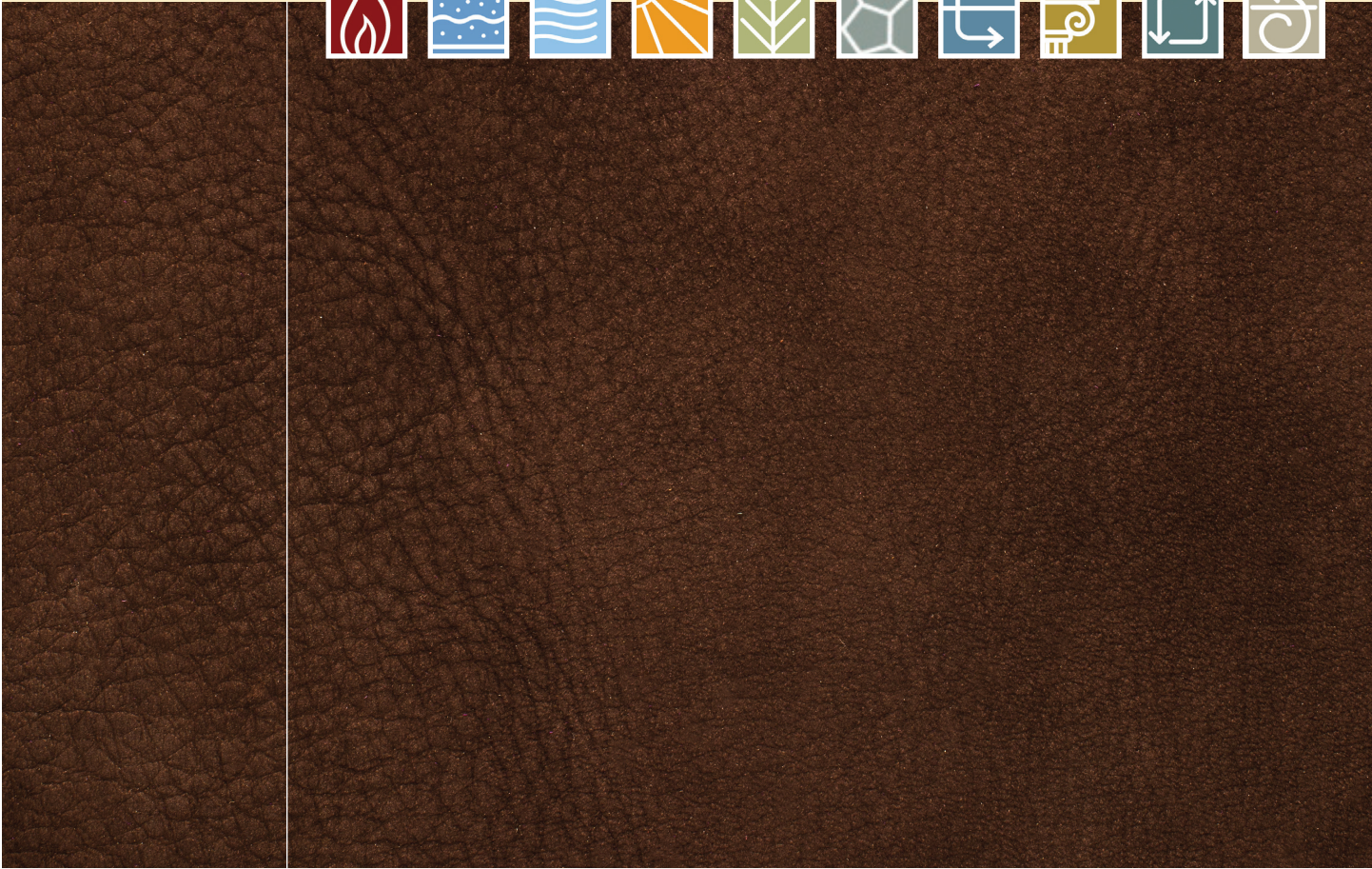




SCHOOL OF ENERGY RESOURCES

2014 Annual Report

University of Wyoming
School of Energy Resources



2014 ANNUAL REPORT OF
THE UNIVERSITY OF WYOMING
SCHOOL OF ENERGY RESOURCES

August 22, 2014

Presented to the Joint Minerals, Business and Economic Development Interim Committee,
Joint Appropriations Interim Committee, and the
Joint Education Interim Committee

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EXECUTIVE SUMMARY

During the eighth year of its existence, the School of Energy Resources (SER) marked the official opening of the Energy Innovation Center (EIC), which the university celebrated with a ribbon-cutting ceremony. SER hosted a media day, introducing the facilities to regional media and conducted many tours of the building and its facilities, particularly the Shell 3-D Visualization lab, to stakeholders and others.

The ERC welcomed three new members.

Following the governor's directive to UW, SER reduced its budget by 6 percent as directed and met the budget expectation for FY2014. Funds not spent in the first year of the budget cycle were invested in critical equipment for Unconventional Reservoirs and Advanced Conversion. Overall for the FY2013/FY2014 Biennium, SER will come in under budget.

SER's academic programs continue attracting more students who are found to be in demand following graduation by employers as evidence of placement rate and starting salaries. Enrollment in the Spring 2014 semester was 67. Enrollment is highest in the Land Management program, and interest in the fossil fuel concentration remains strong. Sixteen of 20 graduates received job offers before graduation, three are continuing with graduate studies while one student elected to post-pone entering the job market. UW established a seamless transfer from the associate degree program to the Energy Resource Management and Development program (ERM&D) bachelor program. Discussions are under way with the College of Health Sciences to align a four-year environmental health and safety program with existing associate degrees. The College of Law with SER support established a new center to promote energy law, regulation and policy, and SER participated in a search and funding for a new Energy Law position. Strong interest continues in the Energy MBA program. Faculty members were hired in energy finance, energy accounting and energy law.

SER faculty members are credited with securing external grants totaling more than \$25 million. The Centers of Excellence continue to seek outside funding to support their operations. Eight Centers of Excellence were active during the fiscal year; two centers are self-supporting and one center completed its association with SER.

The Energy Outreach Program hosted events and talks throughout the year, with great success. Notably, SER's collaboration with Chinese and Australian researchers and policy leaders continued with the International Advanced Coal Technology Conference in March, held in Brisbane, Australia. Energy Outreach coordinated events around the grand opening of the Energy Innovation Center in September 2013 with media, stakeholders and the university community.

In pursuit of its strategic areas of concentration, SER continues to collaborate on the Tier 1 Engineering Initiative, and funds are being allocated to support that. Progress on the High Bay Research Facility continues. SER continues to discuss collaborations with industry partners and to expand collaborations with UW colleges.

The Energy Innovation Center, now open for more than a year, continues to draw interest as a UW-wide resource, particularly with projects that employ expanded computing capacity via the NCAR-Wyoming Supercomputing Center and the university's own expanded computational facilities. With work substantially complete, a ribbon cutting at the EIC was held in September 2013.

SECTION 1 – ADMINISTRATION

The University of Wyoming Energy Resources Council (ERC) was established by statute (W.S. 21-7-117 (e)) to provide direction to the School of Energy Resources in identifying and setting priorities for issues targeted for research and outreach. The ERC consists of 11 members:

- Seven members representing diverse components of Wyoming's energy industries appointed by the Wyoming governor with the consent of the Wyoming Senate; these members serve three-year terms.
- UW president and director of the Haub School (ex officio).
- A member of the UW Board of Trustees, at the invitation of the ERC, to allow greater communication between the boards.
- One member each of the Wyoming Senate, appointed by the president of the Senate, and the Wyoming House of Representatives, appointed by the speaker of the House.

Administration and Organization:

The Energy Resources Council self-selects its chairman and vice chairman.

The ERC meets at least quarterly, including one meeting a year with the UW Board of Trustees in November.

The ERC is supported by the SER director and staff.

The ERC is represented by the UW General Counsel.

The members of the Energy Resources Council are:

Paul Lang, chairman

COO and executive vice president, Arch Coal, Inc.

Tom Lockhart, vice chairman

Wyoming State Representative, chairman, House Minerals, Business and Economic Development Committee

Carl Bauer

President, C.O. Bauer Consulting

Thomas Botts

Retired executive vice president, Royal Dutch Shell

Cindy Crane

Vice president, Interwest Mining Company, PacifiCorp Fuel Resources

David R. Emery

President and Chief Executive Officer, Black Hills Corporation

Jeane Hull

Executive vice president Technical Services, Peabody Energy

Jim Anderson

Wyoming state senator

Rob Wallace

Managing partner, Rob Wallace Group

Richard McGinity,

President, University of Wyoming (ex officio)

Indy Burke

Wyoming Excellence Chair, UW professor and director of Haub School of Environment and Natural Resources (ex officio)

H.L. “Dave” True

University of Wyoming Board of Trustees (ex officio)

In the last year, ERC membership underwent several changes. UW President Richard McGinity joined the board after the departure of President Robert Sternberg. UW Trustee Dave Palmerlee assumed the UW Board of Trustees presidency; Trustee Dave True joined the board earlier this year. Martha Wyrsh stepped down and was replaced by Cindy Crane, vice president of Interwest Mining Company at PacifiCorp Fuel Resources. In addition to his duties with the ERC, Carl Bauer is serving as interim director of the Carbon Management Institute.

The Energy Resources Council met on the following dates:

August 23, 2013

November 15, 2013, joint meeting with the UW Board of Trustees

March 27, 2014

May 23, 2014

For more information about these meetings, please visit the SER website at www.uwyo.edu/ser.

SECTION 2 – FINANCIAL SUMMARY

The Wyoming State Legislature provided \$20,400,000 in funding for SER for the 2013-2014 biennium. During the biennium, UW was instructed by the governor to reduce its budget by 6 percent for FY2014 and SER achieved this mandate by reducing its appropriation by \$612,000. After this reduction, the revised biennial budget for SER was \$19,788,000.

Expenditures for the FY2014 totaled \$12,750,097 (Figure 1). Of that total, SER spent:

- \$3.95 million for salaries and benefits for SER staff and 12 faculty
- \$327,000 for start-up commitments made to SER faculty
- \$1.68 million to support research activities in the eight centers of excellence
- \$123,000 for the Matching Grants Fund
- \$304,000 for Outreach Events
- \$3.7 million for research equipment and support:

- \$1.13 million for the GPU Cluster upgrade
- \$379,000 contribution to expedite order of a second Micro CT instrument
- \$1.2 million for research equipment to establish the Improved Recovery Research Laboratory
- \$350,000 for research equipment in the Advanced Conversion Lab
- \$140,000 for 3-D Visualization upgrades
- \$468,000 in Energy Innovation Center expense
- \$2.6 million for remaining expenses that include graduate assistantships, recruiting, travel, publication, the Summer Energy Institute, office support, etc.

Figure 1. Fiscal Year 2013-2014 Financial Report (Actual)

Academics	Fiscal Year 2013	Fiscal Year 2014	Biennium Totals
Salary/Fringe	\$ 1,792,662	\$ 1,961,193	\$ 3,753,855
Startup	\$ 149,841	\$ 256,718	\$ 406,559
Other support & Programs	\$ 781,398	\$ 1,143,147	\$ 1,924,545
Subtotal Academics	\$ 2,723,902	\$ 3,361,058	\$ 6,084,959
Research			
Salary/Fringe	\$ 660,719	\$ 986,997	\$ 1,647,716
Matching Grant Funds	\$ 257,332	\$ 122,695	\$ 380,027
Center Support	\$ 1,384,106	\$ 1,682,384	\$ 3,066,490
Other support & Programs	\$ 432,162	\$ 3,000,911	\$ 3,433,072
Subtotal Research	\$ 2,734,319	\$ 5,792,986	\$ 8,527,305
Outreach			
Salary/Fringe	\$ 309,874	\$ 285,402	\$ 595,276
Other support & Programs	\$ 317,791	\$ 391,855	\$ 709,646
Subtotal Outreach	\$ 627,665	\$ 677,257	\$ 1,304,922
Administration			
Salary/Fringe	\$ 682,969	\$ 715,993	\$ 1,398,962
Other support & Programs	\$ 117,329	\$ 2,202,804	\$ 2,320,133
Subtotal Administration	\$ 800,298	\$ 2,918,797	\$ 3,719,095
Totals	\$ 6,886,184	\$ 12,750,097	\$ 19,636,281

SER met the budget expectations for FY2014, spending \$19.6 million of its revised budget of \$19.8 million. In the history of SER, a typical pattern of spending during the two-year budget cycle has emerged, in which less spending takes place in the first year and more takes place in the second year, due to the timing of faculty hiring and start up as well as graduate student recruiting cycles.

Funds not spent in FY2013 (\$3.7 million) were invested in research equipment that was badly needed in our SER's Unconventional Reservoirs (Digital Rock Physics and Improved Recovery labs) and Advanced Conversion (coal-to-liquids) research programs. This investment is justified by UW's strategic plan to invest in these niche research areas in the Tier 1 Engineering Initiative.

SECTION 3 – ACADEMICS

SER Academics' mission is to develop an innovative, competent and performance-driven 21st century energy sector workforce. Positioning graduates for success demands both knowledge and skill to adapt to new areas of proficiency, rapidly changing technologies and competencies. Academic initiatives focus on rigor and high standards, continual inspection and modification, student learning outcomes designed for success and the needs of the Wyoming energy enterprise. This report summarizes 2014 outcomes from four main elements of the academic mission: K12 Energy Education, Undergraduate Education, Graduate Education, and Faculty Performance.

K12 Energy Education

SER is committed to coordinating statewide efforts in energy education to enhance the workforce pipeline and promote general energy literacy among all students. Activities are targeted to increase awareness of career opportunities in the energy sector; promote in-service teacher training in energy issues and motivate inquiry-based pedagogy; provide cutting-edge, energy-based lesson plans; connect engaging curriculum and project-based learning with field trips and practical experience; and connect industry and community efforts with K12 energy initiatives.

Activities in 2013-2014 included:

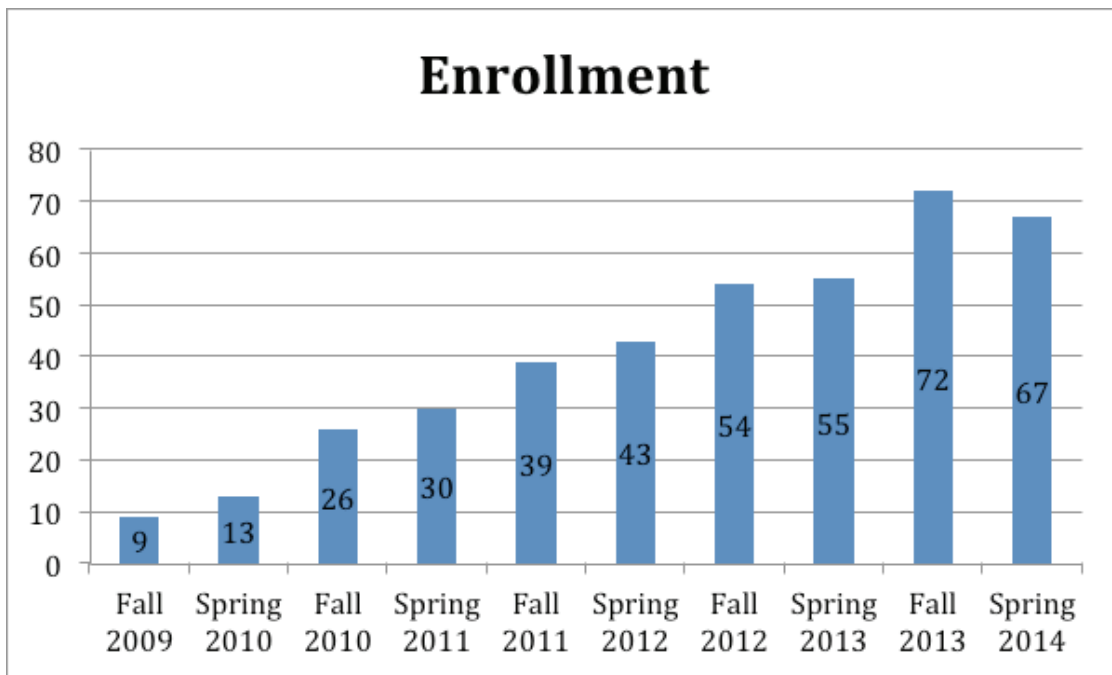
- **ExxonMobil grant** – SER received a \$100,000 grant to expand the scale and scope of K12 Energy Literacy initiatives in Wyoming.
- **Summer Energy Institute** – In conjunction with the UW Science Posse (www.scienceposse.org) and EE Nanotechnology (www.uwyo.edu/nanotech), 17 high school sophomores and juniors attended the seventh annual UW Energy Summer Institute held June 15-20, 2014.
- **Summer Science Camp** – In partnership with Teton Science School and the Posse, a one-week discovery-based science camp was delivered at the Kelly, Wyoming campus. Thirty-four students from Wyoming and Colorado attended.
- **SER support for other science/energy focused K12 programs** – SER provided support and coordination for UW-based K12 programs, including the National Science Foundation-sponsored Science Posse, the Energy and Environmental Nanotechnology program, and the NASA sponsored science education program. Activities are formally assessed to establish outcomes based on defined metrics.
- **Energy and Natural Resource Education Initiative** – SER was a lead participant in developing the statewide Energy and Natural Resource Education initiative report submitted to the Governor's Office. The committee was charged by the Wyoming State Legislature to develop a plan for integrating energy and natural resource content into the K12 curriculum.
- **Energy academies** – SER has continued providing expertise and guidance to the Rock Springs High School Energy Academy, including field trips to energy sites and UW.
- **Involvement of graduate students in the 7th-12th grade classrooms** – Graduate students in energy fields (including those supported by SER) discuss, explain and showcase their research to teachers and students.

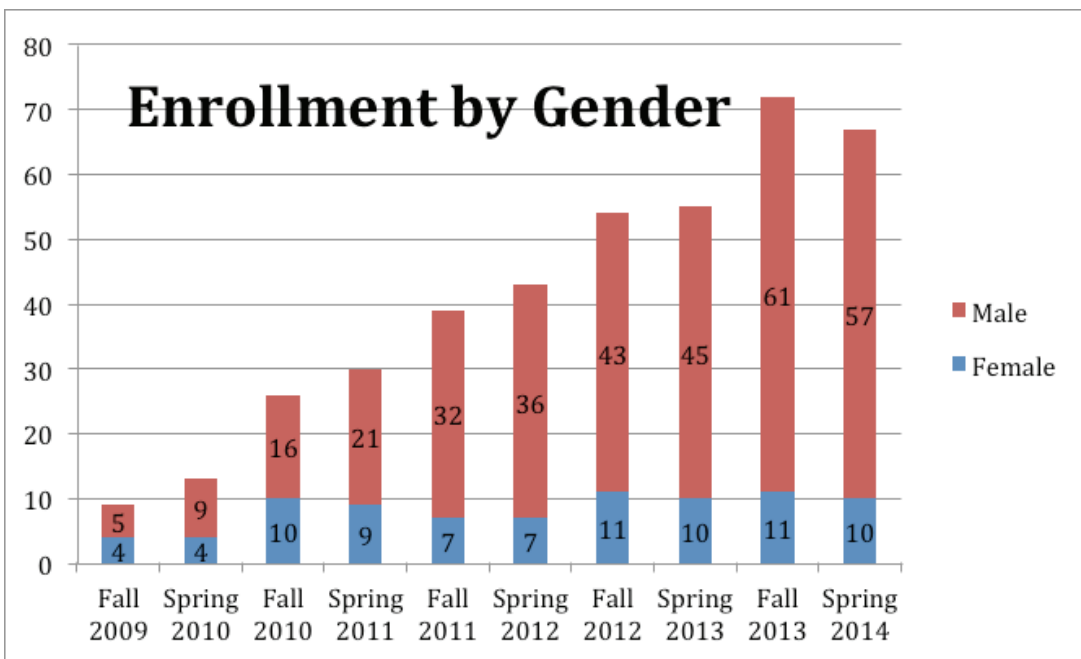
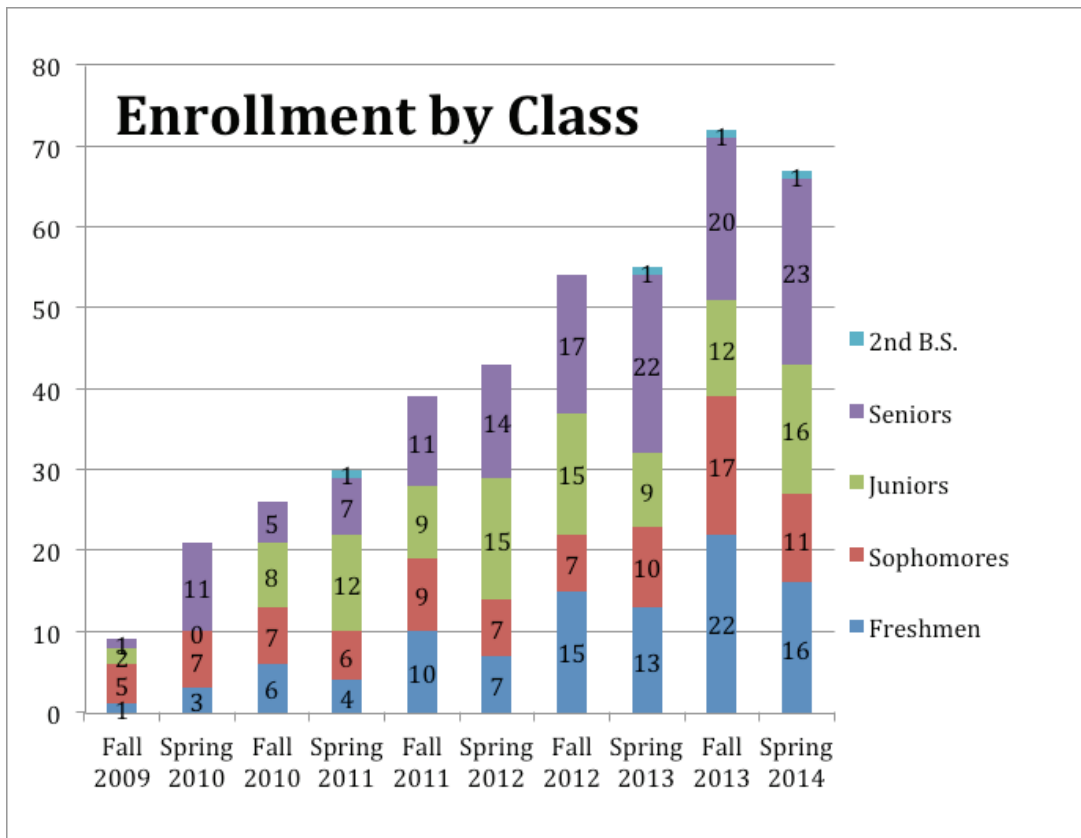
- **Natrona County CAPS Committee** – The deputy director for academics is on the Natrona County Center for Advanced and Professional Studies steering committee charged with designing innovative science, technology, engineering and mathematics (STEM) curriculum.

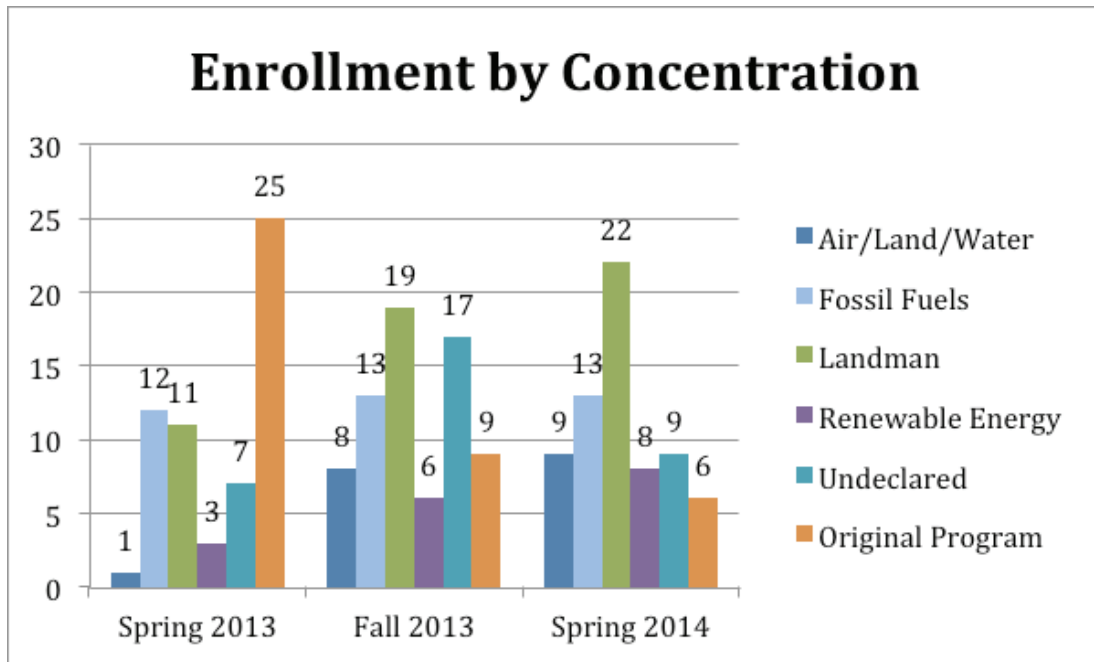
Undergraduate Education

The Energy Resource Management and Development program (ERM&D) is an interdisciplinary energy BS degree program that integrates training in engineering, geology, policy, economics, business, law, and natural resources. This degree connects energy sector problem-solving experiences with classroom learning to prepare students for the workforce needs of the energy-sector. The program has four concentrations: Fossil Fuels, Renewable Energy, Energy Air, Land and Water Management, and Professional Land Management (PLM). The PLM program is one of nine accredited in North America.

As noted below, enrollment for the ERM&D BS degree has increased since its inception in 2009 and enrollment for the Fall 2014 is projected to be approximately 90 students.

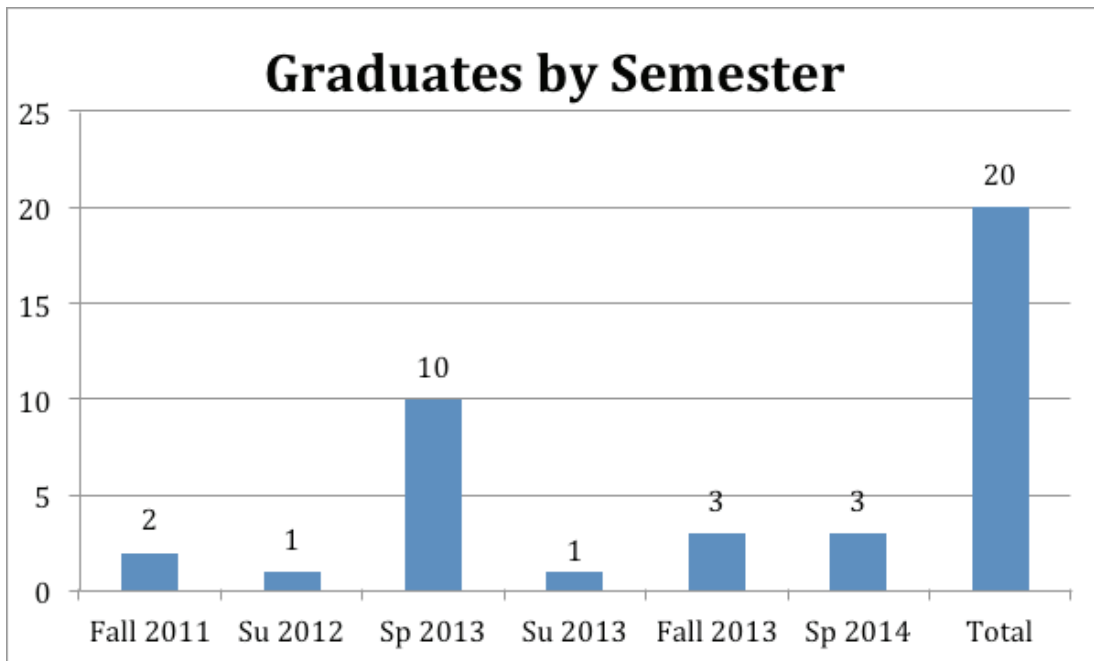






Graduates

- Twenty students graduated as of May 2014.



- 16 graduates received job offers with starting salaries ranging from \$50,000 to \$70,000, three students continued their education, and one student decided to travel before entering the workforce.

- Employers:
 - Belle Fourche Pipeline
 - Calfrac Well Services – SER’s graduate is the first female field engineer hired by Calfrac.
 - Chesapeake Oilfield Services/Nomac Services
 - DCP Midstream
 - Encana
 - Halliburton
 - Infinity Power and Controls
 - InterTech Environmental & Engineering
 - Loenbro (Pipeline Division)
 - Marathon
 - PacifiCorp
 - Trihydro
 - Wood Group PSN
 - Wyoming Oil and Gas Conservation Commission
- Job Titles
 - Air Quality Analyst
 - Associate Supervisor for Wind Operations
 - Cement Field Engineer
 - DOT Compliance Coordinator
 - Engineer II
 - Environmental Analyst
 - Environmental Compliance Coordinator
 - Environmental Engineer
 - Environmental Professional
 - Environmental Services Technician
 - Field Geologist
 - Production Enhancement Field Engineer
 - Project Manager
 - Wireline and Perforating Field Engineer
- Locations: Colorado, North Dakota, Oklahoma, Texas, Wyoming (7).
- Graduate School:
 - University of Wyoming
 - » Graduated with MS Water Quality – Works for Trihydro
 - » Graduated with second Bachelors Petroleum Engineering – Wyoming Oil and Gas Conservation Commission – Engineer II
 - South Dakota School of Mines – MS Geomechanics

Honor Rolls

Students in the Energy Resource Management and Development program named to the University of Wyoming Honor Rolls include:

- President's – 4.0 GPA and complete a minimum of 12 credit hours
- Dean's – 3.4 or better GPA, above freshman standing, and complete a minimum of 12 credit hours
- Dean's Freshman – 3.25 or better GPA and complete a minimum of 12 credit hours
- Provost's – 3.5 or better GPA and complete 6 to 11 credit hours

Table 1. SER Student Honor Rolls

Semester	President	Dean	Freshman	Provost	Total	% ERM&D Students
Spring 2009			1		1	50.0%
Fall 2009	1	1	1		3	33.3%
Spring 2010	1	2	1		4	30.8%
Fall 2010		2			2	7.7%
Spring 2011		2			2	6.7%
Fall 2011		9	1	2	12	30.8%
Spring 2012	3	4	2		9	20.9%
Fall 2012		13	3		16	28.6%
Spring 2013	2	8	1	1	12	21.8%
Fall 2013	3	8	4		15	21.7%
Spring 2014		15	3	1	19	28.4%

Internship and research experiences

Students are strongly encouraged to complete internships and undergraduate research projects. Placement opportunities expand yearly to accommodate all student requests. Below are academic year 2014 placements.

- 1 student with Halliburton
- 1 student with InterTech Environmental & Engineering
- 1 student with Peabody Energy (land management)
- 1 student with Anadarko (land management)
- 1 student with Encana (land management)
- 1 student with True Oil (land management)
- 1 student with Enhanced Oil Recovery Institute
- 1 student with PacifiCorp
- 1 student with the Wyoming State Land Department

Energy Resource Club

A formally recognized UW club focused on energy has been established that SER supervises and funds. Approximately 43 students were involved with the club in AY 2014. Activities included student presentations from internship experiences, study groups, and field trips.

Professional Landman Club

Fourteen students in the Professional Land Management Recognized Student Organization hosted field trips, a student picnic and a golf scramble.

Fellowships, scholarships and external gifts

Significant new academic awards have been supported by external donors. Awards are competitively allocated and open to students/faculty in energy fields from multiple departments at UW.

- The Anadarko Fellowships for Junior Faculty were awarded to Dr. Barry Brewer, assistant professor in the Department of Management and Marketing and Dr. Dongmei Li, assistant professor in the Department of Chemical and Petroleum Engineering
- Nielson Fellowships were awarded to two students in the Energy Resource Management and Development program.
- Two Professional Land Management students received the American Association of Professional Landmen scholarship.
- One Professional Land Management student received a highly competitive scholarship from the Wyoming Association of Professional Landmen.
- One Professional Land Management student received a scholarship from the Denver Association of Professional Landmen.
- Four students received the Nielson Scholarship for Women and Minorities.

International programs

- As a result of agreements between UW and China (Northwest University and China University of Petroleum), four visiting scholars and one MS student are working on energy research projects with SER faculty at UW.
- Two students from China University of Petroleum enrolled in the ERM&D program under a 3+2 arrangement. A similar agreement has been formalized with Northwest University, Xian, China. Several students will be accepted in fall 2014. Students attend the first three years at their home university and two years at the reciprocal institution. Up to 15 Chinese students per year are anticipated.

Community college interactions

Collaboration with Wyoming community colleges has established a seamless transfer from the associate degree program to the ERM&D BS program. Graduates with associate degrees in Environmental Health and Safety programs are matriculating to the ERM&D program. Discussions with the College of Health Sciences to establish a four-year Environmental Health and Safety BS program to align with existing community college degrees are under way.

Graduate Education

Graduate assistantships

SER competitively allocated 12 graduate assistantships (GAs) for energy education and research for the 2014 academic year to faculty in the departments of Chemistry (1), Geology and Geophysics (1), Physics and Astronomy (2), Chemical and Petroleum Engineering (6), Mathematics (1) and Computer Science (1). Since 2007, SER has awarded 114 graduate assistantships.

MBA in Energy

The College of Business in collaboration with SER Academics has established the MBA program focused on energy (see <http://www.uwyo.edu/mba/energy-management/>). Two tracks are available: a MBA in Energy Management and a MBA with an energy emphasis. Enrollment for AY2013-14 was 17 students.

Energy Law

The College of Law, with SER support, established a new center (Center for Law and Energy Resources in the Rockies) to promote energy law, regulation and policy. SER participated in a search and funding for a new Energy Law position. The new faculty member, Tara Righetti, former CEO of Berkeley GeoImaging, a privately held onshore and offshore oil and gas investment company, begins her appointment in September 2014.

SER Faculty Performance

SER faculty members were principal investigators or co-investigators on multi-year extramural grants totaling more than \$25 million (Table 2). They participated in a variety of professional conferences, presentations, non-technical reports, book chapters, various media events, legislative testimonials, industry-based reports, and popular press releases detailed in the next section.

Table 2. SER Faculty Research Awards

Faculty	Award Amounts		Number of Awards	
	PI*	Co-PI**	PI	Co-PI
Fan, Maohong	\$4,020,000	\$890,000	13	2
Parkinson, Bruce	\$3,187,545		13	
Piri, Mohammad	\$2,409,044		3	
Mallick, Subhashis	\$1,046,917		5	
Chen, Po	\$871,962	\$38,610	12	2
Sitaraman, Jay	\$862,273	\$1,321,399	5	3
Kaszuba, John	\$810,628	\$745,663	4	2
Douglas, Craig	\$616,328	\$2,599,005	9	5
Pereira, Felipe	\$493,141	\$5,762,038		
Hufford, Kristina	\$346,884		7	
Considine, Timothy	\$22,000	\$71,000	1	1
Total	\$14,686,722	\$11,427,715	74	21

* Principle investigator

** Co-principle investigator

Faculty Hiring

In support of the SER strategic plan, faculty members were hired in Energy Finance, Energy Accounting and Energy Law. Searches for positions in High Temperature Catalysis, Geomechanics, and Petroleum Systems continue. In addition, SER is participating in the search for and will fund the head position for the Petroleum Engineering department.

SECTION 4 – RESEARCH

State-of-the-art research is a requirement for preserving and growing the value of Wyoming's energy resources while protecting the state's natural wonders. The ability of UW faculty to seek and obtain external research grant funding is greatly enhanced by SER's commitment to provide competitively awarded funds through a variety of mechanisms and programs including: the Matching Grant Fund program, the Advanced Conversion Technology Fund, and the Uranium Research Center. These highly leveraged funds, along with the new Shell 3-D Visualization laboratory, provide UW with excellent opportunities and facilities to compete in a broad spectrum of research endeavors across energy sectors important to the state – natural gas, petroleum, coal, uranium, wind, and solar. Research Centers of Excellence have been formed under SER to facilitate interdisciplinary research in program areas critical to advancing energy technology.

Centers of Excellence

The Centers of Excellence are established with SER seed funding. Centers bring together faculty and graduate students from multiple disciplines to develop important energy research programs. Centers are expected to achieve support through outside funding, within a few years of establishment. These centers are expected to evolve with time; new groups may form to work on emerging problems, and some existing centers may disband as their programs are completed. Eight Centers of Excellence were active in FY2014.

Carbon Management Institute – Ron C. Surdam, director (retired December 2013), Carl Bauer, interim director, and Shanna C. Dahl, deputy director

The Carbon Management Institute (CMI) strives to keep the University of Wyoming at the forefront of geological CO₂ sequestration research and development.

FY2014 Achievements:

U.S.-China Clean Energy Research Center (CERC)

- CMI researchers continue to collaborate with researchers from Northwest University, Xi'an, China
- Chinese researcher finished work at CMI with CMI researchers, cataloging the Ordos basin and identifying similarities between Ordos Basin and Rock Springs Uplift. The report was presented in China
- Collaboration trip to China was made in June and six presentations were made to Chinese partners and collaborators
- Expanded work scope and budget has been submitted to SER and approved

Wyoming Carbon Underground Storage Project (WY-CUSP) – Phase I

3-D/Electromagnetic Data

- The 3-D seismic model continues to be adjusted as new data is available. Additional data obtained from well re-entry is being integrated with core, log suites, and fluid sample observations from the stratigraphic well to provide a more detailed understanding of the sub-surface at the Rock Springs Uplift.
- The EM data is currently being analyzed by WY-CUSP researchers and will be incorporated with additional well data. A collaboration contract was established with OSU to assist in analysis of EM data.

Rock Spring Uplift No. 1 (RSU#1) well update

Supporting activities:

- WY-CUSP researchers continue fluid analyses including rock/chemical reactions.
- Discussions continue with Baker Hughes to finalize implementation of digital geophones to record baseline microseismicity.
- Fluid samples are at Core Laboratory and Energy Lab for analysis.
- Additional core plugs were chosen and taken to Core Lab in Denver.
- The Idaho National Laboratory has received fluid samples; it will test for trace metals.
- The Sandia National Laboratories has begun fluid testing and analysis.

U.S. Department of Energy (DOE) 2 Grant:

- Analysis work has begun on the sealing potential of geologic formations that overlie targeted reservoirs.
- Fluid samples from RSU#1 are being analyzed.
- Checking for additional available fluid samples for Madison and Weber formation.
- RSU#1 data has been reprocessed to focus on the seals. Analysis has begun.
- Continuation application has been submitted to DOE for project year 2.

Program	Budget	Expended	Remaining
CMI operating	\$218,145	\$217,116	\$1,029*
WY-CUSP	\$16,952,572	\$15,687,646	\$1,426,871
CERC	\$842,237	\$869,796	(\$27,558)**
DOE2	\$284,998	\$205,917	\$79,081***
WY-CUSP2	\$5,000,000	\$2,620,725	\$2,379,275

*New funding and budget is anticipated for FY14

**New match funding for Project Year 3 is anticipated from SER

***Reflects only first year fiscal budget

Center for Biogenic Natural Gas Research – Dr. Michael A. Urynowicz, director

The Center for Biogenic Natural Gas Research (CBNG) explores and develops novel methods for production of renewable, clean-burning natural gas from depleted hydrocarbon reserves using indigenous microorganisms.

FY2014 Achievements:

- The CBNG has been working with industry sponsors for the past two years and is moving forward with several new sources of revenue including licensed technology royalties, consulting service fees, and sponsored research. As a result, the CBNG has achieved financial sustainability through a UW/industry partnership. CBNG has achieved self-funding and will not receive funding from SER starting fiscal year 2014.

- Currently working on two Engineering Initiative Research Clusters. Final proposals due June 15th.
- Field demonstration in the state of Louisiana planned for last quarter of 2014.

Center for Energy Economics and Public Policy – Dr. Timothy J. Considine, director

The Center for Energy Economics and Public Policy (CEEPP), working with other leading academic and research centers, provides objective information and analysis for energy policies at the local, state, national, and international levels. The center's goal is to support policy decision-making that balances economic, environmental, and social considerations. These goals are accomplished through research studies and programs estimating the costs and benefits of energy technologies and policies. Serving as a microcosm of many core issues affecting energy and economic development, Wyoming as the second-largest energy producing state, is a natural location for the center.

FY2014 Achievements:

- New grants captured or leveraged with center funds: Awarded: (April 2014): the economic Impacts of Coal, Wyoming Infrastructure Authority, Robert Godby, Roger Coupal, David Taylor, Tim Considine, external funding: \$43,246.

The center funded these projects:

- Center Core, Timothy J. Considine, College of Business, Economics and Finance, two graduate students.
- Wind Power Development Research Program – Phase II, Robert Godby, College of Business, Economics and Finance, Roger Coupal, College of Agriculture, Department of Agricultural Economics, one graduate student.
- Wyoming Natural Gas: Past and Future Challenges, Charles Mason and David Finnoff, College of Business, Economics and Finance, one graduate student.
- Economic Co-optimization of Oil Recovery and CO₂ Sequestration, Klaas van 't Veld, College of Business, Economics and Finance and Vladimir Alvarado, College of Engineering, Chemical and Petroleum Engineering, one graduate student.
- Economic/Ecological Analysis of Externalities Associated with Energy Development, David Aadland and John Tschirhart, College of Business, Economics and Finance, one graduate student.
- Energy Product and Factor Markets Using Experimental Economics, Owen Phillips, College of Business, Economics and Finance and Chris Bastian, College of Agriculture, Department of Agricultural Economics, one graduate student.
- Cost Analysis of Shale Energy Drilling and Production Database, Sherrill Shaffer, College of Business, Economics and Finance and Gary M. Fleischman, Department of Accounting, Texas Tech University (formerly with UW College of Business), two part-time research assistants.

The center has developed a partnership with the Wyoming Infrastructure Authority for these projects:

- Impact of Coal on Wyoming's Economy (see above)
- TOT3 Wyoming-Colorado Intertie Transmission Project: advisory role and supplemental research (shared findings)

- Renewable Energy Development in Wyoming: research regarding renewable development and economic costs and benefits, with College of Engineering, Jonathan Naughton

An initial patent is currently under review at the UW Research Products Center for a tool for evaluating the economic benefit and relative profitability of wind farm location.

Center for Fundamentals of Subsurface Flow – Dr. Mohammad Piri, director and Dr. Felipe Pereira, associate director

The Center for Fundamentals of Subsurface Flow (CFSF) is an interdisciplinary research center devoted to developing original and fundamental research in the area of multiphase multicomponent flow through porous media. Its mission is to expand knowledge in current state-of-the-art experimentation and modeling in multiphase flow to ensure access to subsurface energy resources now and in the future. The center integrates research groups in experimental science, mathematical modeling, and computational science from various UW departments and institutes. Scientists with expertise in distinct aspects of porous media flow and transport problems develop collaborative research projects with other universities/institutions and industry to address new challenges of practical and technological importance. Research will lead to the development of new insight into physics of subsurface flow, new physically based models, computational algorithms, and analytical/numerical models for the study of complex multiscale multiphase flow physics in heterogeneous porous media and applications of these methods.

CFSF researchers have been aggressively seeking funding for research through submission of grant proposals to state and federal agencies as well as private sector entities. In FY14, the center captured or leveraged 12 grants and industry funding worth more than \$42 million.

The center issued a request for proposals on April 1, 2010 for Geologic Sequestration of Greenhouse Gases and Recovery of Unconventional Gas. The research was focused on fundamentals of multiphase flow in porous media in two topic areas:

- Sequestration of greenhouse gas and associated impurities (GGI) in geologic formations, e.g., deep saline aquifers and oil and gas reservoirs.
- Recovery of natural gas from unconventional reservoirs characterized by low permeability.

The projects listed below were evaluated at the end and received positive recommendations to continue another year. They were extended at no cost until May 2014:

- On the Development of the UW-team Simulator for the Injection of CO₂ in Deep Saline Aquifers
PI: Felipe Pereira
- Impact of Co-contaminants Injected with Supercritical CO₂ on Fundamental Flow Properties of Sequestration Schemes in Deep Saline Aquifers: Experimentation and Modeling PI: Mohammad Piri
- Simulation of CO₂ injection in deep saline aquifers with mathematical verification and physical validation PI: Frederico Furtado
- A Bayesian Framework for Enabling Predictive Simulation and Uncertainty Quantification in History Matching Geological Models for CO₂ Injection PI: Victor Ginting
- Fundamental Investigation of Wettability in Supercritical-CO₂/Brine/Rock Systems at Reservoir Conditions: Impact of Co-contaminants PI: Lamia Goual

- An Integrated Well Location Optimization Study for Commercial-Scale CO₂ Storage in A Deep Saline Aquifer PI: Ye Zhang (Co-PIs: K J Reddy; Phil Stauffer)

Dr. Pereira was awarded the prestigious Science Without Borders award by the CNPQ (the Brazilian National Science Foundation) to establish a scientific collaboration with the University of Sao Paulo, the top Brazilian university.

Dr. Goual was granted a National Science Foundation (NSF) CAREER Award.

Prof. Piri established numerous partnerships with private-sector entities (e.g., Hess, Halliburton, Baker Hughes, Saudi Aramco, etc.)

Prof. Piri was granted this patent: M. Piri, Recirculating, Constant Backpressure Core Flooding Apparatus and Method, Patent No.: US 8,683,858 B2, April 01 (2014).

The center hosted a workshop, Experimentation, Mathematical Modeling and Numerical Simulation, May 19-21, 2014, UW Conference Center at the Hilton Garden Inn, in Laramie. Dr. Masa Prodanovich, University of Texas, Austin, and Dr. Patrick O'Leary, Kitware, were invited speakers.

Center for Photoconversion and Catalysis – Dr. Bruce Parkinson, director and Dr. Carrick Eggleston, associate director

The Center for Photoconversion and Catalysis (CPAC) promotes collaboration and experimentation in solar energy conversion, energy storage, and catalyst optimization. The center finds new ways of generating and using energy – emphasizing conversion of light into both electrical and chemical energy – and the closely related catalytic chemistry needed to use new and conventional energy forms more cleanly and efficiently. Resulting knowledge will help minimize energy losses and maximize yields in processes such as biomass conversion, production of photogenerated fuels and conversion of Wyoming's fossil energy sources into cleaner fuels.

The center has initiated study of the use of solar-generated hydrogen as a hydrogen source for coal gasification and coal-to-liquids processes, which has the potential to garner direct industry interest and support. The center anticipates bringing a small demonstration system online during the next biennium. This is in keeping with the SER's interest in value-added processes for Wyoming energy and supports a long-standing need to store solar energy chemically rather than in batteries. In terms of applied research and demonstration projects for teaching, the center is pursuing the installation of grid-tied photovoltaics on the Energy Innovation Center roof. This will make a small contribution to the SER building's total electrical energy needs. CPAC will continue to support seed-grants for research with the potential to lead to full external grants.

FY2014 Achievements:

These grants have been captured or secured with center funds:

- The U.S. Department of Energy EPSCoR (Experimental Program to Stimulate Competitive Research) funded a continuation of UW's Quantum Dot Sensitized Solar Cell project for the period 9/2013-8/2016. This project's PI and co-PIs are from the departments of Chemistry, Physics and Astronomy, and Electrical Engineering – across the Colleges of Arts and Sciences as well as Engineering and Applied Science.
- Dr. Carrick Eggleston (Geology and Geophysics, Arts and Sciences) was awarded a NASA space grant for work on photochemical processes involving oxide and sulfide materials.

- Dr. Brian Leonard (Chemistry, Arts and Sciences) received a Petroleum Research Fund grant (administered by the American Chemical Society).
- Dr. Jing Zhou (Chemistry, Arts and Sciences) was awarded a prestigious CAREER award by the National Science Foundation.
- A PhD student funded by an SER GA position was accepted for a National Renewable Energy Laboratory (NREL) workshop for hands-on photovoltaics experience.

Wyoming Reclamation and Restoration Center – Dr. Pete Stahl, director and Dr. Calvin Strom, associate director

The Wyoming Reclamation and Restoration Center (WRRC) educates students, professionals and the public on land reclamation and ecosystem restoration; facilitates research and disseminates information on effective technologies and best management practices for reclamation of disturbed lands in Wyoming; and provides help to clientele seeking practical solutions for restoring or reclaiming disturbed lands.

FY 2014 Achievements:

- Organized and hosted Wyoming Sage Grouse Habitat Restoration Workshop, March 26-27, 2014, Casper College, McMurry Career Studies Building
- Organized and presented Pinedale Reclamation BMP Workshop, June 12, 2014, Hampton Inn, Pinedale
- Dr. Stahl participated as one of two experts in a Congressional Education Briefing in Washington, D.C., on Land Reclamation and Soil Remediation in Coal and Gas Fields of the Western U.S., Sept 12, 2013
- Dr. Stahl served on the Governor's Sage Grouse Implementation Team
- Dr. Stahl and Dr. Strom serve as members of the Douglas Core Area Restoration Team

WRRC is developing the Wyoming Reclamation and Restoration Database with data provided by 13 energy companies operating in Wyoming to provide information to the U.S. Fish and Wildlife Service relating to the decision on listing the sage grouse as an endangered species.

Published a new Extension Bulletin entitled: Native Plants and Adapted Seeds for Reclamation (B-1256) by Kristina M. Hufford and Rachel D. Mealor.

A number of WRRC-funded graduate projects were completed, including Research on Seed Source Impact on Restoration Success, Sagebrush Reestablishment on Reclaimed Bentonite Mines in the Bighorn Basin and Use of Data Management to Improve Reclamation Success.

WRRC funded one new graduate research project for Mike Zhu, UW soil chemist, to investigate reclamation of Coal Bed Methane Process Water Reservoirs. Additional funding was provided to facilitate completion of three previously funded projects.

WRRC received Bureau of Land Management funding to continue research on revegetation of bentonite mine sites in the Bighorn Basin and to begin a project examining fitness of native plants used in reclamation of disturbed sites in the Powder River Basin. WRRC received funding from the Douglas Core Area Restoration Team to conduct research on Best Methods for Reestablishment of Sagebrush Using Container Grown Seedlings.

WRRC graduate students and staff planted 648 Wyoming big sagebrush seedlings on the Scott Ranch in the Douglas Core Area as part of the sage grouse habitat improvement work.

Three graduate students, working on advanced degrees through WRRC, graduated. Six undergraduate students graduated with the Reclamation Science minor bringing the number of students earning this minor to 83.

Unconventional Reservoirs – Dr. Subhashis Mallick, director

The Center for Unconventional Reservoirs develops algorithms and technology for characterizing unconventional resources. The center has developed state-of-the-art methodologies for characterizing unconventional as well as other types of reservoirs by combining seismic modeling with reservoir simulation. Research results have been published in peer-reviewed journals and presented at international conferences. Part of the efforts to become a self-sustaining center included submittal of three research proposals more than \$17 million. One proposal is for an energy frontier research center (EFRC), of which UW is the lead organization, and encompasses many other top partner universities and industry.

One issue in obtaining funding over the last year has been the reduction and delay of funding from federal agencies. Additional funding is being pursued through an industry-funded research consortium that should make the center independent of federal funding, but will still require at least one year for this consortium to become operational and established. In view of all these, it is anticipated the center will require assistance from the SER for the next biennium so that it is able to continue its research and make the center self-sustaining center within the SER.

The center applied for these grants:

- Multi-physics, multi-scale, and multi-component optimization in a high-performance and distributed computing environment. PI: Subhashis Mallick, Funding Agency: DOE, Advanced Scientific Computing Research (ASCR) program, Project Period- 3 years, Amount requested- \$373,645, Status: Pending.
- Anisotropic waveform inversion combining borehole and surface seismic data. PI: Subhashis Mallick, Funding Agency: DOE, Basic Energy Sciences (BES) program, Project Period- 3 years, Amount requested- \$647,332, Status: Pending.
- Frontier research center for the next generation reservoir characterization and monitoring. PI: Subhashis Mallick (EFRC director), Dario Grana, Vladimir Alvarado, Shunde Yin, Saman Aryana, Tapan Mukerji (Stanford), Mrinal Sen (University of Texas at Austin), Robert Stewart (University of Houston), Michael Tompkins (PolytoPx), Lucy MacGregor (Rock Solid Images), Funding Agency: DOE, Basic Energy Sciences (BES) program, Project Period - 5 years, Amount requested- \$16,232,012, Status: Pending.

The center is launching a new industry-funded research consortium, headed by Subhashis Mallick, Vladimir Alvarado, Dario Grana, and John Kaszuba.

Wind Energy Research Center – Dr. Jonathan Naughton, director

The vision of WERC is to establish an internationally recognized program for conducting wind energy-related research and education and to collaborate with other UW groups to provide service to the state and the nation. The center will strategically partner with other academic institutions, federal laboratories, and companies with complementary capabilities to accomplish this work.

After seven years of support, the Wind Energy Research Center failed to achieve significant outside external support for its energy-related research. The center participants and SER leadership mutually agreed to suspend support until its mission, relevance to Wyoming's economy, and funding approaches can be revised.

Enhanced Oil Recovery Institute – Rob Hurless, acting director

The Enhanced Oil Recovery Institute (EORI) and UW scientists and engineers from various disciplines work with oil producers to assist with recovery of Wyoming's stranded oil through:

- Technology application – apply existing Enhanced Oil Recovery (EOR) technology and create new knowledge when necessary
- Technology demonstration – facilitate testing, evaluation and documentation of enhanced oil recovery technologies in real-world settings
- Technology transfer – benchmark innovative petroleum industry practices and transfer “know how” to Wyoming operators through workshops and conferences
- Economic development – maximize economic potential for application of enhanced oil recovery in Wyoming

More details about this center can be found in the Enhanced Oil Recovery Institute annual report under separate cover.

Matching Grants Fund

Successful academic research programs require significant external funds in the form of grants and contracts to meet their objectives. This is especially true in energy research. External research dollars support undergraduate and graduate students, post-doctoral research staff, purchase of critical equipment, and summer salaries for principal investigators.

The national landscape for research funding is highly competitive. Proposals to national agencies such as the U.S. Department of Energy and the National Science Foundation often have success rates of 20-30 percent or less. As a result, review panels must choose among many excellent proposals. Subtle differences, such as an institution's commitment to help support the research, may dictate any proposal's fate. SER's Matching Grant Fund (MGF) provides significant additional leverage to strong UW proposals, thereby improving the chances of capturing external funding.

Matching grant funds are committed at the time of a UW faculty member's proposal submission to an external agency to improve UW's success rate. With a sometimes significant lag time between proposal submission and award announcements, SER often holds its matching commitments for one year.

MGF Commitments:

- Commitments have been made to provide matching funds through this program every year since FY2007. From 2007 to 2014, 43 of the 107 proposals that received matching commitments from

SER were awarded external grants. Since 2007, \$3,940,042 in SER Matching Grant Fund program funds has leveraged \$17,189,849 in external funds. For every dollar of research funds committed by SER, between three to four dollars in external funding is captured.

Research Topics:

- Each call for proposals contains stipulations that research must be energy-related. The range of research topics has been diverse, such as exploration, production, and improved recovery of oil and gas; aerodynamics of wind turbines; coal conversion technology; energy education and mitigation of environmental impacts.

Outside funding agencies for matching grants are diverse and include:

- U.S. Department of Energy
- American Chemical Society – Petroleum Research Fund
- National Science Foundation
- Idaho National Laboratory
- U.S. Bureau of Land Management
- Center for Revolutionary Solar Photo-Conversion
- Wyoming Wildlife and Natural Resources Trust Fund
- U. S. Environmental Protection Agency (EPA) STAR Program
- Advanced Research Projects Agency – Energy
- Lawrence Livermore National Laboratory
- American Chemical Society Petroleum Research Fund

In the program's first four years, 33 percent of proposals approved obtained outside funding. In the last three years, availability of research dollars – particularly from the federal government – has become limited, reducing the number of proposals that receive outside awards. SER continues to monitor the program's success and to implement process revisions as warranted to ensure future allocations of funds are used to create an advantage for UW faculty.

Uranium Research Fund

In the 2009 General Session, the Wyoming State Legislature appropriated \$1.6 million to the School of Energy Resources for activities related to the in-situ recovery of uranium (ISRU) in Wyoming. The legislation specifies these funds revert by June 30, 2013; however, in the 2012 budget session, the legislature extended the funds' reversion date to June 30, 2015 (House Enrolled Act 005) to allow more time to deploy the research funds.

SER used \$194,537 of the \$1.6 million appropriation toward the following outreach activities:

- September 22, 2009 – Uranium Extraction Workshop, Cheyenne, Wyoming
- October 2009 – Research Priorities for In-Situ Uranium Recovery in Wyoming – report of findings
- *Public Opinion in Wyoming about In-Situ Uranium Recovery*, WYSAC. (2010). Wyoming Survey & Analysis Center, University of Wyoming

- August 4, 2010 – The Future of Uranium Production in Wyoming – A Public Forum on In-Situ Recovery, Laramie, Wyoming
- Analysis of Remediation Strategies for Radionuclide-Contaminated Soils in Uranium Mining – a graduate student research project

The remaining funds (\$1.4 million) are dedicated to funding research related to ISRU. Under the Energy Resources Council's direction and in consultation with the Wyoming mining industry, SER developed a request for proposals to deploy the remaining \$1.4 million for research focusing on optimizing economic recovery of the resource.

The first RFP was released in March 2011 focusing on uranium exploration and ore body characterization and recovery; water management, treatment and disposal; cost effective aquifer restoration technologies; and investigation of the impact of existing regulatory requirements on the economics and timing of ISRU projects in Wyoming. Four proposals were awarded funding of \$826,849, leaving \$578,614.

To deploy the remaining funds, SER released another RFP on June 14, 2012. Three proposals were awarded funding in the amount of \$578,557, leaving \$57 remaining in the fund. Projects awarded funding will investigate enhanced bioremediation of in-situ uranium aquifers, processes for filtering trace metals from production bleed water, and evaluation of restoration by improving geochemical and toxicological characterization of baseline and post-mining site conditions.

All research projects funded through this program are required to submit a final report and to present results in a public forum.

Advanced Conversion Technologies Research Account

Activities of the Advanced Conversion Technologies Research Account are submitted under separate cover to the Joint Minerals, Business and Economic Development Interim Committee. For more information, see the 2014 Report of the Advanced Conversion Technologies Task Force.

Joint U.S.-China Clean Energy Research Center

The School of Energy Resources continues its work with the Advanced Coal Technology Center, which is part of the U.S.- China Clean Energy Research Center, a joint project between the United States and China. The U.S. membership consists of federal, private, and public sectors. The three work areas defined are Building Energy Efficiency, Clean Vehicles, and Advanced Coal Technology. Every component of CERC has a related Chinese component.

For complete information about CERC, please visit:

<http://www.us-china-cerc.org>.

The United States and China are the top consumers of coal in the world, and Wyoming and China share the desire to use coal and increase the viability of the coal industry by looking to conversion technologies that add value to coal. Conducting joint research leverages research funds. In addition, it is likely that commercial-scale projects built in Wyoming will benefit from Chinese partnerships, both financial and technical.

The University of Wyoming is a partner in the Advanced Coal Technology Consortium, and provides \$2.5 million in matching funds from SER's budget and the Clean Coal Technology Fund. These are the partners in the consortium:

- West Virginia, University Research Corporation, prime awardee
- University of Wyoming
- University of Kentucky
- Washington University at St. Louis
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- World Resources Institute
- U.S.-China Clean Energy Forum, Washington State China Relations Council
- Indiana Geological Survey
- National Energy Technology Laboratory

Other entities providing money or other resources are:

- Babcock and Wilcox
- Duke Energy
- LP Anima

The Advanced Coal Technology consortium addresses technology and practices for advanced coal utilization and carbon capture, utilization, and storage. Joint research is conducted in advanced power generation, clean coal conversion technology, pre-combustion capture, post-combustion capture, oxy-combustion capture, CO₂ utilization and sequestration, simulation and assessment, and communication and integration.

SER is taking part in two identified work projects. The first is research on sequestration theory and simulation technology of CO₂ geological storage and large-scale storage strategy. The key features are site characterization, modeling, risk assessment, and brine treatment, reservoir characterization and ranking, and monitoring planning and design. The second is research on novel catalysts and processes for conversion of coal to higher value petrochemical intermediates and fuels. The key foci are reduced cost of catalysts, greater specificity of product yields, and reduced waste streams of CO₂.

The other joint research projects of this consortium are:

- Large-scale post combustion CO₂ capture, utilization, and storage technology
- Microalgae bio-sequestration of CO₂ from flue gas of power plant
- Theory and equipment development for oxy- fuel combustion
- Combined coal pyrolysis, gasification and combustion multi-generation technology

SECTION 5 – OUTREACH

Energy Outreach supports the mission of the SER to be a global leader in building a secure and sustainable energy future.

Speaker Series

The University of Wyoming's School of Energy Resources' 2013-14 Speaker Series hosted top industry and academic professionals from around the world. The events brought together students, faculty, researchers and the public to learn about a wide range of advanced energy technologies and industry trends. The speaker series was held in the EIC's Encana Auditorium. PowerPoint presentations from these speakers are on the SER website.

Professor Wenhau Wang

School of Environmental Science & Engineering, Shanghai Jiao Tong University
"Mercury Emission Control Technologies Developed at SJTU." Attendance: 70

Professor John Kaldi

Chairman, Geosequestration, University of Adelaide and Chief Scientist for the Cooperative Research Centre for Greenhouse Gas Technologies, "Carbon capture and storage: What are the big issues and opportunities for the petroleum industry?" Attendance: 70

David Emery

President & CEO of Black Hills Corporation, "Education, career paths, and opportunities in the energy industry" Attendance: 60

Tom Konrad

Writer/Editor, Financial Analyst, and Investment Advisor specializing in clean energy, "How The Financial Market Shapes the Energy Economy." Attendance: 60

Nick Jones

Research Scientist PG, EORI, "A new look at Coalification – Critters vs. Compaction." Attendance: 60

Randall Luthi

President of the National Ocean Industries Association, "From the Plains to Platforms, Should UW Grads Work Offshore?" Attendance: 45

Rich Halvey

Western Governors' Association, Energy Program Director, "WGA's 10-Year Energy Vision." Attendance: 40

Professor Norman R. Morrow

Wold Chair of Energy & J.E. Warren Distinguished Professor of Chemical and Petroleum Engineering, University of Wyoming, "Improved Oil Recovery: from Low Salinity to Sequential Waterflooding" Attendance: 60

Professor Zhemin Shen

School of Environmental Science & Engineering, Shanghai Jiao Tong University, “Catalytic Mercury Removal for Energy Generation Industries.” Attendance: 60

Professor Xiangping Zhang

Chinese Academy of Sciences, Institute of Process Engineering, “Ionic-based Processes for Sustainable Chemical Engineering.” Attendance: 60

Professor Baoqing Li

Chinese Academy of Sciences, Institute of Coal Chemistry, “The Recent Progress of Coal Technology Development in China.” Attendance: 60

Tom Botts

Retired Executive VP of Royal Dutch Shell, “Things I Wish Someone Would Have Told Me Before Starting the New Job.” Attendance: 35

Conferences and Events

September 4, 2013

Media Day

Laramie, Wyoming

To help publicize the opening of the EIC and introduce its technology and facilities, SER invited media representatives from print, radio and TV. Media outlets represented included the Associated Press, Wyoming Public Media, The Gillette Record, Laramie Boomerang, County10, Wyoming Business Report, WyoFile, UW Institutional Communications, KCWY 13, KGWN 5, and K2 TV. Attendance: 20

September 20, 2013

Hess Digital Rock Physics Laboratory Grand Opening and Technical Presentations

Laramie, Wyoming

This event celebrated the launch of the Hess Digital Rock Physics Laboratory in the Energy Innovation Center, sponsored by Hess Corporation, SER, and UW Department of Chemical and Petroleum Engineering. This new, state-of-the-art research facility includes unique imaging instruments capable of mapping pore space and pore fluid occupancy in rock samples and other porous materials, over a wide range of scales and resolutions. The event included a set of technical seminars by world-renowned scientists as well as a ribbon cutting ceremony. Attendance: 85

October 7-9, 2013

The International Conference on Future Technologies for Wind Energy

Laramie, Wyoming

The International Conference on Future Technologies for Wind Energy, hosted by SER and the UW Wind Energy Research Center, convened scholars, research scientists, and industry representatives share knowledge and experience in researching and developing a range of wind energy technologies. Fifty-seven presentations from 13 U.S. universities (including the best wind programs in the United States and nine well-respected international wind institutions) were given at the conference. Representatives from two large wind companies, Siemens and Vestas, attended. Attendance: 100

November 12, 2013

UW Research presentations on BLM lands – BLM Wyoming Resource Advisory Council Meeting

Laramie, Wyoming

UW faculty and graduate students presented updates of joint energy-related research on BLM lands. Attendance: 55

November 13, 2013

Landscape Discussion on Energy Law in Wyoming

Laramie, Wyoming

Attorneys, scholars, government agency representatives and industry stakeholders heard presentations and discussed relevant energy topics in Wyoming and the world. The conference was a collaborative effort of the College of Law's Center for Law and Energy Resources in the Rockies (CLERR) and the UW School of Energy Resources. Attendance: 180

March 18-19, 2014

International Advanced Coal Technology Conference (IACTC)

Brisbane, Queensland, Australia

The 2014 International Advanced Coal Technology Conference (IACTC) brought together an international array of leading energy experts from government, industry, academic and research sectors to discuss recent advancements in the development and deployment of low-emissions coal-based power and carbon-emission mitigation technologies. The Commonwealth Scientific and Industrial Research Organization (CSIRO) and the University of Queensland in conjunction with the School of Energy Resources and Shaanxi Provincial Institute of Energy Resources & Chemical Engineering hosted the conference at the Queensland Centre for Advanced Technologies in Brisbane, Queensland, Australia March 18-19. A field tour on March 20 in Newcastle, New South Wales included a tour of the Port Waratah coal export facility, the CSIRO Advanced Energy Centre and the Vales Point power plant. Eight University of Wyoming undergraduate and graduate students attended. Wyoming Gov. Mead gave an address on Wyoming's commitment to the use and advancement of coal. Dr. David Bell and Dr. Maohong Fan presented technical talks. Clean Coal Research Fund grant awardees Larry Baxter, Brigham Young University and representatives from LP Amina and Ambre Energy also presented. Attendance: 100

April 10, 2014

Orphaned and Abandoned CBM Well Management Information & Panel Discussion

Laramie, Wyoming

SER and the Center for Law and Energy Resources in the Rockies (CLERR) presented the event focused on issues affecting orphaned and abandoned coal bed methane wells in Wyoming, including the proposed action by the state of Wyoming and the Bureau of Land Management to mitigate their effects. Panel members provided on how wells become orphaned and abandoned, the status of such wells on state, private, and federal land, and the policy goals of Wyoming and federal governments in the process to design a management solution and identify opportunities and outcomes for these wells. Panelists included Cameron Nazminia, policy advisor, Governor's Office; Wyoming State Rep. Eric Barlow, (Campbell/Converse); Bob King, Abandoned Well/Orphan Well supervisor, Wyoming Oil and Gas Conservation Commission; John Goldstein, policy advisor, Environmental Defense Fund; and Michael Urynowicz, director of the Biogenic Natural Gas Research Center and professor of civil engineering. Attendance: Approximately 50

April 17, 2014

Integrated Systems: The Key to Resolving Composite Geologic Problems Symposium

Laramie, Wyoming

Hosted by the School of Energy Resources and the Carbon Management Institute, this symposium brought together industry stakeholders, research scientists, academics and the public for presentations on topics such as thermal evolution with implications for hydrocarbon maturation, produced waters, diagenesis and porosity evolution in Wyoming reservoirs, and tight gas/shale gas to carbon storage techniques. UW President Richard McGinity welcomed the group, and Carl Bauer, interim director Carbon Management Institute, provided the opening comments. Technical presenters included Henry Heasler, chief geologist, Yellowstone National Park; Scott A. Quillinan, senior hydrogeologist, Carbon Management Institute, UW; J. Fred McLaughlin, senior petrographer, Carbon Management Institute, UW; and Zunsheng “John” Jiao, chief geologist, Carbon Management Institute, UW. Attendance: 40

May 19-21, 2014

Workshop: Experimentation, Mathematical Modeling & Numerical Simulation of Porous Media Flows

Laramie, Wyoming

Hosted by the School of Energy Resources and the Center for Fundamentals of Subsurface Flow, this workshop drew scientific researchers, academics and industry stakeholders from around the world. Special short courses and tutorials were offered on topics of image analysis for porous media and extreme scale analysis and visualization. Attendance: 60

Collaborations/Sponsorships

September 12, 2013

Energy Innovation Center Ribbon Cutting

Laramie, Wyoming

UW community members and policy makers, including Gov. Matt Mead, former Gov. Dave Freudenthal, U.S. Sen. Al Simpson, the UW Board of Trustees, UW President Robert Sternberg, and EIC facility donors, attended. Attendance: 200

September 16-19, 2013

GeoWest Conference

Laramie, Wyoming

SER provided sponsorship, tours of EIC and 3-D CAVE demonstrations.

September 17, 2013

ExxonMobil Collaboration

Laramie, Wyoming

ExxonMobil’s Corporate Strategic Research Team met with UW faculty to discuss opportunities for research and engagement.

September 18-20, 2013

Wyoming Oil and Gas Fair

Jackson, Wyoming

SER hosted a booth and made a presence at the Wyoming Oil and Gas Fair.

September 27-30, 2013

Rocky Mountain Rendezvous

Laramie, Wyoming

SER co-sponsored the Rocky Mountain Rendezvous, one of five regional job fairs sponsored by the American Association of Petroleum Geologists and the Society of Exploration Geophysicists, and hosted by UW's Department of Geology and Geophysics. The event, held at the UW Conference Center at the Hilton Garden Inn, attracted both geoscience students and 25 oil and gas companies. Attendance: 375

October 2-4, 2013

CERC-ACTC

Jackson, Wyoming

The U.S. - China Clean Energy Research Center and U.S. Advanced Coal Technology consortium held a joint midpoint review meeting for updates on work themes and presentations, poster sessions and work sessions on collaborative research and development on advanced coal technologies, including carbon capture, storage, and utilization. Gov. Mead provided a keynote address. Attendance: 100

June 24, 2014, March 27, 2014 and January 23-24, 2014

Wyoming Infrastructure Authority Meetings

Laramie, Cheyenne and Sheridan, Wyoming

SER Outreach took part in the Wyoming Infrastructure's Stakeholders meeting on March 27 in Laramie and the WIA's Quarterly meeting in Cheyenne on January 23-24, 2014.

Publications and Website

- SER General Brochure was updated in March 2014.
- Hess Digital Rock Physics Laboratory video was produced and completed.
- The SER website continually undergoes revisions to update content and provide information in a clear and easy-to-understand form.
- The SER e-newsletter continues distribution to approximately 2,500 people monthly.

SECTION 6 – STRATEGIC AREAS OF CONCENTRATION

SER has been fortunate to secure support for a strategic plan that sets priorities for accomplishments by energy programs at UW, and additional support that provided matching funds to build a new High Bay Research Facility (HBRF) to house large-scale energy research as part of this plan.

The plan focuses on these key areas of concentration:

- Exploiting unconventional reservoirs that contain fossil energy resources that do not flow at economic rates or produce economic volumes of oil and natural gas without stimulation or other enhanced processes.
- Climbing the value chain by creating essential consumer products, such as liquid fuels and petrochemicals, through conversion and other manufacturing activities that add value to and create new markets for energy resources that are now sold as commodities.
- Developing wind and solar energy technologies that improve efficiency, mitigate the impacts of variable supply and inadequate transmission capacity, and convert output to higher-value products,
- Progress in programs that address the first two of these areas of concentration has been impressive. Research programs, external support from the public and private sector, and graduate student participation continues to grow. Major new contributions and research contracts have been committed to by Hess Corporation, Halliburton, Saudi Aramco, and ExxonMobil in unconventional reservoirs, with several serious inquiries still in the works from other companies. Well-funded research and graduate student participation is also continuing in the area of coal-to-liquids research, and private sector support seems imminent.

SER continues to look at ways to mitigate against intermittency in the energy supply, find additional uses for the state's power resources, extend its collaborations with UW colleges, and to integrate UW's computational resources with energy research.

Planning for the HBRF is progressing; design documents and a construction schedule are under development.

Collaborations to achieve Tier 1 status for the College of Engineering and Applied Science continue and funds are being allocated for that.

SECTION 7 – ENERGY INNOVATION CENTER

The EIC celebrated its grand opening in September 2013. It supports the University of Wyoming and the SER in achieving the mission of positioning Wyoming as a global leader in energy education, research and outreach.

This state-of-the-art research and collaboration facility, located on the northwest corner of UW's Laramie campus, includes 27,300 net square feet of highly technical research space, as well as office, classroom, and meeting space. Approximately 12,500 square feet of the EIC is designated for six rapidly reconfigurable, ultra-modern laboratory spaces that will play a key role in advancing SER's strategic areas of concentration.

The design and construction of the \$25.4 million EIC was made possible through private donations and State of Wyoming matching funds. Encana provided the largest private donation for the building with a \$5 million commitment in 2007 that was matched by the state. Generous private donations were also given by BP, Shell, Peabody Energy, Arch Coal, Marathon Oil, Questar, and ConocoPhillips. The building was completed under budget.

As one of the most advanced research facilities at the university, the EIC provides students, researchers, and academic professionals the opportunity to actively engage in, observe, and support advancements in sustainable energy technologies.

Shell 3-D Visualization Laboratory

The Shell 3-D Visualization research laboratory remains the only four-walled CAVE (Cave Automatic Virtual Environment) and 3-D visualization laboratory in Wyoming. The laboratory enables researchers to visualize and interact with highly complex data sets and visualize scenarios to further the research goals of SER and provide a unique resource to SER, the university community and other users. The laboratory connects to the NCAR Wyoming Supercomputing Center (NWSC) and UW's Advanced Research Computing Center (ARCC), which provides supercomputing power for faster processing of complex data and enhanced imaging.

Since the Shell 3-D Visualization Center has opened, numerous groups from around Wyoming and the region have taken tours and seen demonstrations in the CAVE. This includes members of the Wyoming Legislature, corporate executives, faculty and administrators from other universities in the region and numerous K12 students from around Wyoming. In addition to demonstrations, several researchers from UW are using the CAVE to visualize large and complicated data sets, allowing for more thorough data analysis.