

Annual REPORT

2024



Strategic Academic Offerings

Innovative Research

Stakeholder Outreach

ACADEMICS

RESEARCH

OUTREACH



UNIVERSITY
OF WYOMING

School of
Energy Resources

*Prepared for the Wyoming Legislature
Joint Minerals, Business, and Economic Development Committee
Joint Appropriations Committee
Joint Education Committee*

THE UNIVERSITY OF WYOMING SCHOOL OF ENERGY RESOURCES (SER) ANNUAL REPORT FISCAL YEAR 2024

July 1, 2023 through June 30, 2024

WHO WE ARE

SER LEADERSHIP

Holly Krutka, Ph.D. | Executive Director

Scott Quillinan | Senior Director, Research

J. Fred McLaughlin, Ph.D. | Director, Center for Economic Geology Research

Trina Igelsrud Pfeiffer | Director, Center for Carbon Capture and Conversion

Eugene Holubnyak | Director, Hydrogen Energy Research Center

Kara B. Fornstrom | Director, Center for Energy Regulation and Policy Analysis

Kami Danaei, Ed.D. | Director, Academic Programs

Kyle Summerfield | Program Manager, Shell 3D Visualization Center

Rachel Ferrell | Director, Business Operations

Christine Reed | Director, Outreach

ADMINISTRATIVE SUPPORT

Kristi Russow | Executive Administrative Assistant

Pat McLean | Office Associate, Sr.

OUR MISSION

Energy-driven economic development for the state of Wyoming.

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ABOUT THE SCHOOL OF ENERGY RESOURCES

The University of Wyoming (UW) School of Energy Resources (SER) was created in 2006 to enhance the University's energy-related education, research, and engagement. SER directs and funds cutting-edge energy research and technology development, which integrates with the formulation and conduct of academic programs at UW and bridges academics and industry through targeted engagement efforts. The partnerships formed between academics and industry ensure programs are relevant, current, and deliver impact and high value to stakeholders and the State.

Since its inception, SER has maintained flexibility in its focus and structure to meet the changing needs of Wyoming's energy industries and the State's economy—which is now more critical than ever.

This report highlights SER's significant achievements from July 1, 2023, through June 30, 2024, in academics, research, newly emerging areas of focus, and engagement to keep UW and Wyoming at the forefront of the energy sector.



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GLOSSARY OF ACRONYMS

#

3D Viz - Shell 3D Visualization Center

A

AAPL - American Association of Professional Landmen

A&S - College of Arts & Sciences

ARPA-E - Advanced Research Projects Agency-Energy

ATR - Advanced Technology Resources

C

CAQ - Center for Air Quality

CarbonSAFE - Carbon Storage Assurance Facility Enterprise

CBEA - Center for Business and Economic Analysis

CBNGR - Center for Biogenic Natural Gas Research

CCCC - Center for Carbon Capture and Conversion

CCUS - Carbon Capture, Utilization and Storage

CEGR - Center for Economic Geology Research

CEPS - College of Engineering and Physical Sciences

CEPWM - Center of Excellence for Produced Water Management

CERPA - Center for Energy Regulation & Policy Analysis

CM - Critical Minerals

CO₂ - Carbon Dioxide

COE - Centers of Excellence

CORE-CM - Carbon Ore, Rare Earth and Critical Minerals

CSU - Colorado State University

D

DAC - Direct Air Capture

DFS - Dry Fork Station

DJ - Denver-Julesburg

DOE - Department of Energy

E

EES Concentration - Energy and Environmental Systems

EIC - Energy Innovation Center

EGU - Electric Generation Units

EORI - Enhanced Oil Recovery Institute

EMF - Energy Matching Funds

EPA - Environmental Protection Agency

ERC - Energy Resources Council

ERM - Energy Resource Management (minor)

ERMD - Energy Resource Management and Development

F

FEED - Front End Engineering Design

FY24 - Fiscal Year 2024

G

GGRB-WRB - Greater Green River Basin and Wind River Basin

H

H₂ERC - Hydrogen Energy Research Center

HERO - Hermiston, Oregon

I

INL - Idaho National Laboratory

ITC - Integrated Test Center

K

KHI - Kawasaki Heavy Industries

L

LANL - Los Alamos National Laboratory

M

MOU - Memorandum of Understanding

MTR - Membrane Technology and Research

MSHA - Mine Safety and Health Administration

MW - Mega Watt

N

NEPA - National Environmental Protection Act

NERC - Nuclear Energy Research Center

NETL - National Environmental Technology Laboratory

NRC - Nuclear Regulatory Commission

NREL - National Renewable Energy Laboratory

NSF - National Science Foundation

P

PCOR - Plains CO₂ Reduction Partnership

PLM Concentration - Professional Land Management

PNNL - Pacific Northwest National Laboratory

PRB - Powder River Basin

PREC - Partnerships for Research and Education in

Chemistry
PtG - Pilot-to-Gas

R

REE - Rare Earth Elements
RENEW - Research Explorations for Nuclear
Energy in Wyoming
RFP - Request for Proposals
RNG - Renewable Natural Gas

S

SAREC - UW Sustainable Agriculture Research and
Extension Center
SER - School of Energy Resources

T

TAP - Technology Associated Program

U

USAF - United States Air Force
USEA - United States Energy Association
USGS - United States Geological Survey
UW - University of Wyoming

V

VR - Virtual Reality

W

WERC - Wind Energy Research Center

WIP - Wyoming Innovation Partnership
WRF - Weather Research and Forecasting
WRI - Western Research Institute
WylC - Wyoming Innovation Center



ENERGY RESOURCES COUNCIL

The University of Wyoming Energy Resources Council (ERC) was established by Wyoming statute 21-17-117(e) to guide SER in setting priorities for energy-related academics, research, and outreach. The ERC, consisting of leaders from industry, the legislature and UW, provides direction for responsive, internationally recognized, interdisciplinary energy-related programs that are integral constituents of the University's identity.

Required by provision (c)(iv) of WY Stat § 21-17-117 and in accordance with WY Stat § 9-2-1010 through 9-2-1014., SER submits its budget directly to the ERC for review and approval before final submission to the governor.

The ERC contributes a unique business perspective on the diverse research and workforce demands of both Wyoming's private and public energy sectors, and is responsible for producing a valuable return on the State's investment in UW's energy programs.

The ERC currently consists of thirteen members. Seven members represent diverse sectors of Wyoming's energy industries and are appointed to three-year terms by the governor with confirmation by the Senate.

Additional members include one member from the Wyoming Senate (appointed by the President of the Senate), one from the House of Representatives (appointed by the Speaker of the House), and four ex-officio members and liaisons: the President of the University of Wyoming, the Director of the Haub School of Environment and Natural Resources, a representative from the Wyoming Governor's office, and an informal seat is occupied by a member of the UW Board of Trustees.

SER GOVERNANCE

BOARD MEMBERS

Cindy Crane, Chairwoman
CEO, Enchant Energy

Jim Anderson, Vice Chairman
Wyoming State Senator, Natrona County

Carl Bauer
President, C.O. Bauer Consulting, Inc.

Donald Burkhardt, Jr.
Wyoming House of Representatives,
Carbon County

Mark Doelger
President and co-owner, Barlow & Haun, Inc.

David Emery
Retired Chairman and CEO, Black Hills
Corporation

Vello A. Kuuskraa
President, Advanced Resources
International, Inc.

Charlene Russell
Vice President of Commercial Development
for North America, Baker Hughes

Chad Teply
Senior Vice President, Transmission and Gulf
of Mexico at Williams

EX-OFFICIO MEMBERS AND LIAISONS

Edward Seidel
President, University of Wyoming

Dave True
Trustee, University of Wyoming

Randall Luthi
Senior Policy Advisor, State of Wyoming

John Koprowski
Dean, UW Haub School & Ruckelshaus
Institute



LETTER FROM THE EXECUTIVE DIRECTOR

Greetings from the School of Energy Resources (SER)!

Pulling together the annual report each year provides an opportunity to take time to ponder all that has occurred over the last 12 months. In the last fiscal year, SER built a strong foundation, which we will utilize long into the future to serve students, faculty, staff, industry partners and the state of Wyoming.

A significant goal for SER's academic program is to offer instructional opportunities to any UW student interested in energy. In pursuing this goal, SER ramped up marketing for our undergraduate major and saw enrollment from Fall 2022 to Fall 2023 grow from 41 to 51 students. SER's new minor enrollment grew from 16 to 19 students. SER began accepting enrollment in two new certificates, one focused on carbon capture, use and storage and the other focused on land administration – both offered by leveraging existing coursework across UW. With support from Idaho National Laboratory, SER also offered a new course focused on the fundamentals of nuclear energy. Today SER's academic program serves students from across UW.



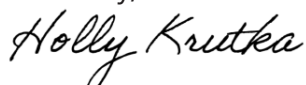
Dr. Holly Krutka
Executive Director

SER's outreach program continues to reach an increasing number of individuals – aiming to bring experts at UW, grow awareness of energy innovation in Wyoming, support landowners and continue our drive toward transparency in sharing all that SER does. And we even launched a new podcast!

While SER, and other energy researchers across the nation, experienced unusually lengthy delays in the contracting process for competitive grants, that did not stop our research team from once again performing at the highest level in FY24. They continued to lead Wyoming CarbonSAFE focused on commercial-scale CO₂ storage, assumed administration of the Wyoming Integrated Test Center, began construction on the coal refinery at the Wyoming Innovation Center in Campbell County, set the bar on science related to rare earth elements and critical minerals associated with coal, built areas of expertise in cutting-edge hydrogen research, started a new oil and gas program, collaborated on virtual reality applications for Wyoming, supported the state's elected and appointed officials with policy and regulatory studies, and so much more.

Perhaps what we are all most proud of is the impact we know we are having. Through our graduates, outreach and research projects, we are increasingly engaged with stakeholders across Wyoming. I commit that we will continue to focus on our mission and ensuring that Wyoming will continue to be a leading energy producer for the Nation.

Sincerely,

A handwritten signature in black ink that reads "Holly Krutka".

Holly Krutka, Ph.D.

LEADERSHIP ACCOLADES

ENERGY RESOURCES COUNCIL

Representative Don Burkhardt Receives Special Award from American Nuclear Society

The Honorable Donald E. Burkhardt, Jr. was recognized by the American Nuclear Society as a Special Award recipient for 2023. Established in 1962, the special award recognizes an individual or group for outstanding achievements in a specific area of work. Candidates are nominated and selected based on the criteria for a particular topic each year.

A representative in the Wyoming Legislature for District 15, Burkhardt was recognized for his leadership in encouraging nuclear energy to be a part of Wyoming's overall portfolio in order to address the unique challenges of reducing emissions, providing reliability, while also satisfying high energy demand.



Energy Resources Council Chairman Cindy Crane Appointed CEO of PacifiCorp

Chairman Cindy Crane of the Energy Resources Council was appointed as the new CEO of PacifiCorp. Crane stepped into the leadership role at the company with over 30 years of experience in the electric power industry.

Crane's dedication to public service has extended far beyond her own career and has been an asset in guiding the energy-related activities at UW. Through her prowess, she contributes a unique business perspective on the diverse research and workforce demands of both Wyoming's private and public energy sectors as a member of the ERC.



SCHOOL OF ENERGY RESOURCES

Executive Director Holly Krutka Honored as 2023 Woman of Influence

School of Energy Resources Executive Director Holly Krutka was honored by the Wyoming Business Report as a 2023 Woman of Influence.

Created in 2013, the Wyoming Business Report has been recognizing influential women working within the State that exemplify leadership, creativity, ethical business practices, innovative thinking, unquestionable character, and more, in order to acknowledge and celebrate their contributions to Wyoming communities.

Krutka was recognized as the 2023 honoree in the category of Energy, Mining and Utilities, receiving multiple nominations from UW faculty, staff, community members, and industry partners around the State.





ACADEMIC PROGRAM

PRACTICAL TRAINING

The Academic Program in the School of Energy Resources is dedicated to setting students up for success in their careers by encouraging practical training experiences through internships and connecting with professionals. FY24 saw an increase in students participating in such opportunities.

Industry Internship Programs

During the summer of 2023, many students in both concentrations of the Energy Resource Management and Development (ERMD) degree program benefited from industry-led internships to gain valuable hands-on experience and forge important relationships with professionals in the energy field.

Eight students in the ERMD program spent their summer working for companies including Peabody Energy, Tallgrass Energy, Genesis Alkalai, Wyoming Stockgrowers Association, Kemmerer Operations Water & Environmental Technologies, and ConocoPhillips.

"There is a lot of value in 'learning by doing.' Internships really allow us to connect what we do in the classroom with the real world. I don't think we fully understand the significance of what we are learning in class until we apply it. I am pleased to report that I felt very well prepared." ~Kendall Klos

Legislative Internship Program

During the legislative budget session, two students in the ERMD degree program participated in the Wyoming Legislative Internship Program.

Rachel Reese of Johnstown, Colo., and **Tyler Schlagel** of Cheyenne, Wyo., spent over 40 hours among Legislative Service Office staff, Wyoming legislators, and other elected officials during the 2024 session to gain a new appreciation for, and perspective on, representative democracy and public service in Wyoming.



MENTORSHIP PROGRAM

SER offers a mentorship program to any student in an SER academic program. In FY24, thirteen students were involved in the program where juniors and seniors mentor sophomores and freshmen, and trips are organized to engage with industry and learn in the field.

ACADEMICS

WHO WE ARE

Kami Danaei, Academic Director

Tanner McClure, Academic Coordinator

Heather Chandler, Office Associate, Sr.

Kristen Pritchett, Director, Professional Land Management Program

Randall Violett, Director, Energy and Environmental Systems Concentration

Ashli Tomisich, Director, Student Success and Experiential Learning

Helen Qin, Office Associate, Sr.

MAJOR ACCOLADES

Kami Danaei was selected for the Leadership Wyoming Class of 2025.



STUDENT ACCOLADES

Ainsley Harris, a Energy Resource Management and Development student in the Professional Landman Concentration, was awarded the Bill Goodin Scholarship through the Denver Association of Professional Landmen (DAPL).



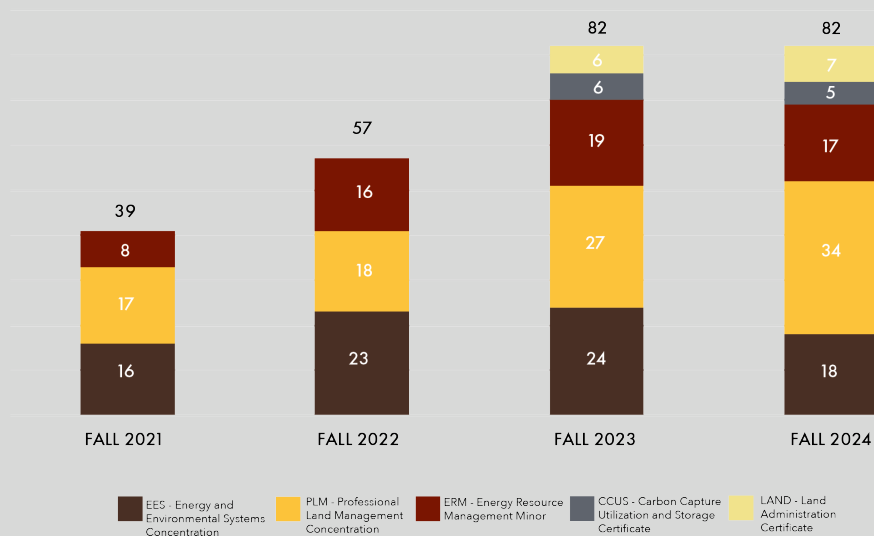
Connor Fleming, a Energy Resource Management and Development student in the Professional Land Management Concentration, was accepted into the inaugural University of Wyoming Leadership Academy.



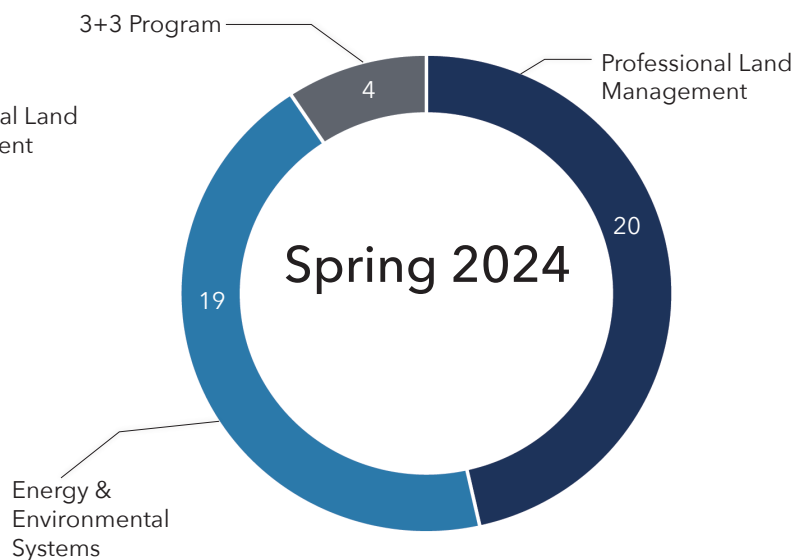
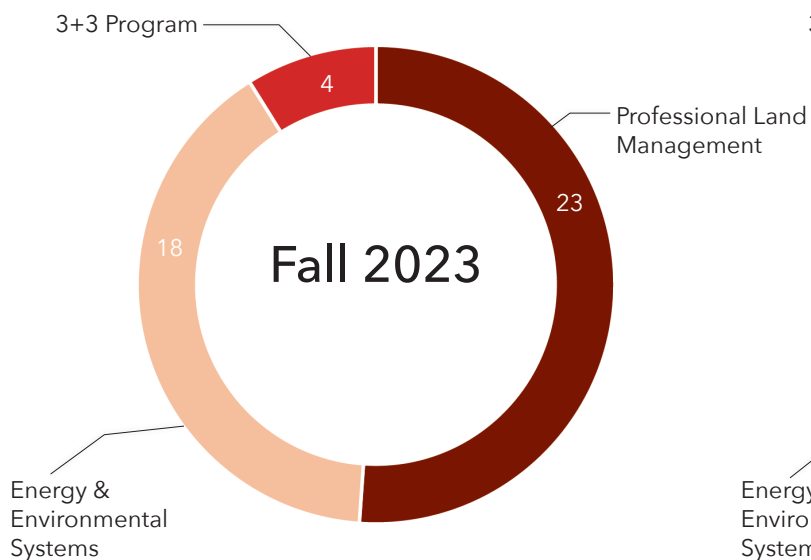
100% Employment within six months of graduation, or placement in a graduate or professional program.

BY THE NUMBERS

SER PROGRAM STUDENT ENROLLMENT



Enrollment by Program Concentration



NIELSON TEXTBOOK SCHOLARSHIPS

Fall 2023 - \$11,990.76 | Spring 2024 - \$14,192.35
Summer 2024 - \$15,773



Total Amount Awarded
FY24

\$41,956.11

BY THE NUMBERS

Enrollment in Energy Resources (ERS) Courses

Impacts on UW Community

In addition to students pursuing a major in Energy Resource Management and Development (ERMD), there were an additional 74 non-ERMD students enrolled in ERS classes over the fall and spring semesters representing 34 different majors.

Top non-ERMD Majors taking ERS classes

Environmental Systems	
Science.....	9
Chemical and Biomedical	
Engineering.....	7
Exploratory Studies.....	5
Geology.....	5

GRADUATES

School of Energy Resources Academic Programs: FY24 Graduates

TOTAL GRADUATES 22

Fall 2023			10
ERMD Major	PLM Concentration		2
ERMD Major	EES Concentration		2
	ERM Minor		3
	Land Admin. Cert.		3
Spring 2024			11
ERMD Major	PLM Concentration		2
ERMD Major	EES Concentration		4
	ERM Minor		3
	Land Admin. Cert.		2
Summer 2024			1
	ERM Minor		1



EXPERIENTIAL LEARNING OPPORTUNITIES

University of Wyoming Faculty, Staff and Students Visit Idaho National Laboratory

A cohort of University of Wyoming faculty, staff and students visited Idaho National Laboratory (INL) in Idaho Falls, Idaho, as part of a collaborative effort to strengthen connections and facilitate research opportunities between the two entities.

Hosted by INL and coordinated with the UW School of Energy Resources (SER) and the College of Engineering and Physical Sciences, the multidisciplinary group represented 10 different departments, including the departments of Geology and Geophysics, Chemistry, Mathematics and Statistics, Physics and Astronomy, and multiple engineering disciplines.

Students Visit Hydraulic Fracturing Operation in Northeast Wyoming

Six students in the ERMD bachelor's degree program visited a hydraulic fracturing operation in northeast Wyoming as part of the SER mentorship program.

The WRC Energy Group hosted the group north of Glenrock, Wyo., where two horizontal wells were being fracked to completion. On a guided tour, students learned the step-by-step process of hydraulic fracturing from water acquisition and reuse to proppant mixing and injection.

Students Visit Laramie River Power Station

As part of the SER mentorship program, ERMD students visited Basin Electric Power Cooperative's Laramie River Power Station in Wheatland, Wyo. to learn how the coal-fired power plant operates.

Student Club Promotes Annual Trip to Wyoming Oil and Gas Conservation Commission (WOGCC)

The Student Chapter for Energy Resources, a student-run organization at UW, is dedicated to developing relationships between UW students and the energy industry, as well as fostering a sense of community from both a professional and student perspective.

As part of the club's activities, it promotes the opportunity to attend the WOGCC to all interested students affiliated with the ERMD program. Students learn first-hand the duties and operations of the organization, sit in on examiner hearings, tour the facility, as well as observe the full commission hearings.

Energy Field Course

Every other summer, SER offers an Energy Field Course. Various facets of energy resource management and development are covered by visits to oil and gas wells, coal mines, power plants, wind farms, and other energy production and research sites. Over the course of five days, students visited eleven different sites in the state of Wyoming.



SER FACULTY

COLLABORATIVE SOLUTIONS

SER recruits and retains multidisciplinary faculty with expertise relevant to Wyoming's energy industry. Housed in 6 different departments across 4 UW Colleges and Schools, professors in the School of Energy Resources are internationally recognized energy experts who are actively involved in both energy research and teaching. Committed to achieving top learning outcomes, SER faculty develop students' curiosity and capacity for complex problem solving. Demonstrating its collaborative nature and focus on Wyoming energy education, outreach and research, SER also has many adjunct faculty whom collaborate closely with both SER faculty and staff.

Professor Tara Righetti was appointed to serve a two-year term as the chair on the White House Council on Environmental Quality Task Force for Carbon Dioxide Capture, Utilization, and Sequestration on Federal Lands and Outer Continental Shelf Permitting.



Professor Saman Aryana received a Fulbright Award to conduct research in Australia. He will engage with the University of New South Wales, studying and exchanging ideas on topics related to new energy technologies.



Professor John Kaszuba spent the fall 2023 semester on sabbatical in Edinburgh, Scotland working in collaboration with the Geology Department at the University of Edinburgh.

Professor Subhasish Mallick received the 2023 SEG Reginald Fessenden Award. This honor is awarded to those who have made a specific technical contribution to exploring geophysics.

Professor Dario Grana was named to the second Presidential Fellows Program cohort at the University of Wyoming. Grana also served as interim department head for the Department of Geology & Geophysics.

Professor Maohong Fan was named to the National Academy of Inventors, a member organization comprising U.S. and international universities. Fan was also recognized by the University of Wyoming Office of Research and Economic Development with an inaugural Research and Innovation Excellence Award.

FACULTY MEMBERS

Tim Considine, SER Professor of Economics

Craig Douglas, SER Professor of Mathematics and Statistics

Maohong Fan, SER and Carrell Family Professor of Energy and Petroleum Engineering

Subhashis Mallick, SER Professor of Geology and Geophysics

Bruce Parkinson, Emeritus SER Professor of Chemistry

Po Chen, SER Associate Professor of Geology and Geophysics

Dario Grana, SER Professor of Geology and Geophysics and Wyoming Excellence Chair

John Kaszuba, John and Jane Wold Centennial Chair in Energy, SER Professor of Geology and Geophysics

Tara Righetti, Occidental Chair of Energy and Environmental Policies and SER Professor of Law

ADJUNCT FACULTY MEMBERS

Saman Aryana, Occidental Chair of Energy and Environmental Technologies and Professor of Chemical and Biomedical Engineering

Erica Belmont, Associate Professor of Mechanical Engineering

Boone Beausoleil, Adjunct Professor, Nuclear Fuels Engineering, Idaho National Laboratory

Jonathan Brant, Professor of Civil and Architectural Engineering

Ben Cook, Senior Assistant Dean and Professor of Economics

Caleb Hill, J.E. Warren Chair, Nielson Faculty Fellow, Associate Professor of Chemistry

Shane Murphy, Associate Professor of Atmospheric Science

Jonathan Naughton, Professor of Mechanical Engineering

Soheil Saraji, Associate Professor of Energy and Petroleum Engineering

Michael Stoellinger, Associate Professor of Mechanical Engineering

Temple Stoellinger, Professor of Environment and Natural Resources and Wyoming Excellence Chair

Haibo Zhai, Roy & Caryl Cline Distinguished Chair in Engineering and Professor of Civil and Architectural Engineering

Kam Ng, Associate Professor of Civil and Architectural Engineering

Mary Lou Dunzik-Gougar, Associate Professor of Nuclear Engineering, Idaho State University

Michael Urynowicz, Professor of Civil and Architectural Engineering

SELECT FACULTY PUBLICATIONS

Liu, Mingliang & **Grana, Dario** & Mukerji, Tapan. (2024). Geostatistical Inversion for Subsurface Characterization Using Stein Variational Gradient Descent with Autoencoder Neural Network: An Application to Geologic Carbon Sequestration. *Journal of Geophysical Research: Solid Earth*. 10.22541/essoar.171104220.03785450/v1.

T. Righetti; M. Fermeglia; *Introduction - Decarbonizing Oil and Gas and Energy: Carbon Capture and Storage*, OIL, GAS & ENERGY LAW J. 3 (2023), www.ogel.org. URL: www.ogel.org/article.asp?key=4088

Chung-Ching Wang, En-Jui Lee, Wu-Yu Liao, **Po Chen**, Ruey-Juin Rau, Guan-Wei Lin, Chung-Ray Chu; Cluster Analysis of Slope Hazard Seismic Recordings Based Upon Unsupervised Deep Embedded Clustering. *Seismological Research Letters* 2023; 94 (4): 1877-1891. doi: <https://doi.org/10.1785/0220230011>

Tara Righetti *Justice for Extractive Territories, in The Power of Energy Justice & the Social Contract* (Raphael Heffron & Louis de Fontenelle, Eds.) Springer Nature (2023).

Tara Righetti, Stephen Easton, **Charles Nye**, *Kit and Reese Lanik v. Dauntless Oil & Gas, Inc., in Materials in Trial Advocacy: Problems & Cases* (Thomas A. Mauet, The Hon. Warren D. Wolfson & Stephen D. Easton, eds), Aspen Publishing (10th ed. 2023).

Maohong Fan, X. Chen, *Carbon dioxide capture using covalent organic frameworks*, US Patent App. 18/122,940, 2023.

David C. Rode, Jeffrey J. Anderson, **Haibo Zhai** and Paul S. Fischbeck, *Modifying the EPA's New Power Plant Rules to Eliminate Unnecessary Reliability Risks*, *Environmental Science & Technology*, 2023, Volume 57, Issue 30, Pages 10904-10906.



Hassnain Asgar, Sohaib Mohammed, Alexa Socianu, **John Kaszuba**, Pavel D. Shevchenko, Greeshma Gadikota, *Dissolution and reprecipitation of amorphous silica in silica Rich shales induces Non-Monotonic evolution of porosity in acidic reactive environments*, *Fuel*, Volume 337, 2023, 127144, ISSN 0016-2361, <https://doi.org/10.1016/j.fuel.2022.127144>.

Mallick, S. (2024). *Optimization Using Genetic Algorithms - Methodology with Examples from Seismic Waveform Inversion*, in *Genetic Algorithms - Theory, Design and Programming* (Edited by Yann-Henri Chemin). IntechOpen. doi: 10.5772/intechopen.113897.

Danchen Li, **Soheil Saraji**, **Zunsheng Jiao**, Ye Zhang, *An experimental study of CO2 injection strategies for enhanced oil recovery and geological sequestration in a fractured tight sandstone reservoir*, *Geoenvironmental Science and Engineering*, Volume 230, 2023, 212166, ISSN 2949-8910, <https://doi.org/10.1016/j.geoen.2023.212166>.

Hua Yu, **Kam Ng**, **Chooikim Lau**, *New coal char-based bricks: Effects of curing temperature, humidity, pressing pressure, and addition of superplasticizer on the physical, mechanical, and thermal properties*, *Case Studies in Construction Materials*, Volume 19, 2023, e02529, ISSN 2214-5095, <https://doi.org/10.1016/j.cscm.2023.e02529>.

RESEARCH SUMMARY

SER's research programs focus on maximizing energy production, minimizing environmental footprint, and leading technology innovation, always to benefit the state. Through its Centers of Excellence (COE), SER bridges the gap between academia and industry – and ensures deployment of technology and policy solutions.

Energy Equipment Funding

The School of Energy Resources and the College of Engineering and Physical Sciences (CEPS) joined forces to fund UW employees in need of energy-related laboratory equipment – including repairs – or supplies to conduct energy-related research.

Out of the 41 funding proposals received, eight proposals were funded by SER, and nine were funded by CEPS, with a total of \$4.5 million allocated for equipment purchases.



SER funds graduate students conducting energy-related research in multiple departments at UW. In FY24, SER funded 79 graduate assistants.

SER-FUNDED GRADUATE STUDENT ACCOLADES

Ellen Polites

Ellen Polites, a fifth-year Ph.D. student in the Department of Geology & Geophysics was the recipient of a U.S. Department of Energy Office of Science Graduate Research Program Award, and conducted her research at the Pacific Northwest National Laboratory.



Danish Kumar

Graduate Research Assistant Danish Kumar in the Department of Civil and Architectural Engineering and Construction Management was recognized with the UW Excellence in Global Engagement Award for his work on hydrogen and carbon capture, utilization, and storage (CCUS).



ChooiKim Lau

Engineering researcher ChooiKim Lau received the 2024 Outstanding Master's Thesis Award. Lau's thesis on the coal-derived bricks set the stage for the entire array of coal-derived building products under development at UW.



WHO WE ARE

Scott Quillinan,

Senior Director of Research

Tiffany Bishop, Project Specialist

David Lucke, Project Specialist

Martha Reisch, Project Specialist

CENTERS OF EXCELLENCE

Center for Economic Geology Research,

Directed by J. Fred McLaughlin

Center for Energy Regulation & Policy Analysis, Directed by Kara Fornstrom

Center for Carbon Capture and Conversion,

Directed by Trina Igelsrud Pfeiffer

Shell 3D Visualization Center, Managed by Kyle Summerfield

Hydrogen Energy Research Center,

Directed by Eugene Holubnyak

FACULTY-LED

CENTERS OF EXCELLENCE

Nuclear Energy Research Center, Directed by Tara Righetti and Caleb Hill

Center for Produced Water Management, Directed by Jonathan Brant

Center for Air Quality, Directed by Shane Murphy

Wind Energy Research Center, Directed by Jonathan Naughton and Michael Stoellinger

Center for Biogenic Natural Gas Research, Directed by Michael Urynowicz

PARTNER RESEARCH ORGANIZATIONS

Enhanced Oil Recovery Institute, Directed by Lon Whitman

RESEARCH GROUPS

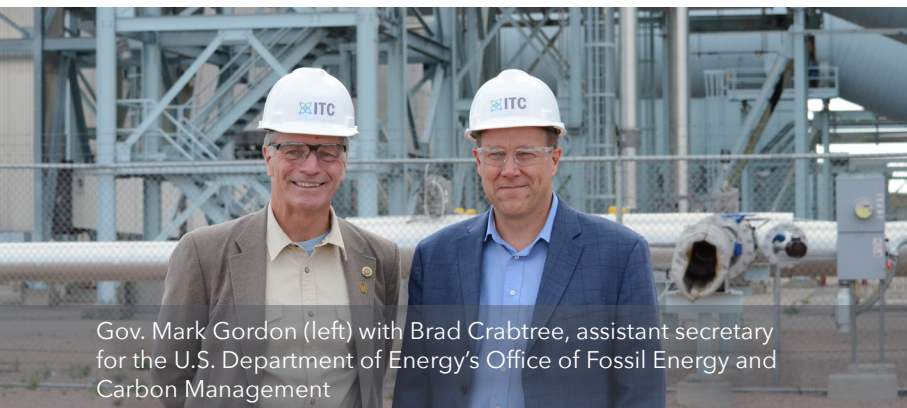
Jurisprudence of Underground Law and Energy, Directed by Tara Righetti

WYOMING INTEGRATED TEST CENTER

Wyoming Integrated Test Center Featured in Western Governor's Association Workshop

As chair of the Western Governors' Association (WGA), **Gov. Mark Gordon** hosted a special workshop at Gillette College and the Wyoming Integrated Test Center (ITC) to showcase efforts driving carbon capture, utilization and storage (CCUS) technology in Western states.

The workshop convened federal, state, local and industry stakeholders from around the West to discuss various aspects of CCUS, including federal programs, regulatory implications and technology implementation.



Gov. Mark Gordon (left) with Brad Crabtree, assistant secretary for the U.S. Department of Energy's Office of Fossil Energy and Carbon Management

Technology Showcase

The School of Energy Resources hosted CCUS technology and project developers – with potential carbon capture customers – at a Technology Showcase at the Wyoming Integrated Test Center.

The event provided Powder River Basin coal users, other private entities and representatives of the U.S. Department of Energy the opportunity to learn about different CCUS technologies being tested at the facility and meet with the companies developing them.



MTR Carbon Capture was one of many ITC tenants to showcase their capture technology at the event.

TENANT UPDATES AND PARTNERSHIPS

TDA Research Inc.

The U.S. Department of Energy's (DOE) Office of Clean Energy Demonstrations announced the selection of TDA Research Inc. to negotiate an award of up to \$49 million to test a carbon capture system at the ITC.

Membrane Technology and Research

Membrane Technology and Research (MTR) Carbon Capture was selected to receive \$4.6 million in funding from the DOE Office of Clean Energy Demonstrations to develop a Front-End Engineering Design (FEED) study for an integrated carbon capture and storage (CCS) at the ITC.

Colorado State University and University of Wyoming Algae Project

Wyoming's Integrated Test Center will host a new \$2.5 million project with Colorado State University, the University of Wyoming and Living Ink Technologies to convert an industrial source of carbon dioxide into high-value materials through an algae-based carbon transfer process.

MOU Signed with LETA

A memorandum of understanding (MOU) between the University of Wyoming School of Energy Resources and Low Emission Technology Australia (LETA) was signed to conduct collaborative research efforts in the advancement of energy technology.

The agreement will also leverage the technology testing capabilities of the ITC and the interest of LETA members to see carbon capture technology continue to advance.



FACULTY-LED CENTERS OF EXCELLENCE & RESEARCH GROUPS

NUCLEAR ENERGY RESEARCH CENTER (NERC)

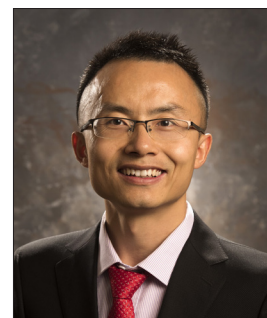
NERC is focused on interdisciplinary nuclear-energy capacity building across the UW community, and cultivating new resources in nuclear research.

Faculty Scholars Program

NERC selected faculty member **Xiang Zhang** to receive funding under the Faculty Scholars Program.

The program, supported by a grant from the Nuclear Regulatory Commission's (NRC) University Nuclear Leadership Program and funds from the Wyoming Legislature, focuses on developing new areas of nuclear-focused research and supporting junior faculty advancement.

Selected through a competitive proposal process, Zhang was recognized for his efforts in expanding nuclear-related research and his potential to make important contributions to Wyoming and to the development of a robust community of researchers and students working in nuclear energy on campus.



Nuclear Innovation Bootcamp

NERC Co-Director **Tara Righetti** and SER Researcher **Madeleine Lewis** traveled to Japan to participate in the 2023 Nuclear Innovation Bootcamp. The two-week intensive course brings together a select group of students and early-career professionals from all over the world to equip them with the tools and understanding needed to approach clean energy challenges.

Upon returning, NERC submitted a competitive proposal to the Nuclear Innovation Alliance to host the 2024 Nuclear Innovation Bootcamp. The proposal was accepted and the University of Wyoming was chosen as the 2024 host site.

JURISPRUDENCE OF UNDERGROUND LAW & ENERGY (JOULE)

JOULE is a research group designed to conduct innovative legal research that advances the understanding of the rules and relationships governing the use of the subsurface and development of energy and natural resources.

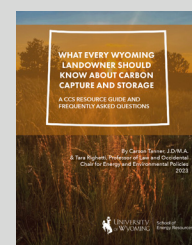
Federal Pore Space Valuation Workshops

JOULE hosted two workshops to investigate valuation for pore space in carbon capture, utilization and storage projects as part of a study entitled, "Understanding Pore Space Values: A Technical, Legal and Economic Analysis of Valuation Methodologies and Contractual Structures."

The first workshop was focused on information gathering and listening related to the section of the report on federal agency authority and processes for granting sequestration rights in pore space, while the second workshop investigated valuation methodologies.

Pore Space Landowner Guide

JOULE released a resource guide for Wyoming landowners addressing frequently asked questions regarding carbon capture and storage, and provides landowners guidance when exploring options to lease their pore space.



CENTER OF EXCELLENCE FOR AIR QUALITY (CAQ):

The CAQ is involved in research concerning emissions from oil and gas exploration and production activities, and methane monitoring and mapping technology.

SABER Project Update

The CAQ launched the Site-Aerial-Basin Emissions Reconciliation (SABER) project in collaboration with Colorado State University. The project will quantify methane emission in the Denver-Julesburg Basin of Colorado followed by the Upper Green River Basin in Wyoming. The project will reconcile emissions estimates from industry leak detection, ground teams, airborne teams, a tower network, and a model of bottom-up emissions.

ASIA-AQ Project

Graduate students in the CAQ gained flight time in a NASA DC-8 aircraft as part of the Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) campaign in order to measure the ethane and methane mixing ratio.

WIND ENERGY RESEARCH CENTER (WERC):

WERC is a collaboration with the College of Engineering and Physical Science dedicated to improving wind energy technology and its applications in Wyoming.

Industry Assistance

WERC helped Prairie Eagle Companies with a basic wind resource assessment for some of their reclaimed land on Wyoming coal mines for an initial feasibility study of wind energy projects.

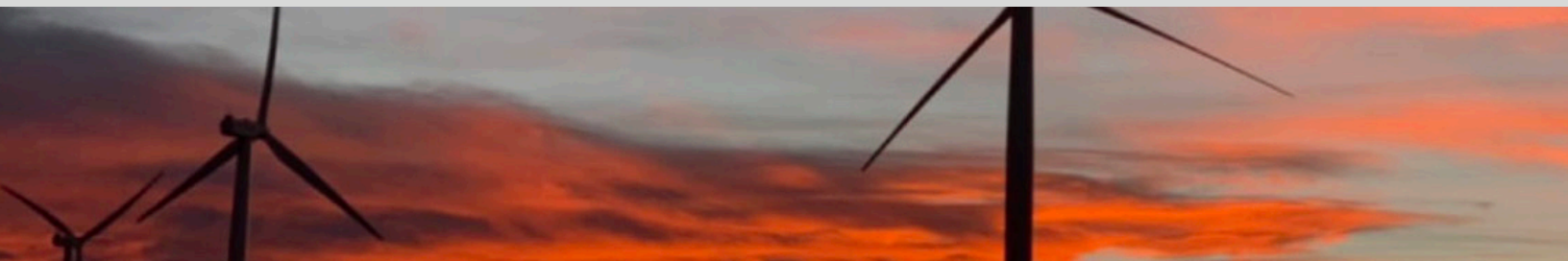
Collaborations and Partnerships

- WERC is working with SER's Hydrogen Energy Research Center to explore opportunities to utilize stranded wind resources in Wyoming for hydrogen production.
- WERC is working with the UW School of Computing to develop high fidelity simulations of wind turbines and wind plants.
- WERC Co-Director **Jonathan Naughton** provided wind mechanical expertise to the NASA-Langley research team on a study of space launch systems in a wind tunnel.



Selected WERC Publications

Lianxia Li, **Michael Stoellinger**, Maysam Mousaviraad, "Rigorous benchmarking of an iterative IBM solver by comparison to body-fitted mesh results," *Computers & Fluids*, Volume 277, 2024, 106281, ISSN 0045-7930, <https://doi.org/10.1016/j.compfluid.2024.106281>. (<https://www.sciencedirect.com/science/article/pii/S0045793024001130>)



CENTER OF EXCELLENCE FOR PRODUCED WATER MANAGEMENT (CEPWM):

CEPWM provides innovative science and engineering research for application in energy industries that are economical and sustainable.

Coal-derived Membranes for Water Treatment

The CEPWM deployed an integrated magnetic conditioning and membrane-based desalinization system at the City of Laramie's wastewater treatment plant to evaluate how conditioning can reduce the energy consumption of desalinization systems.

CEPWM staff also developed a processing technique for converting Wyoming coal into a high-quality conductive carbon being evaluated for creating proton and ion exchange membranes. This effort is under preliminary commercialization evaluation. Together with researchers from the UW Department of Chemistry, CEPWM researchers have also demonstrated the viability of recovering critical minerals from produced waters using smart membranes developed at UW.

Critical Mineral Recovery

During FY24, CEPWM secured an externally funded research grant with Comstock Fuels to develop processing techniques for enhancing hydrogen yields during electrolysis and to increase the conversion efficiencies of lignin feedstocks during biorefining processes.



Cowboy Clean Fuel's cutting-edge technology is the result of over 15 years of dedicated research at the University of Wyoming's Center for Biogenic Natural Gas Research.

CENTER FOR BIOGENIC NATURAL GAS RESEARCH (CBNGR):

CBNGR develops and commercializes technologies to enhance the production of renewable, clean-burning natural gas using indigenous microorganisms.

The University of Wyoming was issued a new patent developed at the CBNGR, "Methods for Microbial Gas Production and Use as Isotopic Tracer." The patent was added to the existing portfolio of patents under Cowboy Clean Fuels (CCF) exclusive UW technology license.

CCF is an early-stage clean energy and climate tech company established for the sole purpose of commercializing UW technologies developed by the CBNGR at SER. The company uses biomass feedstock to produce biogas and sequester carbon in depleted coalbed methane wells in the Powder River Basin. The company received a matching grant of \$7,792,653 from the Wyoming Energy Authority for its "Triangle Unit Carbon Capture and Storage Project."

CENTERS OF EXCELLENCE

CENTER FOR ECONOMIC GEOLOGY RESEARCH

The mission of the Center for Economic Geology Research (CEGR) is to investigate solutions to the challenges in Wyoming's fossil fuel and mineral industries. CEGR research projects explore opportunities to use Wyoming's distinctive geology and resources in order to develop those opportunities, diversify Wyoming's economy, and to maintain competitiveness.



NEW PROJECTS

Class VI Geologic Database

A collaborative project proposed by the University of Wyoming School of Energy Resources' Center for Economic Geology Research (CEGR), the Wyoming State Geological Survey (WSGS) and the Wyoming Department of Environmental Quality (DEQ) will create a data-verified Class VI geologic database providing a unique service to carbon storage developers and regulatory agencies for the state of Wyoming.

To be funded, in part, by the U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management, the award will advance DOE's regional initiative to accelerate carbon management deployment.

The proposed database will provide geotechnical information that has been compiled and verified from established, public geologic databases and entities. It also will include a record of key social considerations and community benefits that developers should consider when preparing Class VI well permit applications to DEQ.

Williams Echo Springs CarbonSAFE Phase II

The School of Energy Resources (SER) is lead a fourth major carbon capture and storage project under the Office of Fossil Energy and Carbon Management's Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative.

The planned \$11.2 million Williams Echo Springs CarbonSAFE project aims to conduct a storage complex feasibility study to develop a saline carbon dioxide (CO₂) storage hub for current and future industries in the Echo Springs area of south-central Wyoming.

To be conducted in collaboration with midstream natural gas company Williams, the two-year study plans to permit and drill a deep stratigraphic test well and interpret the resulting data, models and documents for further site development.

WHO WE ARE

J. Fred McLaughlin, Director

Zunsheng 'John' Jiao, Program Manager, Subsurface Storage and Modeling

Erin H.W. Phillips, Program Manager, Critical Materials

Tim Fischer, Program Manager, Oil & Gas

Davin Bagdonas, Research Scientist/Coal and Rare Earth Elements

Charles Nye, Senior Research Professional and Project Manager

Bob Gregory, Associate Research Scientist/Geochemistry

Matthew Johnson, Research Scientist/Geomodeling

Ying Yu, Research Scientist/Reservoir Engineering

Selena Gerace, Senior Research Scientist/Community Engagement and Policy

Madeleine Lewis, Assistant Research Scientist/Law and Policy

Grant Copeland, Assistant Research Scientist/Geochemistry

Lily Jackson, Assistant Research Scientist/Regional Geology

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Autumn Eakin, Associate Research Professional, Subsurface Geology

Pallavi Pokharel, Assistant Research Professional, Community Engagement

Madison Mankin, Assistant Research Professional, Workforce Development

Maryam Lakjaa, Assistant Research Professional, Petroleum Engineering and Finance

CARBON CAPTURE, STORAGE AND UTILIZATION

Wyoming CarbonSAFE Project: Phase III

The Wyoming CarbonSAFE project is CEGR's flagship carbon capture, utilization and storage (CCUS) project, working to advance a commercial-scale CO₂ storage complex.

The team submitted a draft Environmental Assessment (EA) for the proposed Wyoming CarbonSAFE Project which was opened for public comment in January of 2023. UW's proposed project would capture carbon dioxide CO₂ from Basin Electric's Dry Fork Station in Gillette, Wyoming, and transport it via pipeline to several EPA Class VI Underground Injection Control (UIC) permitted injection wells for permanent geologic storage.

FY24 Carbon Capture Project Updates

- ✓ The Sweetwater Storage Hub project underwent a lengthy contract negotiation period and will officially start in FY25 with a total project budget of \$54,128,127.
- ✓ The HERO Basalt CarbonSAFE project underwent a lengthy contract negotiation period and will officially start in FY25 with a total project budget of \$10,524,930.
- ✓ Utilizing the Peabody Innovation and Technology Fund, CEGR researchers conducted CCS feasibility studies and economic impact studies for retrofitting PRB coal-fired power plants for carbon capture technologies.

SELECT CEGR PUBLICATIONS

- Cao, Ruoshi & Miller, Quin & Davidson, Casie & Gallin, William & Reidel, Stephen & **Jiao, Zunsheng** & **McLaughlin, Fred** & Schaef, Todd. (2023). Gigaton Commercial-Scale Carbon Storage and Mineralization Potential in Stacked Columbia River Basalt Reservoirs. 10.21203/rs.3.rs-2679618/v1.
- Na Yuan, Shuoshi Wang, **Ying Yu**, Changlong Chen, Bor-Jier Shiau, Jeffrey H. Harwell (2023). Expanded Salinity Window of Middle-Phase Microemulsions and Reduced Surfactant Adsorption by Hydrotrope. Langmuir 2023, 39, 48, 17175-17189.
- **Yu, Ying**. An Initial Approach of Multiple Linear Regression in CO₂-water Relative Permeability Prediction for Carbon Storage Projects. Preprints 2024, 2024061849. <https://doi.org/10.20944/preprints202406.1849.v1>

NEW RESEARCH PROGRAM

Energy Engagement, Leadership, and Careers (ELC) Program

A new program dedicated to community engagement, leadership and workforce development for energy-producing and energy-adjacent districts in Wyoming has been launched by SER.

The Energy Engagement, Leadership and Careers (ELC) Program will work toward the development of a skilled energy workforce; engage industry stakeholders; empower communities by incorporating local knowledge into program development and research; advance social science capacity building; and inspire the next generation of leaders through innovative education.

The program will be fully established in FY25 with CEGR staff members holding dual appointments with Energy ELC.



RARE EARTH ELEMENTS AND CRITICAL MINERALS

CORE-CM (Carbon Ore, Rare Earth and Critical Minerals)

The DOE-awarded projects are part of a national strategy to finding alternative domestic sources of rare earth elements and critical minerals, as well as to focus on expanding and transforming the use of coal and coal-based resources to produce coal-based products using carbon ore.

The SER-led projects in the Greater Green River and Wind River Basin (GGRB-WRB) and the Powder River Basin (PRB) have continued to build expansive networks of stakeholders in order to assess the feasibility of a new rare earth and critical mineral industry in Wyoming. Annual forums were held in each basin as the projects wrapped up. Phase I will conclude for both projects in FY25.

CEGR ACCOLADES

Fulbright Award

Erin Phillips, a researcher in the University of Wyoming's School of Energy Resources, will receive a Fulbright Award to conduct research associated with energy challenges and sustainable resource management, specifically as they relate to critical materials.



Beginning in January 2025, Phillips will be based in Bergen, Norway, at NORCE – an independent research institution dedicated to addressing societal issues and to increasing sustainable value creation at the local, national and global levels. Over the course of five months, she will work with collaborators at the host institution to conduct a comparative study of the parallels between critical materials supply chains in Norway and Wyoming.

Research and Innovation Excellence Award

SER Program Manager **Zunsheng 'John' Jiao** was recognized in the inaugural Research and Innovation Excellence Awards by the UW Research and Economic Development Division for their outstanding contributions to UW's research services and infrastructure.

Jiao joined the research team at SER in 2011 and has led or been a major contributor to all major geologic projects, and his leadership on geological modeling is nationally recognized.

He led efforts for the US-China Clean Energy Research Center, the Rock Springs Uplift Project, and currently serves as the Principal Investigator for the Sweetwater Storage Hub.



OIL AND GAS

Mowry Shale Project

During FY24, SER significantly bolstered its oil and gas staff to provide leadership on the Mowry Shale project and to work with SER's partner organization, the Enhanced Oil Recovery Institute. Dr. **Tim Fischer** joined the research staff at CEGR to serve as Oil & Gas Program Manager and will oversee the UW-led projects that received seed funding from SER to explore the Mowry with an expanded scope of work including an economic analysis and machine-learning applications.

The Mowry Shale project is focused on unconventional recovery of oil and gas from the tight shale formation in the Powder River Basin.

CENTERS OF EXCELLENCE

CENTER FOR ENERGY REGULATION AND POLICY ANALYSIS

The primary function of the Center for Energy Regulation and Policy Analysis (CERPA) is to produce meaningful, high-quality, impartial analysis to inform policymakers, stakeholders, and the public about issues critical to the economic development of Wyoming's energy resources.



POLICY SUPPORT

During FY24, CERPA provided policy support both internally and externally to SER. During the legislative session, CERPA closely monitored and tracked energy-related bills by providing daily updates of activity and committee meeting schedules.

Outside SER, CERPA provided assistance to the Wyoming Governor's Office, the Wyoming Energy Authority, the Joint Minerals Committee, and the Enhanced Oil Recovery Institute by supplying research briefs on timely issues under discussion, as well as support in responding to proposed rules issued by the federal government.

SELECT PUBLICATIONS AND RESOURCES

CERPA published white papers and research briefs to inform lawmakers, the public, and industry in Wyoming on policy issues, regulatory challenges, or relevant topics of interest related to energy production and mineral development.

Social License for Wyoming's Energy Future: A Replication Study

This study explores the perspectives, values, needs, and concerns of Wyoming residents in relation to energy in Wyoming. It is a replication of a 2020 study published as "Social License for Wyoming's Energy Future: What Do Residents Want?". Both studies were motivated by a desire to understand what Wyoming residents want in relation to energy and why. This replication provides an update and comparison to the 2020 study and allows SER to analyze how Wyoming residents' perspectives about energy have evolved over time.

Hydrogen Development with CCS in Wyoming

This paper begins in Part I by providing an overview of existing and developing applications for hydrogen in a net-zero economy, a description of existing hydrogen production methods (aka the "Hydrogen Rainbow"), and the increasing demands and incentives for clean hydrogen deployment. Specifically, the paper analyzes funding provisions in the IJA and IRA that aim to accelerate development of the clean hydrogen industry. In Part II, the paper turns to an analysis of the geographic, economic, legal, and regulatory features that render Wyoming a particularly well-suited location for a blue hydrogen economy. As discussed in Part III, numerous projects to advance blue hydrogen development are already underway in Wyoming.

WHO WE ARE

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Madeleine Lewis, Esq.,
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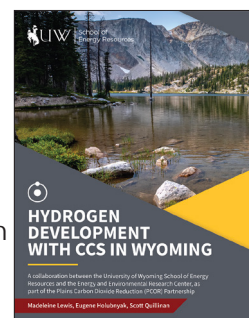
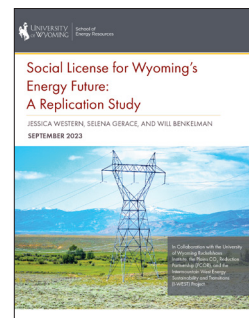
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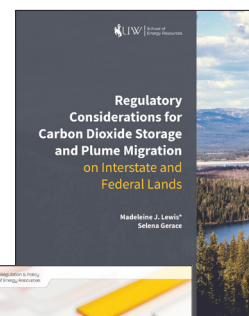
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Regulatory Considerations for Carbon Dioxide Storage and Plume Migration on Interstate and Federal Lands

Despite Wyoming's efforts to proactively establish a favorable regulatory and statutory framework for the development of its pore space, the challenge of widespread CCS deployment is ultimately a regional one, requiring coordination with Wyoming's neighboring states and numerous federal land agencies to mobilize the high volume of shared pore space resources that transcend state boundaries. This paper identifies and analyzes the scope of legal and regulatory concerns arising from the potential for interstate CO₂ storage by looking at the current regulation and permitting structures in neighboring states as well as the challenges posed on federal lands.



Headed West: The Challenges and Opportunities Facing Exports of Wyoming Natural Gas to Decarbonizing Western Markets

This paper provides an overview of natural gas production in Wyoming, explains the challenges facing exports of the State's natural gas posed by other states' energy policies, and describes how Wyoming is uniquely positioned to thrive given the low-carbon attributes of its natural gas resource.



Analyzing the EV Rule

In 2023, the Environmental Protection Agency (EPA) proposed new emissions standards so restrictive on tailpipe emissions that compliance will require around two-thirds of cars and nearly half of medium-duty trucks sold in the year 2032 to be Electric Vehicles (EVs). The EPA claims this EV rule would yield \$1.6 trillion in "net benefits" for Americans through 2055 by estimating costs over a series of categories including pre-tax fuel savings, vehicle technology costs, maintenance savings, climate benefits, charging stations and grid upgrades, repair savings, energy security benefits, air pollutant benefits, and increased refueling time. This study provides an analysis grounded in economic fundamentals of each category, and compares those results to the EPA's, and was published in the Winter 2023-2024 issue of Regulations by the Cato Institute.

Nuclear White Paper Series

CERPA is working on a series of six white papers exploring and evaluating the components of a domestic integrated nuclear industry. In FY24, the first two papers in this series were released. The first paper quantifies the opportunities and the economic outcomes of fostering a uranium enrichment industry in Wyoming, while the second paper explores the economic prospects for nuclear component manufacturing in Wyoming.



Community Benefits Plan (CBP) Toolbox

CERPA released a resource guide and webpage to help Wyoming stakeholders craft community benefit plans (CBPs) in Wyoming. The toolbox provides a summary of key resources and strategies to use as guidance for developing CBPs in relation to applications for federal funding from the U.S. Department of Energy.



Other CERPA Publications

- **M. Lewis**, "Defining Environmental Justice: What it Means to Energy Communities," Natural Resources & Environment Volume 38, Number 3, Winter 2024. © 2024 by the American Bar Association.

CENTERS OF EXCELLENCE

CENTER FOR CARBON CAPTURE AND CONVERSION

The mission of the Center for Carbon Capture and Conversion (CCCC) is to develop new high-volume uses for coal and to explore new opportunities in an evolving carbon market. CCCC delves into the potential marketable properties of higher-value coal products from Wyoming coal. The technologies and products developed in CCCC are focused on large-scale, commercial application.



THERMO-CHEMICAL PROCESS TECHNOLOGY

The CCCC has continued to advance its thermo-chemical process technology to efficiently decompose Powder River Basin coal which yields high-value liquids and solids that are then used to create environmentally friendly, non-energy products.

Both processes are at a critical juncture in which scale-up is necessary in order to produce enough feedstock material for downstream manufacturing research.

Fast Pyrolysis Processing

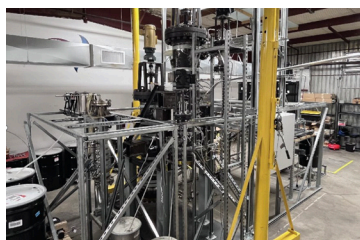
The pyrolysis field demonstration plant broke ground for construction at the Wyoming Innovation Center (WylC) in Gillette Wyoming. An electric rotary calciner was installed in April of 2024. This equipment will be used to dry Powder River Basin (PRB) coal for both the pyrolysis field demonstration plant and the Solvent Extraction field demonstration plant.



The main product from the pyrolysis plant is coal char which is used to manufacture high volume products such as building materials and soil amendment. The large volume of coal char from this plant will allow the downstream product research to advance more quickly.

Solvent Extraction of Coal

Construction of the solvent extraction pilot plant commenced in Laramie. The pilot plant will be operational in FY25.



The byproduct of the solvent extraction process yields a liquid feedstock, which is used to manufacture useful products such as coal-based asphalt binder with a lower carbon footprint.

WHO WE ARE

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Louis Muller
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Yi Yao,
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Ali Zanjamijan,
Assistant Research Professional, Polymers

UW FACULTY PRINCIPAL INVESTIGATORS

Kam Ng, Associate Professor of Civil and
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Jing Zhou, Professor of Chemistry

Michael Stoellinger, Associate Professor of
Mechanical Engineering

John Oakey, Professor of Chemical
Engineering

Jonathan Brant, Professor of Civil and
Architectural Engineering

RESEARCH AFFILIATES

Jeramie Adams, Western Research Institute

Paul Behrens, Senior Research Consultant

COAL-TO-PRODUCTS FIELD DEMONSTRATION SHOWCASES

Coal-Derived Building & Construction Products

The first-generation char-bricks were removed from the demonstration house and replaced by the second-generation char-bricks. The second-generation bricks were machine pressed instead of being made by hand. There will be another year of seasonal testing to collect performance data on these new bricks.

Other building materials such as block paver, stone veneer, and char-based structural grout are being evaluated for scale-up and economic viability.



Agricultural & Soil Fertility Products

Researchers in the CCCC began a fourth year of testing the coal char soil amendment at Powell Research Center and the Sustainable Agriculture Research and Extension Center (SAREC). Favorable data from previous harvests have generated three publications on coal char performance. The coal char soil amendment is also being used for three reclamation projects: two in Wyoming and one in New Mexico.

A formal collaboration with Western Sugar Cooperative was established to conduct full scale semi-commercial demonstrations of the coal char soil amendment products augmented with Wyoming-sourced nutrient products.

Coal-Based Asphalt Products

Led by scientists at Western Research Institute (WRI), a coal-derived asphalt binder formulation (COphalt) has been identified using the coal extract from the Solvent Extraction process. CCCC staff is working closely with WRI to develop the process that can be scaled-up to produce the extract needed for the asphalt product. COphalt is a green alternative which can be either blended with petroleum asphalt binder or substituted completely. The extract produced can be used for either paving or roofing applications.

Rare Earth Elements

CCCC assisted with research in Rare Earth Element (REE) extraction and separation for DOE CORE-CM projects (GRB-GWRB and PRB). Research using weak acids for REE extraction were explored on raw coal and coal waste streams. This research is ongoing with multiple extraction approaches being explored.

SELECT CCCC PUBLICATIONS

- **Zanjanijam, A. R.**, Wang, X., Ramezani, M., **S. Holberg**, & Johnson, P. A. "Phenolic resin/coal char composites: Curing kinetics and thermal/mechanical performance." *Polymer*, 281 (2023), 126103 <https://doi.org/10.1016/j.polymer.2023.126103>.
- Wang, X., **Zanjanijam, A. R.**, **Holberg, S.**, Thomas, H. C., & Johnson, P. A. "Coal char as an economical filler for phenolic composites." *Composites Part B*, 264, 110923. <https://doi.org/10.1016/j.compositesb.2023.110923>.
- **Thapa, Resham B.**, Roger H. Coupal, Mohan B. Dangi, and Peter D. Stahl. 2024. "An Assessment of Plant Growth and Soil Properties Using Coal Char and Biochar as a Soil Amendment" *Agronomy* 14, no. 2: 320. <https://doi.org/10.3390/agronomy14020320>
- **Thapa, Resham B.**, Sean X. Tang, and Peter D. Stah. "Initial greenhouse observations on use of coal char as a soil amendment: Influences on plant growth and soil water holding capacity." (2024).

CENTERS OF EXCELLENCE

HYDROGEN ENERGY RESEARCH CENTER

The mission of the Hydrogen Energy Research Center is to identify and quantify the relative competitive advantages of Wyoming in an emerging low-carbon hydrogen



economy. H₂ERC focuses on all forms of clean hydrogen with: low-cost coal via gasification, massive natural gas resources via methane reforming, and relatively high-capacity wind energy via electrolysis, as well as potential for solar, nuclear, and more.

NEW PROJECTS

Supercritical Water Desalination and Oxidation with Autothermal or Steam Methane Reforming

H₂ERC was selected to lead a collaborative project integrating a produced water thermal desalinization technology along with autothermal or steam methane reforming (ATR/SMR) for efficient hydrogen production.

Funded by the Department of Energy and partnered with Los Alamos National Laboratory; Engineering, Procurement and Construction LLC (EPC); and Williams, one of the nation's largest energy infrastructure companies, the project aims to demonstrate hydrogen production using water produced during oil and gas extraction.

Geologic Hydrogen

H₂ERC will be working on a University of Texas at Austin-led project to explore geologic hydrogen. The proposed \$1.7 million project was selected for funding from the Department of Energy Advanced Research Projects Agency Energy (ARPA-E) and will aim to stimulate hydrogen production from iron-rich rocks using natural catalysts. In collaboration with H₂ERC, the team will explore the feasibility of this process on different rock types across the United States, including basalts from the Midcontinent Rift in Iowa, banded iron formations in Wyoming and ultramafic rocks in the Midwest.

Orange Hydrogen

Hydrogen produced by injecting carbon-enriched water into iron-rich rock formations, where a chemical reaction occurs, generating hydrogen while simultaneously capturing carbon dioxide.



WHO WE ARE

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Charles Nye, Senior Research Professional
and Project Manager

Dayana Jones,
Assistant Research Professional, Energy
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Will Lawler,
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Sarah Buckhold,
Assistant Research Professional, Mechanical
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Robert Cincotta,
Assistant Research Professional, Chemical
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DOCTORAL STUDENTS

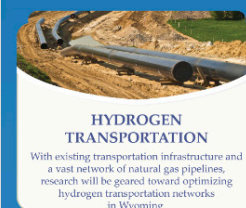
Sheida Sheikheh,
Ph.D. Candidate, Energy and Petroleum
Engineering

WHAT WE DO



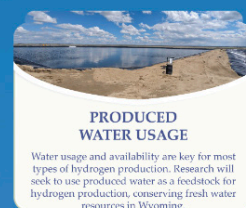
Lead applied research and collaborate with Wyoming stakeholders to support growth of a hydrogen industry focused on serving the state's existing energy customers and growing new markets.

RESEARCH AREAS



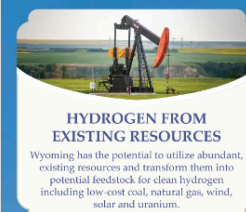
HYDROGEN TRANSPORTATION

With existing transportation infrastructure and a vast network of natural gas pipelines, research will be geared toward optimizing hydrogen transportation networks in Wyoming.



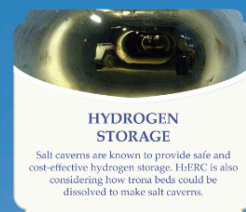
PRODUCED WATER USAGE

Water usage and availability are key for most types of hydrogen production. Research will seek to use produced water as a feedstock for hydrogen production, conserving fresh water resources in Wyoming.



HYDROGEN FROM EXISTING RESOURCES

Wyoming has the potential to utilize abundant, existing resources and transform them into potential feedstock for clean hydrogen including low-cost coal, natural gas, wind, solar and uranium.



HYDROGEN STORAGE

Salt caverns are known to provide safe and cost-effective hydrogen storage. H₂ERC is also considering how trona beds could be dissolved to make salt caverns.

Wyoming Innovation Partnership Phase II

The Wyoming Innovation Partnership (WIP) selected the University of Wyoming to receive \$693,514 in support of creating a new hydrogen economy.

The project, "Advancing Blue Hydrogen Production and Transport Infrastructure in Wyoming," examines the technical, economic, environmental, social and policy issues related to nuclear-powered hydrogen produced from conventional and renewable gas resources in Wyoming.



Stranded Wind for Hydrogen Production

H₂ERC is working in collaboration with the Wind Energy Research Center to investigate the feasibility of using Wyoming's stranded wind, or wind resources not located close enough to electric transmission to be connected economically, for off-grid hydrogen production.

CAPACITY BUILDING AT THE UNIVERSITY OF WYOMING

Phase II - Hydrogen Production and Transportation Research for Wyoming

Three University of Wyoming research proposals were selected to receive seed funding through the H₂ERC's Hydrogen Production and Transportation for Wyoming initiative.

The funding was part of Phase II of a funding initiative to promote and facilitate hydrogen research among current UW faculty members and researchers that will be applicable in Wyoming. Phase II proposals were requested to focus on three areas of interest: hydrogen transportation, electrolysis hydrogen production systems or hydrogen production from Wyoming's coal resources.

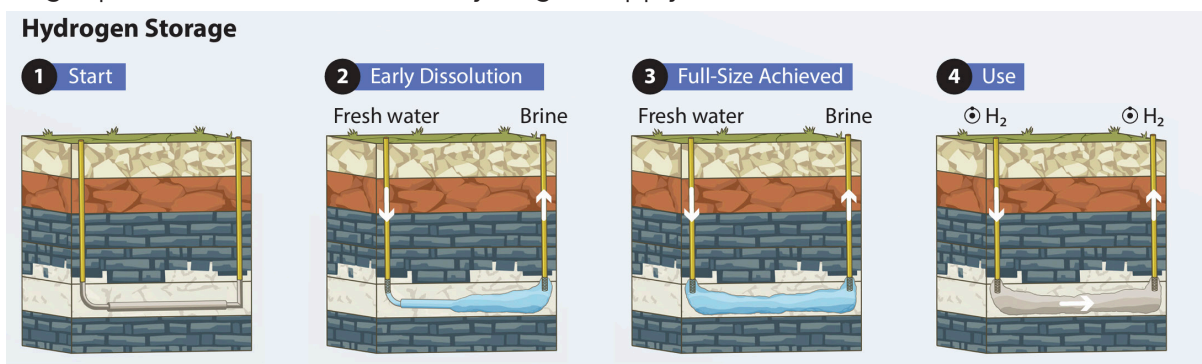
PUBLICATIONS

Geologic Hydrogen Storage

A collaborative study on hydrogen storage from researchers in the University of Wyoming's College of Engineering and Physical Sciences and the School of Energy Resources (SER) yielded a publication in the *International Journal of Hydrogen Energy*.

The study investigated the effect of hydrogen treatment on the mechanical properties of sandstone samples from the Hulett member of the Sundance Formation, a potential underground hydrogen storage host in Wyoming.

Funding for the study was made possible by SER's Hydrogen Energy Research Center (H₂ERC) and is the direct result of the "Hydrogen: Make, Move, Use or Store" initiative that supported UW faculty-led projects investigating topics across all levels of the hydrogen supply chain.



- Ehsan Dabbaghi, **Kam Ng, Tyler C. Brown, Ying Yu**. "Experimental study on the effect of hydrogen on the mechanical properties of Hulett sandstone." *International Journal of Hydrogen Energy*, Volume 60, 2024, Pages 468-478, ISSN 0360-3199, <https://doi.org/10.1016/j.ijhydene.2024.02.210>.

CENTERS OF EXCELLENCE

SHELL 3D VISUALIZATION CENTER

The mission of the Shell 3D Visualization (3D Viz) Center is to foster new knowledge and insight, support interdisciplinary research, and drive integration between research computing, data science, visualization, human interaction, and data-capture technologies by leveraging state and national opportunities.



SELECT PROJECTS IN PROGRESS

Unmanned Aircraft Systems Program

The 3D Viz Center acquired a small drone geared toward video and photography captures. The drone has been used to capture imagery to enhance active projects in the center.

Navajo Transitional Energy Company Application

The 3D Viz Center is working with the Navajo Transitional Energy Company (NTEC) to produce a public outreach application for desktop, mobile, and web platforms. The team travelled to New Mexico during FY24 to capture data on location for the client.

Wyoming Innovation Partnership

The University of Wyoming hosted an immersive reality training conference as part of the Wyoming Innovation Partnership (WIP).

The three-day event brought together educators from Wyoming community colleges and secondary education institutions, as well as workforce service professionals from across the State to learn about integrating virtual reality (VR) and augmented reality (AR) resources.

Led by **Kyle Summerfield**, program manager for the 3D Visualization Center, the VR subcomponent of the WIP consortial infrastructure program works to expand the capacity of Wyoming's higher education institutions to integrate VR technology into courses and programs; develop and create VR applications; and coordinate the deployment of these resources to maximize return on investment.



WHO WE ARE

Kyle Summerfield,
Program Manager and Lead Developer

James Amato,
Assistant Research Professional, GIS and Remote Sensing

Cole James,
Assistant Research Professional, Asset Developer

Kyle Carncross,
Assistant Research Professional, Software Developer

Phil Black,
Assistant Research Professional, VR Development

CONTRACTORS

Jerry Evans, Mechdyne



Gov. Mark Gordon delivers keynote remarks at the Wyoming Innovation Partnership Immersive Reality Training Conference as UW's Kyle Summerfield, event organizer, looks on.

SER RESEARCH UNIT SUPPORT

Wyoming CarbonSAFE Project

The 3D Viz Center launched its 360-degree outreach and communication application to help the public understand the mechanics of underground carbon storage as part of the Wyoming CarbonSAFE project in the Powder River Basin.

The interactive visualization tool allows users to see and experience the sheer scale and depth of the project, as well as understand the different geological formations that serve as storage zones and caprock seals.



Char Brick Digital Twin

In collaboration with the Center for Carbon Capture and Conversion, the 3D Viz Center began work to create a digital twin of the coal-derived brick demonstration house. The 3D Viz Center is utilizing sensor data covering a one-year period to compare the state of both structures at any point in the dataset. Using the drone for image capture of the site, renderings were produced using different techniques.



Technology Associate Program

The Technology Associate Program (TAP) in the 3D Viz Center is an internship program designed to train interns in virtual reality, animation, and augmentation software and techniques.

**Student Interns Trained in the
TAP Program in FY24**

5

Public Tours

The 3D Viz Center regularly provides educational tours to elementary school groups, Energy Innovation Center guests, campus partners and collaborators, and the public to showcase the technological capabilities that can be utilized to enhance classroom learning and energy outreach.

OUTREACH AND ENGAGEMENT

Outreach supports research and stand-alone efforts to engage with local, regional, national, and international stakeholders and community members on efforts within the School of Energy Resources to advance energy-driven economic development for the state of Wyoming.



EXTERNAL VISIBILITY

School of Energy Resources Executive Director Holly Krutka was interviewed by national news correspondent Bill Whitaker on "60 Minutes" as part of an episode exploring Wyoming's energy strategy and innovation in the state.

The segment on the long-running Sunday night CBS News program focused on Gov. Mark Gordon and his pledge to make Wyoming net negative for carbon emissions. He discusses support for every type of energy development while addressing climate concerns through innovation.



LIVE EVENTS AND CONFERENCES

Rocky Mountain Professional Landman Conference

The School of Energy Resources hosted the third annual Rocky Mountain Professional Landman Conference. Spearheaded by the Student Chapter for Energy Resources Club, the in-person forum seeks to bring together industry professionals and professional landman alumni in the Rocky Mountain region to showcase the profession, discuss current topics and issues facing the industry and explore career paths and opportunities for future graduates.

Landscape Discussion of Energy Law & Policy in the Rockies

The UW School of Energy Resources, Haub School of Environment and Natural Resources and the College of Law's Center for Law and Energy Resources in the Rockies (CLERR) hosted the 10th annual Landscape Discussion on Energy Law and Policy in the Rockies. The conference focuses on energy-related legal, regulatory and policy issues of current interest in Wyoming and the Rocky Mountain region.

Distinguished Speaker Series

SER Outreach brings energy leaders to campus to share cutting edge research, the latest industry trends, and expertise on new energy technologies. FY24 featured 9 different speakers on varying energy topics.

WHO WE ARE

Christine Reed

Director of Outreach and Energy Resources Council Secretary

Sabrina Kaufman

Marketing Outreach Coordinator and Graphic Designer

Landman

Total Number of In-Person Registrants

136

Law & Policy

Total Number of In-Person Registrants

159

Total Number of Virtual Registrants

54

DISTINGUISHED GUESTS

Harold Hamm

The School of Energy Resources, in partnership with the College of Engineering and Physical Sciences and the College of Business, hosted a fireside chat and book signing event with Oklahoma oilman Harold Hamm.

EPA Administrator Michael Regan

Michael Regan, administrator of the U.S. Environmental Protection Agency (EPA), wrapped up a two-day tour of Wyoming – at the invitation of Gov. Mark Gordon – with a visit to the University of Wyoming School of Energy Resources.

The visit, which took place Aug. 8-9, 2023, showcased the robust energy sector in the state, as well as the commitment to advanced technologies and the work occurring at SER and across UW to support the State's energy sector while balancing environmental protection.

Alex Epstein

The School of Energy Resources and the College of Engineering and Physical Sciences hosted New York Times bestselling author Alex Epstein for a public presentation and book signing.



NEW INITIATIVES

Energy Frontier: The Wyoming Landscape Podcast

The School of Energy Resources launched a new podcast series, titled "Energy Frontier: The Wyoming Landscape," which brings together academic researchers, industry professionals, students, policymakers and more to explore energy topics, including SER's research efforts and developing Wyoming projects.

Energy Roadshow

The School of Energy Resources launched an "Energy Roadshow" public outreach series intended to provide a platform for community members across the state to learn about different research and energy projects led by SER, specific projects going on in the area, and general information about the energy industry in Wyoming.

CONTINUING ENGAGEMENT ACTIVITIES

- Internal Newsletter and External Quarterly Newsletter
- Electronic News Blog and Collaborative Press Releases

News Stories
and Press
Releases on
SER in FY24

98

WEBSITE AND SOCIAL MEDIA MANAGEMENT

- In FY24, the SER website was migrated to a new platform
- Social media followers and engagement increased

FINANCIAL STATEMENT

The financial team at SER manages the standard appropriation from the Wyoming legislature, and administers the multi-million dollar research program funded by the state, the private sector and federal cooperative agreements (aka grants).



PERSONNEL SUPPORTED BY SER FUNDING

295 People

Faculty and Staff.....117

Student Support.....178

Graduate Assistants (79)
Hourly, Non-Benefitted (99)

WHO WE ARE

Rachel Ferrell,
Director of Business Operations

Carrie Ver Burg,
Assistant Director, Business Operations

Cindy Ishkanian,
Grants Manager

Frankie Vogt,
Business Manager

Kimmie Takaki,
Business Manager

Norbert Longsworth,
Accountant



STANDARD BUDGET ALLOCATION

Fiscal Year July 1, 2023 - June 30, 2024

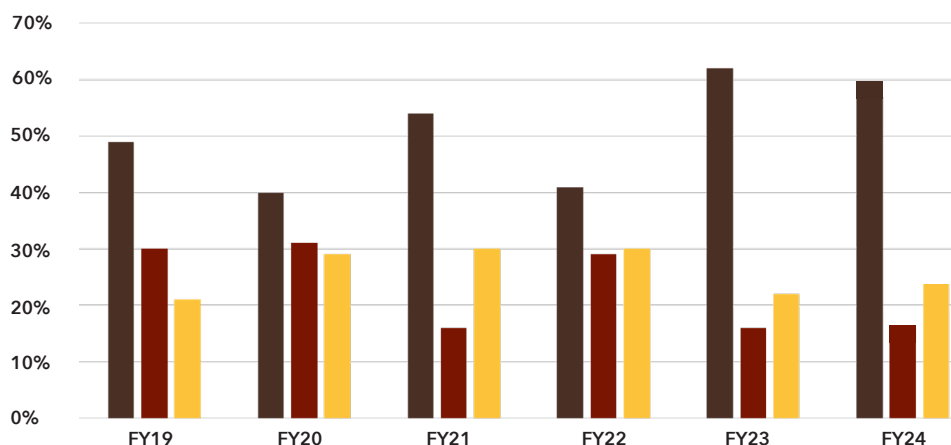
\$9,553,904

Standard Budget Allocation Areas of Distribution



At a Glance

**School of Energy
Resources Standard
Budget Allocations
FY19 - FY24**

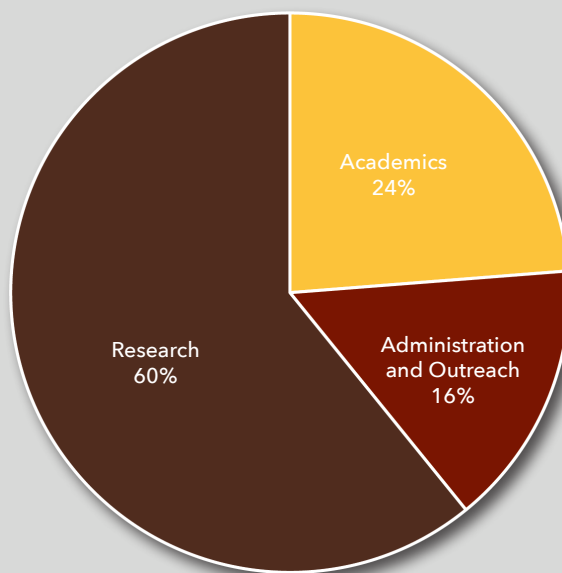


FINANCIAL STATEMENT

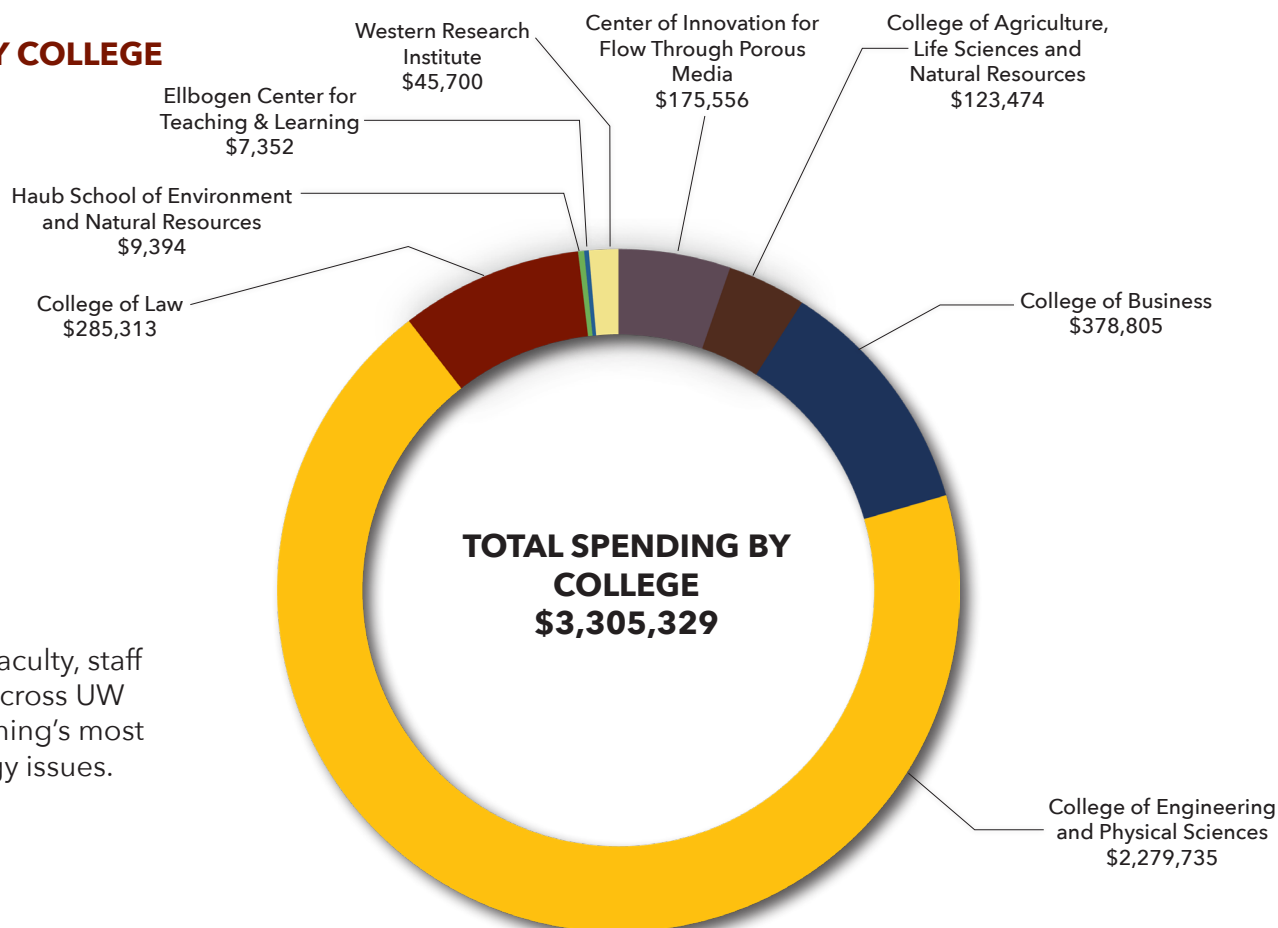
STANDARD BUDGET EXPENSES



TOTAL EXPENDITURES:
\$9,553,904



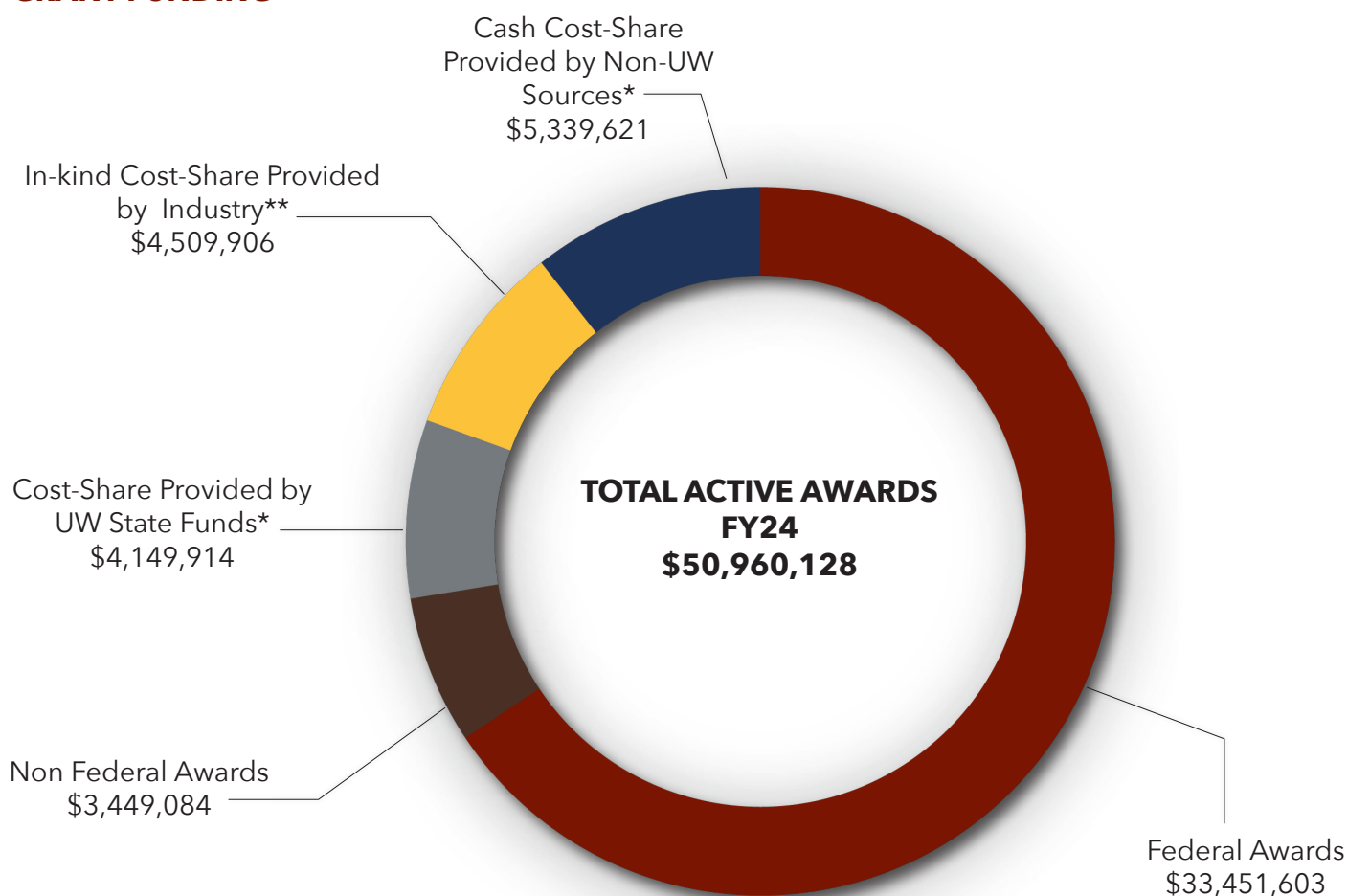
SPENDING BY COLLEGE



SER supports faculty, staff and students across UW to tackle Wyoming's most pressing energy issues.

FINANCIAL STATEMENT

GRANT FUNDING



\$50,960,128

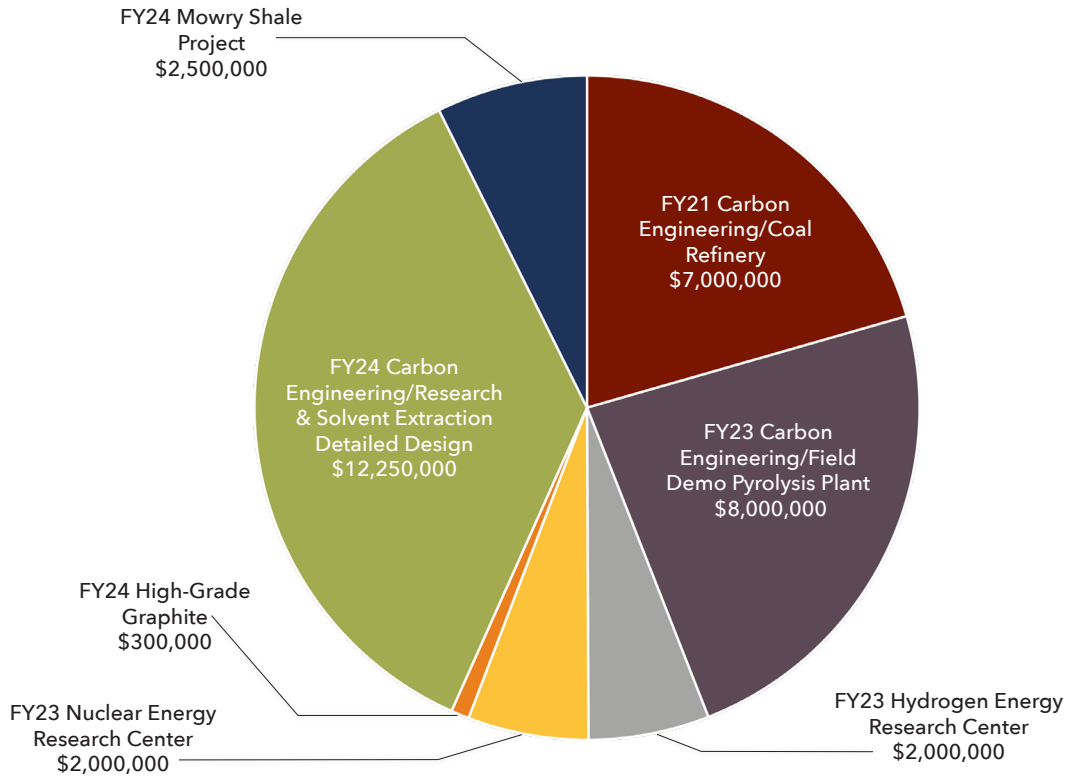
Awards Funded.....	48
UW Departments Funded.....	9
Principal Investigators Supported.....	24
Internal SER P.I.s	13
External UW Dept. P.I.s	11

*Cost-Share - the resource contributions to a sponsored project beyond the amount funded by the sponsor. Could be from SER, industry partner, legislative support or from a state agency.

**In-kind Cost Share - does not involve an exchange of money, rather, outside entities provide services at no-cost to UW.

EXCEPTION FUNDING

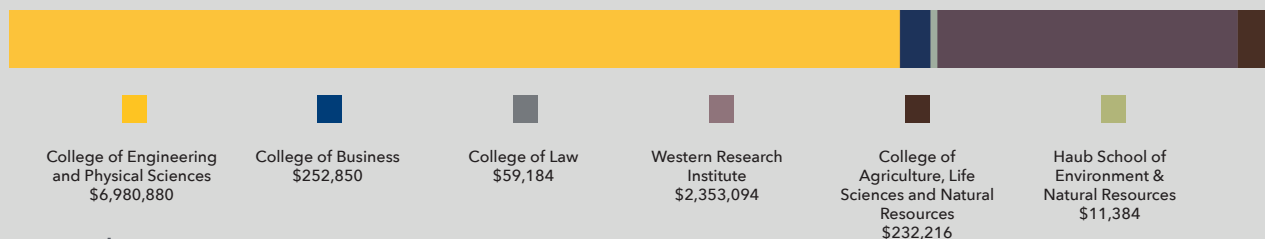
EXCEPTION FUNDING TOTALS



FUNDING ALLOCATION AND TOTAL SPENDING THROUGH FY24

	SPENDING	EXCEPTION FUNDING TOTALS
FY21 Carbon Engineering/Coal Refinery	\$ 6,900,728	\$ 7,000,000
FY23 Carbon Engineering/Field Demo Pyrolysis Plant	\$ 2,328,898	\$ 8,000,000
FY23 Hydrogen Center of Excellence	\$ 1,365,655	\$ 2,000,000
FY23 Nuclear Energy Collaboration	\$ 961,631	\$ 2,000,000
FY24 High-Grade Graphite	\$ 124,989	\$ 300,000
FY24 Carbon Engr/Research & Solvent Extraction Detailed Design	\$ 3,299,520	\$ 12,250,000
FY24 Mowry Shale Project \$2.5M	\$ 629,645	\$ 2,500,000
Total	\$ 15,611,067	\$ 34,050,000

EXCEPTION FUNDING SPENDING BY COLLEGE



FOUNDATION ACCOUNTS

Fiscal Year July 1, 2023 - June 30, 2024

Arch Resources Technology and Sustainability
FundChristine A. Barry Nuclear Energy Student
Enrichment FundConocoPhillips CO₂ Storage Excellence FundDirectors Discretionary Funds for the School of
Energy Resources

Energy Vault SER Student Competition

ExxonMobil K-12 Energy Education & Workforce
Development InitiativeJonah Energy LLC Fund for the Center of
Excellence in Air Quality

Hydrogen Energy Research Center

Integrated Testing Center Investment Fund (ITC
Fund)Kenneth G. Burnes CO₂ Storage Excellence Fund

Martin Knauss Energy Student Enrichment Fund

Charles Koch Foundation UW Energy Policy Fund

Marathon Interdisciplinary Fossil Fuel Research
LabNextEra Energy Resources Excellence Fund in
Professional Land ManagementJames E. Nielson Excellence Fund for the School
of Energy ResourcesNon-Endowed Chair in Subsurface Energy and
Digital InnovationOccidental Chair in Energy and Environmental
TechnologiesOccidental Chair of Energy and Environmental
PoliciesPeabody Education, Innovation and Technology
Fund

PureWest Energy Natural Gas Research Fund

Rita Meyer Nuclear Energy Excellence Fund

School of Energy Resources Building Fund

School of Energy Resources Support Fund
Students and Faculty

SER - Professional Land Management Program

SER - Reservoir Characterization Collaboratory

Tallgrass CO₂ Storage Excellence Fund

J.E. Warren Chair for Energy & Environment

Williams CO₂ Storage Excellence Fund

John & Jane Wold Chair Energy

York Future of Energy Exception Scholarship

\$20,674,688 – Total Market Value*(as of June 30, 2024)***\$785,194 – Estimated Payout for FY24***(as of June 30, 2024)*

SELECT MAJOR GIFTS

Tallgrass CO₂ Storage Excellence Fund

A \$250,000 charitable gift from Tallgrass, doubled by state of Wyoming matching funds created a CO₂ Storage Excellence Fund.

The excellence fund will provide the essential support to advance existing efforts in carbon capture, utilization and storage from research and demonstration to commercialization, thus benefiting the future Wyoming economy.

The student study lounge in the first floor of the Energy Innovation Center is named to reflect Tallgrass' gift.



Williams CO₂ Storage Excellence Fund

A \$250,000 gift from energy infrastructure leader Williams, matched with funds from the State of Wyoming, will advance carbon capture, utilization and storage.

The gift supports the newly created CO₂ Storage Excellence Fund, which will provide increased flexibility in addressing key challenges for the near, medium and long term. Most immediately, the excellence fund will provide support needed for current projects to transition from research and demonstration to commercialization.

NextEra Energy Resources Excellence Fund in Professional Land Management

A major gift from NextEra Energy Resources, LLC will support the growing Professional Land Management program in the School of Energy Resources.

The gift of \$30,000 over three years established the Excellence Fund in Professional Land Management which will be used to expand the recruiting efforts and maximize student retention.

DONOR SPOTLIGHT

Nuclear Energy Education and Student Engagement

Two major gifts to the will kick-start private support for nuclear energy education and student engagement.

Both funds are intended to encourage UW students to grow their expertise in nuclear energy through programs SER is developing with other units, especially the College of Engineering and Physical Sciences.

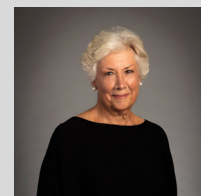
The Christine A. Barry Nuclear Energy Student Enrichment Fund

The Christine A. Barry Nuclear Energy Student Enrichment Fund was recently established as an endowment to support students in the long-term with opportunities such as covering travel costs, conference attendance, special camps, summer programs, field tours, and other experiential learning opportunities.



The Rita Meyer Nuclear Energy Excellence Fund

The Rita Meyer Nuclear Energy Excellence Fund was established as an expendable fund to provide students with immediate resources in support of educational opportunities both inside and outside the classroom.



The School of Energy Resources has accounts housed in the UW Foundation for the support of energy development, faculty research, and student success. Anyone wishing to make a financial contribution to SER may do so to any of the accounts listed on the previous page, or contact a UW Foundation representative about making a major gift and establishing a new account.

OUR GENEROUS DONORS

Arch Resources
Gene A. and Susan Aydinian
Stephane D. Baker-Bowen
Robert C. Balsam, III
Christi and Kurtis J. Barry
Kenneth Burnes
BWX Technologies, Inc. (BWXT)-
Corporate Headquarters
Kevin Carman and Susan Welsh
Duke and Heidi W. Cooley
Dan Crumb
Kami J. and Saeed Danaei
Jake Dippel
Fred Eden
Enbridge, Inc.-Houston, Texas
ExxonMobil Foundation, Inc.
Maohong Fan
Preston T. Farnsworth
Fidelity Charitable Gift Fund
Ryan J Fogg
Kara B. and Justin R. Fornstrom
Theodora A. and Kit S. Freedman
Thomas A. and Susan L. Galles
Jacob T. and Brenda K. Haseman
Caleb M. Hill and Kristin R. Di Bona
Eugene Holubnyak
Morgan M. Horbatko
Cynthia S. Ishkanian
JCI Consulting, LLC
John P. Ellbogen Foundation
Martin E. and Gail D. Knauss
John L. and Nancy Marie Koprowski
Kristopher C. Koski
Holly Krutka and Mark Alan Watkins
Richard D. Lynch, Jr and Marilyn Lynch
Rita C. Meyer and Stephen J. Miller
Louis C. Muller
Boyd E. Nelson
NextEra Energy, Inc.-Corporate
Headquarters
Maxwell A. Northam
Peabody Energy Corporate
Headquarters
Kristen and Christian Pritchett
PureWest Energy, LLC
Scott A. and Kirsten M. Quillinan

Rare Element Resources, Inc.
Christine M. and Christopher
Reed
Tara K. Righetti
Rocky Mountain Power
Foundation
Kristi and Craig R. Russow
Pamela J. Sajec
Jacob B. Schneider
Katie Schwieger
Shell Oil Company Foundation-United
States
Derek A. Smith
Douglas R. and Vanessa Smith
Lindsey Stinson
Gene R. and Gail Strid
Tallgrass Energy-Littleton
Dave and Melanie A. True

Trevor S. Turmelle
Emma F. Vannoy and Adam Bohling
Carrie A. Ver Burg
Angela C. and Thomas E. Ver Ploeg
Francis R. and Abby Vogt
Waypoints Wyoming
Christopher Welch
Western Skies Strategies
Tanya D. and Heath Wheeler
Jon D. and Sara Wilcox
Williams Companies
Foundation
Wold Foundation
Wyoming Association of Professional
Landmen
Aeri E. and Skip York
Haibo Zhai

MAKE A GIFT

CONTACT THE UW FOUNDATION



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School of
Energy Resources