011, 10 researchers were jointly employed by Idaho National Laboratory and an Idaho university. Known as joint appointments, these scientists and engineers educate students and also perform cutting-edge research, helping to build the research and education capacities of the CAES partners. The program has proven to be an effective recruitment strategy for universities and INL.

Reaching Students Early

Approximately 400 K-12 educators attended three hands-on regional workshops sponsored by i-STEM, of which CAES is a member. i-STEM's approach is to train Idaho teachers to integrate science, technology, engineering, and math into their classrooms and pique students' interest in these subjects early on. i-STEM has grown significantly over the past few years and has expanded into all regions of the state.

Opportunities for Students

CAES provides university students with opportunities to conduct cutting-edge research in state-of-the-art laboratories. During FY 2011, 47 students interned or conducted graduate-level research at CAES.



48 Number of Idaho university researchers and students supported through CAES-funded exploratory research projects in FY 2011.

\$42,000 Amount CAES has distributed in college scholarships since FY 2009 (\$10,000 of which was awarded in FY 2011).

10 Number of joint appointments CAES and INL are supporting at Idaho universities to bolster energy research and education.

Looking Ahead

Collaboration is the key to CAES' success. During the next year, the CAES leadership team will focus on building new relationships and strengthening existing collaborations between its partners as well as with industry, government, and other universities and research entities.

Priorities for FY 2012 include:

- Growing the number of industry/private sector collaborations.
- Establishing CAES as a legal entity and developing a structure for fiscal viability.
- Continuing to build the CAES research portfolio by winning new awards/contracts, publishing papers and presenting at conferences, and conducting cutting-edge research.
- Continuing to attract students to the universities' nuclear science and engineering and other energy-related programs.
- Securing \$3 million in state funding, the amount needed to sustain collaboration with the universities.

Ultimately, CAES success will be measured against its ability to:

- Build value and promote trust amongst its partners.
- Create distinct, unique, and complementary capabilities and programmatic opportunities.
- Renew and build the scientific and engineering talent pool.
- Promote creativity, innovation and diversity across the partnership.
- Achieve long-term fiscal health.
- Attract world-class researchers and affiliates, for whom being associated with CAES is highly sought after and prestigious.
- Generate technology-based economic development.

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Coats, E., M. Gregg, and R. Crawford, "Effect of Organic Loading and Retention Time on Dairy Manure Fermentation," Bioresource Technology, 2011.

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