CAES News

CAES Center for Advanced Energy Studies

AUG.-OCT. 2016

Finding wealth in Wyoming's water

CAES, University of Wyoming work toward demonstration project

Oil and gas exploration in Wyoming doesn't bring only oil and gas to the surface. There's salty wastewater as well, in massive quantities: 1.266 trillion gallons a year, enough to cover an area the size of Connecticut a foot deep with plenty to spare.

Until now, the brine has been disposed of by pumping it back into the ground through injection wells. For researchers from Idaho National Laboratory and the Center for Advanced Energy Studies, however, the brine offers possibilities for desalinization and recovery of rare earth elements.

CAES researchers Aaron Wilson and Dan Wendt, along with Travis McLing and Rob Podgorney, visited the Cowboy State in mid-June to meet with counterparts at the University of Wyoming, which has close ties to the state's oil and gas industry. McLing said their hope remains that UW will be able to play matchmaker with the operator of a drilling site with the right conditions for two individual demonstration projects they are developing between now and 2019.

In 2015, INL received $1 million from the Department of Energy's Office of Energy Efficiency and Renewable Energy to study desalinization using Switchable Polarity Solvent Forward Osmosis (SPS-FO), a patented technology Wilson and his INL colleagues have pioneered. With SPS-FO, water from the brine permeates through a membrane. A more concentrated solution on the membrane's far side draws fresh water away from the salt, producing water clean enough to be used at least for irrigation. For the "further processing" to work, however, the process needs an energy input. This is where geothermal heat from the subsurface enters the equation.

For a successful pilot there is a "Goldilocks" consideration on two fronts: The water can't be too hot or too cold, and it can't be too saline, McLing said. Once the technology is successfully piloted it can be applied to a wider range of brine conditions. Last of all, they need a willing partner.

The economics make sense in two ways. "They're already producing water anyway, and they have to pay to dispose of it," McLing said. By eliminating the disposal cost and having a value-added product (irrigation water), the economics of such a project pencil out positively.

"If they can take the water that's being produced anyway and process it, it can be used for irrigation instead of being injected,"McLing said. "Water has a fair amount of value."

A pump jack operating at an oil well in east-central Wyoming. Researchers from CAES and the University of Wyoming are looking at ways of putting to use the massive amounts of water that are brought to the surface during oil and gas exploration. (University of Wyoming photo)

The SPS-FO pilot is in tandem with a three-year collaborative relationship between INL and the University of Wyoming's Carbon Management Institute and the U.S. Geological Survey, developing new methodologies to analyze trace elements in high-salinity brines.

The U.S. Department of Energy announced in June 2016 that the UW/INL/USGS research project was one of four selected to receive up to $4 million to assess the occurrence of rare earth minerals and other critical materials that may be dissolved in high-temperature fluids associated with energy extraction.

Rare earth elements (REEs) are used in everyday devices such as rechargeable batteries, cellphones, catalytic converters, magnets and fluorescent lighting. During the past 20 years there has been an explosion in demand. For strategic reasons, the United States has sought to explore where they can be extracted in North America.

About CAES

The Center for Advanced Energy Studies (CAES), a consortium of Idaho National Laboratory, Boise State University, Idaho State University, University of Idaho, and University of Wyoming, is a public/private research center that provides research capabilities, energy-related educational opportunities and industry assistance to fuel economic growth.

'It makes so many more things possible…'

PROFILE: Dr. Richard T. Jacobsen CAES associate director

Dr. Richard T. Jacobsen, *CAES associate director*

Few people know their way around Idaho's higher education system better than Dr. Richard T. "Dick" Jacobsen, a 1963 University of Idaho (UI) graduate who has served as engineering dean at both UI and Idaho State University (ISU). All that time, he's envisioned a cooperation between Idaho's three research universities in sync with Idaho National Laboratory (INL), pooling resources in a noncompetitive, mutually beneficial way.

"INL is the region's national laboratory," he said. "Over the years we've made significant advances."

As a CAES associate director, Jacobsen said he hopes to develop a broader mission for CAES, making it a place where a new generation of nuclear researchers and engineers can be allowed to do world-class research. "We are looking at a new workforce, new ideas and new technologies," he said.

Jacobsen was an associate director for Bechtel BWXT in 2003 when he learned INL was being named the U.S. Department of Energy's lead laboratory for nuclear energy. When DOE awarded a 10-year INL contract to Battelle Energy Alliance, it required BEA to establish the Center for Advanced Energy Studies.

"We needed to have all three universities all together," he said. Jacobsen received a call from ISU President Arthur Vailas in November 2015 asking whether he would be willing to represent the university as CAES associate director. His desire to see CAES become a place where Idaho's university research capabilities can be pooled with INL's expertise has taken root from the Upper Snake River Valley all the way to Pocatello.

"It's something a lot of people have dreamed about for a long time," he said. "It makes more things possible than ever before."

CAES innovation & industry leader's article published

Dr. Howard Grimes
CAES director for Innovation & Industry Partnerships

An article featuring the CAES business model, by Dr. Howard Grimes, CAES director for Innovation & Industry Partnerships, has been selected for publication in the September 2016 journal Energy Research & Social Science.

The article, entitled "Creating a 'Collaboratory' environment to transcend traditional research barriers: Insights from the United States," highlights how CAES has dramatically increased competitive DOE funding to three Idaho universities. The article was posted online June 3 and can be found at www.sciencedirect.com.

CAES addressing changes in regional energy picture

Mike Hagood, *CAES director of Program Development*

Located in the resource-rich Intermountain States, the Center for Advanced Energy Studies (CAES) is in a unique position to provide insight into the challenges and opportunities in a region where the energy picture is changing dramatically from year to year, says Mike Hagood, the center's director of program development.

"We're sitting in a region rich in energy resources, and also transportation and energy infrastructure," he said. "These are dynamic times."

Consider the challenges Wyoming's coal industry is facing. It is unlikely there will be any more coal-fired power plants on the West Coast, and states like Washington and Oregon are increasingly reticent to expand their port facilities to allow more coal to be shipped to China and the Far East. In partnership with the University of Wyoming, CAES is helping researchers explore methods for converting coal into value-added products such as graphene and liquid fuels.

"INL's role in regional energy initiatives is going to be enabled through CAES," said Hagood. The CAES consortium provides support, focus and thought leadership in several areas:

- Regional clean energy innovation.
- Public-private team approaches to research, development, demonstration and deployment (RDD&D).
- Regional clean energy approaches, systems policy and energy education.
- At-scale systems analysis, integration, testing and validation.
- Regional partnership centers of excellence that attract RDD&D talent.

CAES receives R&D awards, infrastructure grants

CAES received substantial support from the U.S. Department of Energy in June with the announcement of more than $2.4 million in energy research and development awards and infrastructure grants.

The news came in an announcement that more than $35.5 million has been awarded for Nuclear Energy University Programs (NEUP) in Fiscal Year 2016.

Boise State University, Idaho State University and University of Idaho, all members of the consortium that forms CAES, were designated to receive a total of $2,480,805. Here is a breakdown:

FY 2016 R&D

A Science Based Approach for Selecting Dopants in FCCI-Resistant Metallic Fuel Systems (University of Idaho, $800,000)

Advanced Electrochemical Separations of Actinide/Fission Products via the Control of Nucleation and Growth of Electrodeposits (University of Idaho, $350,000)

FY 2016 Nuclear Energy Enabling

Effects of High Dose on Laser Welded, Irradiated AISI 304SS (Boise State University, $500,000)

Enhancing Irradiation Tolerance of Steels via Nanostructuring by Innovative Manufacturing Techniques (Idaho State University, $500,000)

FY 2016 Infrastructure

Boise State University received $250,000 for an aerosol jet printer in order to establish additive manufacturing capability to make functional materials and sensor devices for nuclear energy applications

Idaho State University received $80,805 to replace the BF3 detectors in the AGN-1 Reactor with modern B-10 lined detectors.

CAES Art exhibit blends research, imagination

Art and science have enjoyed a long relationship through the ages, which is one reason why the Center for Advanced Energy Studies (CAES) has invited the public to see how research and imagination can intersect to produce fascinating images. Since mid-June, 13 winning submissions from the CAES ARTernative Energy Contest have been on display in the CAES Gallery at the east end of the building's second floor, also on the CAES ARTernative Energy Contest website. All images were captured in the course of energy-related scientific research and are captioned with explanations of what they represent.

FIRST PLACE

The World of Uranium *(Dr. Darryl P. Butt, Dr. Brian Jaques, Kelci Lester – BSU)*

A Virtual Peek Beneath Wyoming *(Nick Jones, Emma-Jane Alexander – UW)*

Biomass in Blue *(Dr. Allison Ray – INL, Lisa McDougall – ISU)*

Tidal Wave *(Dr. Joshua Kane, Tammy Trowbridge – INL)*

SECOND PLACE

Microscopy of a Precursor *(Jacqueline Hodge – BSU)*

Zygnema *(Lisa McDougall – ISU)*

Fiber Optic *(David Chichester, Chris Morgan – INL)*

THIRD PLACE

Formation of Framboids *(Dr. Darryl P. Butt, Dr. Brian Jaques, Kelci Lester – BSU)*

Corn Stover Streaks *(Dr. Allison Ray – INL, Lisa McDougall – ISU)*

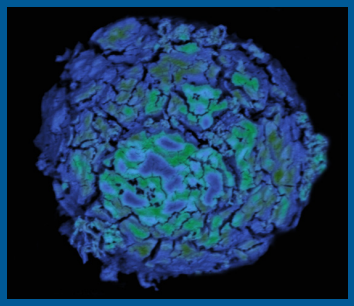
Silver Wires with Iodine Condensate *(Mary Adamic, Dr. Matt Watrous, Tammy Trowbridge – INL)*

FOURTH PLACE

Fireworks *(Jatuporn Burns – BSU)*

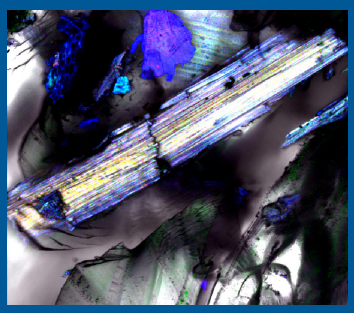
Laminar, Transition, and Turbulent Flow in a Nuclear Reactor Channel *(Dr. Brian Williams, Dr. Donald McEligot, Dr. Glenn McCreery – ISU)*

End View of ATR Fuel Element *(Dr. Sean O'Kelly, Jeff Brower – INL)*

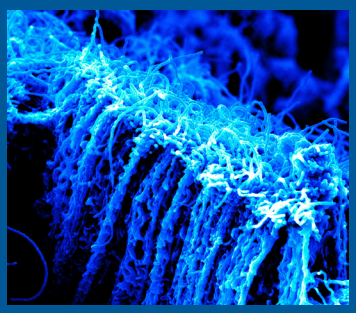


World of Uranium
Darryl P. Butt, BSU
Dr. Brian Jaques, BSU
Kelci Lester, BSU

A Virtual Peek Beneath Wyoming
Nick Jones, UW
Emma-Jane Alexander, UW



Biomass in Blue
Dr. Allison Ray, INL
Lisa McDougall, ISU



Tidal Wave
Dr. Joshua Kane, INL
Tammy Trowbridge, INL

Molecular to industrial

High-strength steel pioneered at INL, CAES gets Motor City tryout

As automakers seek new ways to make cars and trucks lighter and more fuel efficient, CAES may be able to take some credit for helping achieve that end.

NanoSteel, a company that spun out from Idaho National Laboratory in 2002, has used the Microscopy and Characterization Suite (MaCS) at CAES to study the chemical hierarchy of nanoscale grains. This research is essential to forming consistent nanostructures in the fabrication of advanced high strength steel (AHSS).

Now NanoSteel and its manufacturing partner, AK Steel Corporation of West Chester, Ohio, have announced the first delivery of AHSS to General Motors for testing.

Weight reduction is one of the most cost effective ways of improving a vehicle's fuel efficiency. NanoSteel's AHSS has a tensile strength of 1200 MPa (megapascal), and 50 percent elongation. Standard steel materials with equivalent formability have low tensile strengths of several hundred MPa.

While automakers are considering aluminum and carbon-fiber-reinforced plastic (CFRP), the least expensive solution is always going to be steel, said Ellen Bossert, NanoSteel's executive vice president and chief marketing officer. Steel is commonly used as the core skeleton for a car, because of its strength and stiffness. While aluminum has advantages for the skin, stronger lighter steel for the body-in-white and chassis parts is where the real weight savings are achieved.

The challenge all along has been developing a high strength nanostructured steel while simultaneously achieving ductility and cold formability, said Dr. Daniel Branagan, the onetime INL researcher who is now NanoSteel's chief technical officer. Branagan spent several years developing nanostructured coatings, but the goal all along has been to develop AHSS on a scale that can be incorporated into the auto industry's existing manufacturing infrastructure.

Although NanoSteel's corporate headquarters are in Providence, R.I., and its automotive division in Troy, Mich., its research and development center remains in Idaho Falls and its ties to the lab are still strong. When it came time to research nanostructures, CAES and Boise State University had what the company needed. "(It's) a very unique partnership that offers world class equipment to support our design innovation," Branagan said.

CALENDAR

AUGUST 9-10
Intermountain Energy Summit:
Innovations and Opportunities in Clean Energy
Shilo Inn and Suites, Idaho Falls, Idaho

AUGUST 19
INL Family Open House, 9 a.m.-2 p.m.

AUGUST 25-26
Second Annual Snake River Geothermal Meeting
INL Energy Innovation Laboratory, Idaho Falls, Idaho

SEPTEMBER 8-9
CAES's Energy Policy Research Conference
More details are here: http://epi.boisestate.edu/eprc/

OCTOBER 14
2016 Landscape Discussion on Energy Law & Policy in the Rockies
University of Wyoming Conference Center, Laramie, Wyoming

Visit the CAES online calendar for more details on each event: https://caesenergy.org/newsroom/calendar/

CAES by the Numbers

(April-June 2016)

21
special CAES tours

479
Visitors experienced the Computer-Assisted Virtual Environment

485
Science, Technology, Engineering and Math (STEM) outreach visitors learned about CAES research

16-50155-02-R4