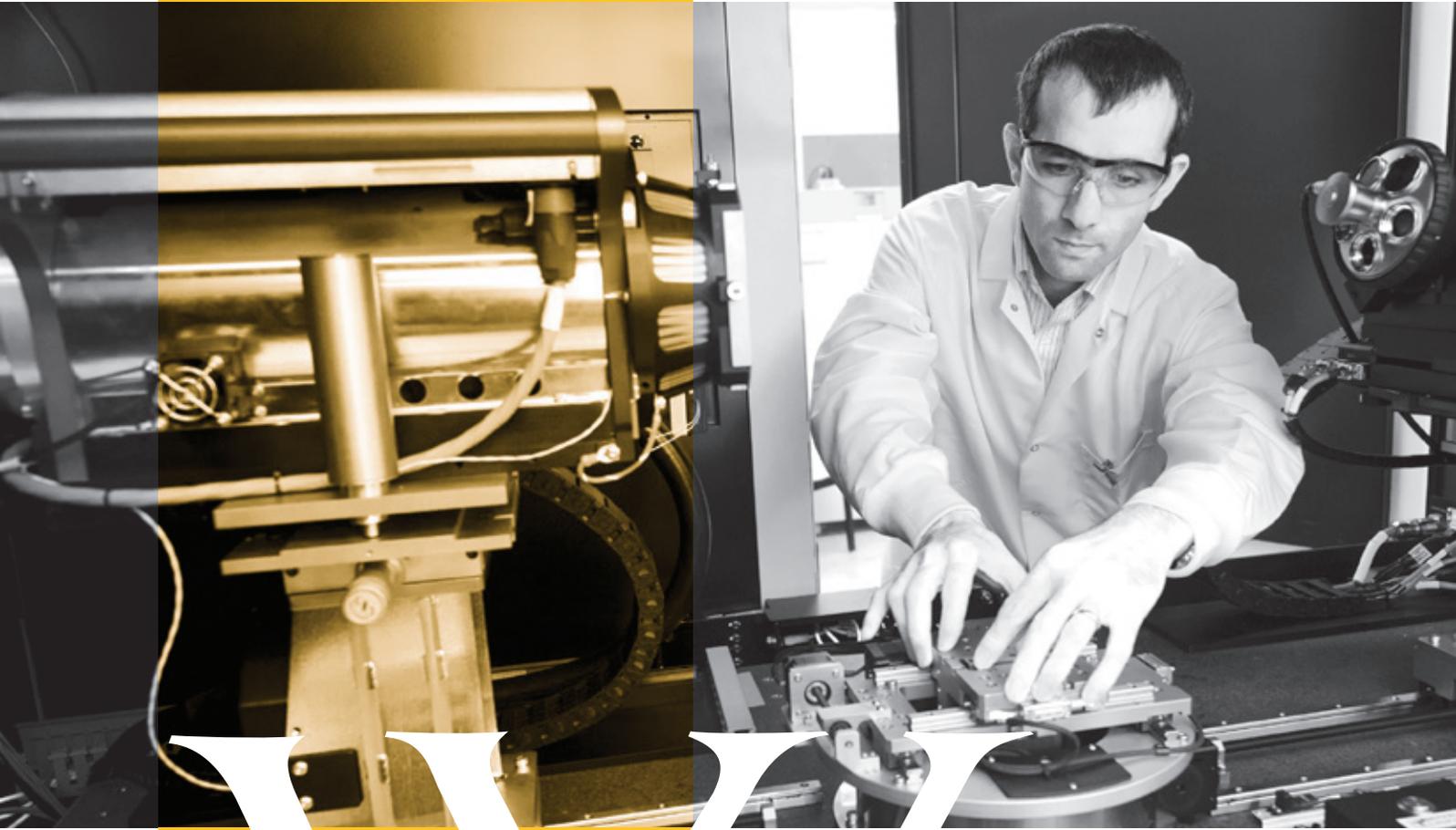
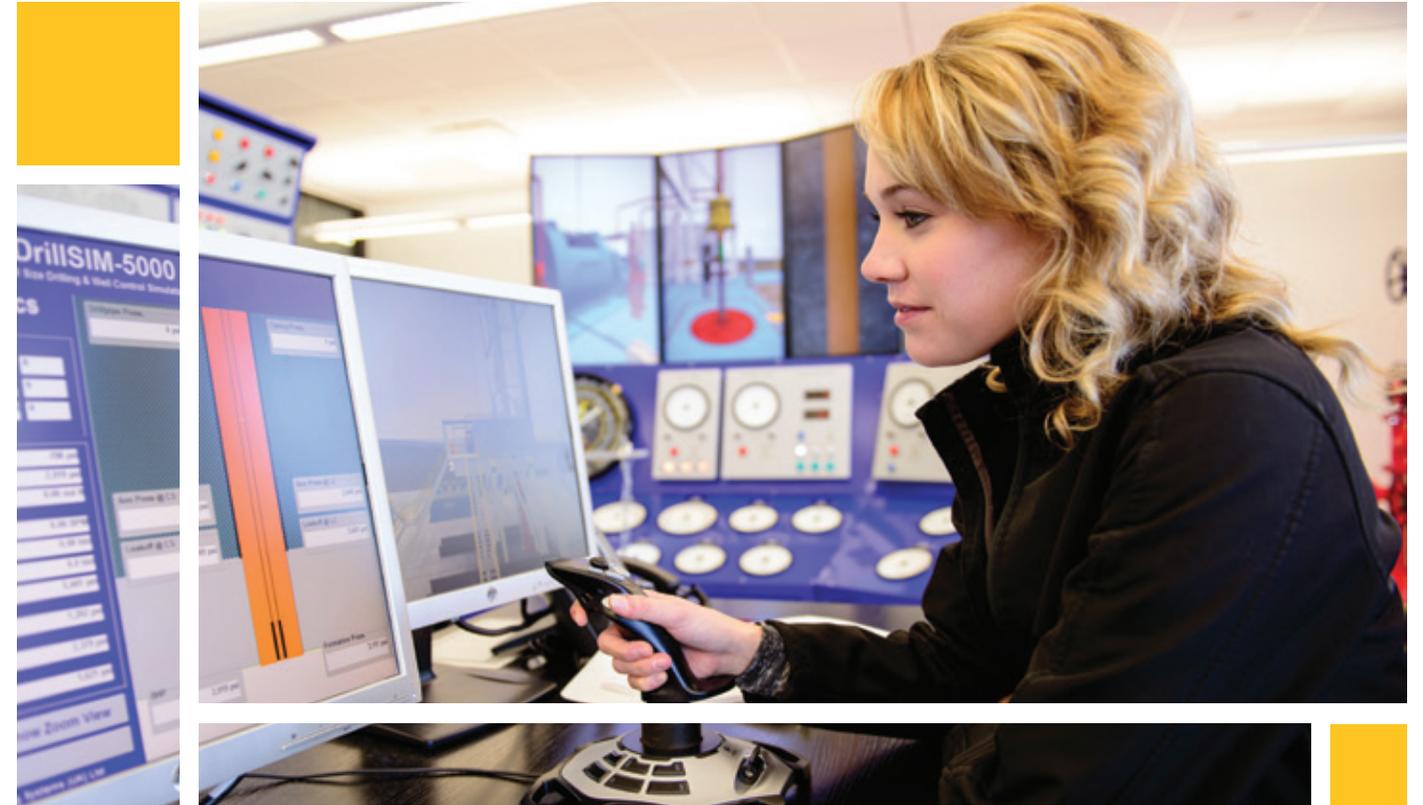
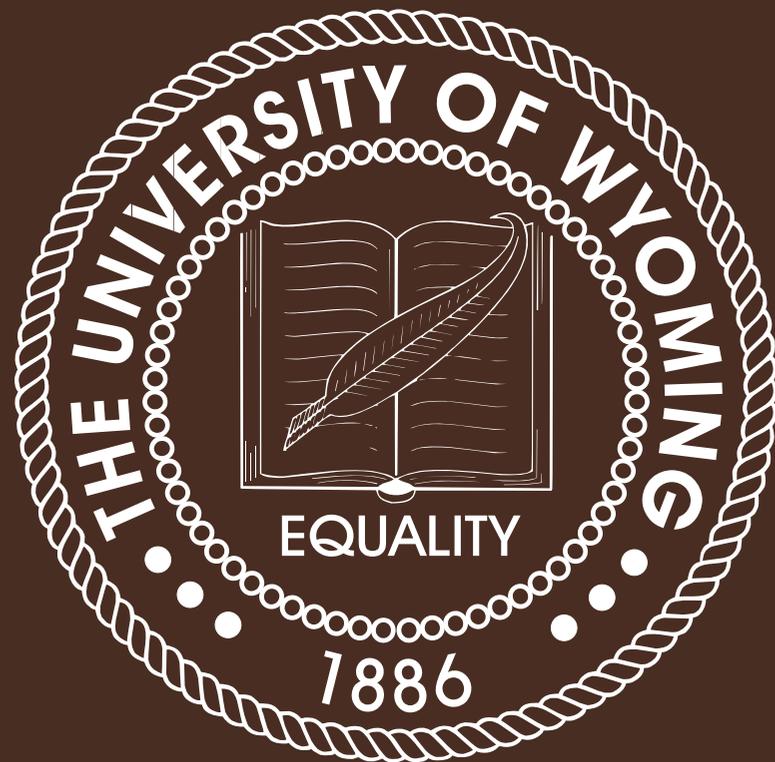


TIER-1 ENGINEERING INITIATIVE



UNIVERSITY OF WYOMING
COLLEGE OF ENGINEERING
AND APPLIED SCIENCE
RESEARCH AND
ECONOMIC DEVELOPMENT



“ It is a top priority for my administration to create the vision to lead the university toward a Tier-1 academic and research institution in areas of excellence appropriate for Wyoming. ”

- Wyoming Governor Matt Mead

TIER-1 ENGINEERING INITIATIVE



IT BEGAN IN 2012.

Wyoming Governor Matt Mead and the state Legislature pursued a lofty goal to elevate the University of Wyoming, the state's only four-year institution. The aim was to achieve Tier-1 status and reach the national forefront in both education and research.

To address the challenge, Mead created the Wyoming Governor's Energy, Engineering, STEM Integration Task Force. He charged the members to develop a "well-articulated, understandable strategy that will enable us to fulfill the challenge of becoming Tier-1."

The task force is comprised of influential industry leaders, businessmen, and state representatives, including Tom Botts, Greg Hill, Dick Agee, Dave Bostrom, Chad Deaton, Eric Marsh, former Wyoming Governor Dave Freudenthal, Paul Lang, Wyoming State Representative Tom Lockhart, Wyoming State Senator Phil Nicholas and Brigadier General Pat Burns. *(For more information on the task force, see pages 20-21)*

Thanks to the leadership of Mead and the task force, significant strides have been made in fulfilling the Tier-1 Engineering Initiative.

In March 2014, Mead and the Legislature appropriated biennium funding of \$8 million for Phase I of the Engineering Initiative, in addition to \$18.4 million for facilities development.

The Tier-1 Engineering Initiative will ultimately shape the legacy of many groups in the coming years. As part of a broad campaign by the governor, the state Legislature, and UW, the Tier-1 reach includes the Science Initiative and Education Initiative at Wyoming.

And the process is moving forward with substantial momentum.

Facilities like the Michael B. Enzi STEM Facility, Energy Innovation Center, High Bay Research Facility and new Engineering Building will provide necessary infrastructure for this unprecedented growth.

Four main research centers of excellence have been defined, and crucial research is moving this initiative forward. Additional centers will be developed in the future, including research in critical water resources.

Key industry partnerships have been developed, and many more are in the works.

BUT THERE'S MUCH MORE TO BE DONE.



“ We have a duty to the state of Wyoming to fill the goals of the Tier-1 Initiative—to the citizens of Wyoming and the industries that employ them. ”

MICHAEL PISHKO

Michael Pishko, an accomplished chemical engineer and experienced administrator at Texas A&M University, stepped into his role as dean of the University of Wyoming's College of Engineering and Applied Science in March 2015.

Pishko, a professor of chemical engineering and biomedical engineering, previously served as director of the National Center for Therapeutics Manufacturing at Texas A&M since 2009. He also served as head of that university's Department of Chemical Engineering from 2007 to 2011.

“We have a duty to the state of Wyoming to fill the goals of the Tier-1 Initiative—to the citizens of Wyoming and the industries that employ them,” Pishko says. “That's something we need to spend more time on, engaging in innovative research programs that directly benefit the state and finding ways of getting value-added products out of resources besides just energy. There are lots of things that can be done to create new economies in Wyoming.”

His experience at Texas A&M included leading workforce development and education programs for the Texas A&M

Center for Innovation in Advanced Development and Manufacturing. His role with the National Center for Therapeutics Manufacturing included work on academic, workforce training and K-12 outreach initiatives.

Pishko also has worked extensively with private industry and holds numerous patents in the field of biomedical engineering.

Before going to Texas A&M, Pishko was on the chemical engineering faculty of Pennsylvania State University. He received his Ph.D. (1992) from the University of Texas at Austin and his master's (1987) and bachelor's (1986) degrees from the University of Missouri-Columbia, all in chemical engineering.

“We're delighted to have someone of Dr. Pishko's profile and background assume this important leadership position at UW,” UW President Dick McGinity says. “This is a time of incredible opportunities for the College of Engineering and Applied Science, and we have the right person to lead the college in capitalizing on these opportunities that he and many others recognize will have a significant, positive impact on Wyoming's economy.”

OUR ASPIRATIONS



WHAT IS A TIER-1 COLLEGE?

A Tier-1 college is a nationally recognized institution of academic excellence and world-class research. The goal of the Tier-1 Engineering Initiative is to elevate UW's College of Engineering and Applied Science to national prominence in undergraduate education and selected areas of research and to enhance economic development in Wyoming. To this end, the implementation plan of the initiative focuses on the following strategic goals.

Excellence in Undergraduate Education. The College of Engineering and Applied Science has solid educational programs that produce talented graduates who are in demand by employers. Our goal is to enhance these programs and expand our local recognition to a national reputation.

World-Class Research and Graduate Education. Research leading to discovery and innovation often happens at the interface between different disciplines—where ideas and talents intersect to solve pressing problems. We seek to build world-class interdisciplinary research capabilities in selected areas that will have significant impact on Wyoming and the nation and enrich student mentoring.

Productive Economic Development Through Partnerships. We will promote discovery and innovation and seek productive partnerships with state and national agencies and industry to actualize research findings and catalyze economic development in Wyoming.

K-14 STEM Education. Strength in K-14 education can enhance the quality and quantity of students who pursue STEM (science, technology, engineering and mathematics) programs at UW and ultimately pursue high-impact careers in the state. We will introduce STEM concepts early in the K-12 educational experience, and we will also enrich the STEM skill sets of UW's freshmen and sophomore students to improve performance and retention.



UW President Dick McGinity has made the university's resources available to realize the Tier-1 initiative.

The effort stands as the largest single project undertaken in university history. It stems from the desire for the College of Engineering and Applied Science to reacquire the competitive position it once held in the 1970s and 1980s.

The project will completely transform the College of Engineering and Applied Science, which has outgrown its facilities due to increasing enrollment.

The \$115 million investment is meant to double the size of the College of Engineering and Applied Science, which currently has about 1,420 undergraduates and 230 graduate students.

“ This is about changing the way we're educating engineers and preparing them for the real world. ”

- Tom Botts, retired executive vice president of global manufacturing for Royal Dutch Shell

RESEARCH CENTERS OF EXCELLENCE

UW's School of Energy Resources has partnered with the College of Engineering and Applied Science for facilities and investments to enhance education and research in the following areas. The School of Energy Resources includes many elements of the following **research centers of excellence (COE)** in its strategic initiatives.



VLADIMIR ALVARADO

Associate department head and professor, Chemical and Petroleum Engineering
COE: Improved Oil and Gas Recovery

Team: Teresa Lehmann from the Department of Chemistry, John Oakey from the Department of Chemical and Petroleum Engineering, John Kaszuba from the Department of Geology and Geophysics, Michael Urynowicz from the Department of Civil and Architectural Engineering, and Klaas van 't Veld from the Department of Economics and Finance

IMPROVED OIL AND GAS RECOVERY

Department of Chemical and Petroleum Engineering Professor Vladimir Alvarado's center of excellence will focus on improved oil and gas recovery in unconventional reservoirs. A generous donation from ExxonMobil funded an advanced core-flooding dynamic geochemical flow-thru system and a state-of-the-art microfluidic experimental platform. The team has also received U.S. Department of Energy funding.



MAOHONG FAN

Professor, Chemical and Petroleum Engineering
COE: Clean Coal and Gas to Liquids

Team: David Bell and Hertanto Adidharma from the Department of Chemical and Petroleum Engineering and Yuan Zheng and Michael Stoellinger from the Department of Mechanical Engineering

CLEAN COAL AND GAS TO LIQUIDS

This innovative coal-conversion project led by Department of Chemical and Petroleum Engineering Professor Maohong Fan aims to produce a synthetic gas that can be used in the production of value-added chemicals. Donations from Peabody Energy Inc. and Arch Coal Inc. were matched by the state to support this promising research. Wyoming is the most prolific coal-producing state in the United States, but in 2013, Wyoming coal production fell by 3 percent, making Fan's research all the more timely.

RESEARCH CENTERS OF EXCELLENCE



DIMITRI MAVRIPLIS

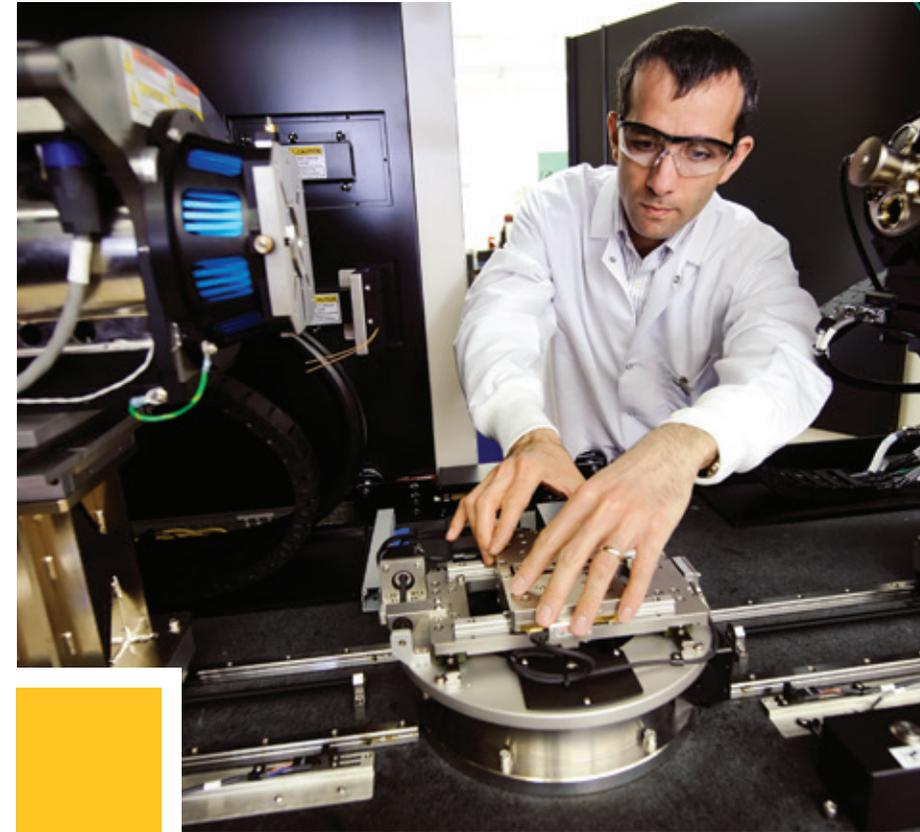
Professor, Mechanical Engineering

COE: High-Performance Computational Science and Engineering

Team: Michael Stoellinger from the Department of Mechanical Engineering, Xiaohong Liu from the Department of Atmospheric Science, and Liqiang Wang and Amy Banic from the Department of Computer Science

HIGH-PERFORMANCE COMPUTATIONAL SCIENCE AND ENGINEERING

Led by Department of Mechanical Engineering Professor Dimitri Mavriplis, this work continues developing world-class computational research infrastructure. The state has made major investments both on campus and in attracting the NCAR-Wyoming Supercomputing Center to the state. In addition, management of big data and the development and use of sophisticated high-fidelity computer-based simulation models are becoming increasingly important across a wide range of industries, such as the energy industry and advanced manufacturing.



MOHAMMAD PIRI

Wyoming Excellence Chair in Petroleum Engineering; professor, Chemical and Petroleum Engineering

COE: Oil and Gas Flow in Unconventional Reservoirs

Team: Lamia Goual and Saman Aryana from the Department of Chemical and Petroleum Engineering and Dario Grana from the Department of Geology and Geophysics

OIL AND GAS FLOW IN UNCONVENTIONAL RESERVOIRS

About 50 to 70 percent of the original oil remains stranded in Wyoming's aging fields, and enhanced oil recovery methods have the potential to retrieve an additional 5 to 15 percent. Wyoming Excellence Chair in Petroleum Engineering Mohammad Piri, an international leader in the field, will lead his team as they examine oil and gas flow in unconventional reservoirs. Their research includes a permeability simulator model to improve oil and gas reservoir rock yield forecasts, improved reservoir characterization methods, a fundamental pore-scale model for establishing oil and gas flow in reservoir rock, and screening of new surfactants and nano-fluids to stimulate oil and gas productivity.

FACILITIES



ENERGY INNOVATION CENTER

A \$25 million public-private investment, the home to the School of Energy Resources was completed in 2013. It is a collaborative facility where students, researchers, academic professionals and industry partners can engage in solving critical challenges in the energy industry.

MICHAEL B. ENZI STEM FACILITY

Providing 32 teaching laboratories equipped for chemistry, biology, physics, mathematics and computer science, this facility will host classes in fall 2015. It represents a \$50 million public investment.



NCAR-WYOMING SUPERCOMPUTING CENTER

Since 2012, UW has enjoyed privileged access to the NCAR-Wyoming Supercomputing Center in Cheyenne. It represents a \$100 million public-private-federal facility investment. It's one of the world's fastest big-data computers.

TIER-1 TIMELINE

2007-2008

Anadarko donates \$1.5 million for energy education and research (doubled to \$3 million by state matching funds)

BP donates \$5 million for energy education and research (doubled to \$10 million by state matching funds)

ConocoPhillips donates \$500,000 for energy education and research (doubled to \$1 million by state matching funds)

Marathon Oil donates \$1 million for energy education and research (doubled to \$2 million by state matching funds)

Shell donates \$2 million for the Shell 3-D Visualization Center (doubled to \$4 million by state matching funds)

2009-2012

Arch Coal donates \$1.5 million for student and faculty support for improved technologies for energy extraction from coal (doubled to \$3 million by state matching funds)

Baker Hughes donates \$500,000 for UW's energy research and academic program (doubled to \$1 million by state matching funds)

Hess donates \$4.4 million to establish digital rock physics lab in Energy Innovation Center and another \$600,000 to sponsor research (doubled to \$8.8 million by state matching funds)

Marathon donates \$1 million for UW's energy research and academic program (doubled to \$2 million by state matching funds)

Peabody Energy donates \$2 million to create Peabody Energy Clean Coal Technology Laboratory (doubled to \$4 million by state matching funds)

Shell donates \$500,000 for UW's energy research and academic program (doubled to \$1 million by state matching funds)

2013-2014

UW School of Energy Resources opens the Energy Innovation Center

ExxonMobil donates \$2.5 million to support science and technology education and oil/gas technology research (doubled to \$5 million by state matched funds)

Halliburton donates \$2 million to support construction of High Bay Research Facility and another \$1 million for researching unconventional reservoirs (doubled to \$6 million by state matched funds)

Hess donates \$2 million to support construction of High Bay Research Facility, \$1.5 million for instrumentation in digital rock physics lab, \$800,000 to purchase computation for reservoir imaging and \$700,000 for sponsored research concerning unconventional reservoirs

Ultra Petroleum donates \$2 million to support and enhance UW's energy research and academic program (doubled to \$4 million by state matched funds)

Governor Mead and the Wyoming State Legislature approve biennium funding of \$8 million for Phase 1 of the Engineering Initiative, in addition to the \$18.4 million for facilities development.

2015

Michael Pishko takes over as Dean of College of Engineering and Applied Science

Michael B. Enzi STEM Facility set to open

High Bay Research Facility breaks ground

Hess donates \$15 million, including \$5 million for the High Bay Research Facility, \$5 million for sponsored research on unconventional oil and gas reservoirs, \$4.5 million for equipment and technology within the High Bay Research Facility, and \$500,000 for laboratory performance development (leveraged to \$29.5 million by state matching funds)

Hess is the single largest corporate partner in UW history, with investments totaling \$25 million since 2013

Baker Hughes donates \$1 million to support research into the behavior of multi-phase fluids in oil and gas reservoirs at UW's Hess Digital Rock Physics Laboratory



WHAT'S NEXT?



NEW ENGINEERING BUILDING

The new Engineering Building will be a learning and discovery continuum to promote innovation and creativity. It will offer an integrated approach to education and research by crystalizing the latest thinking from wide-ranging perspectives.



HIGH BAY RESEARCH FACILITY

This facility will be equipped to carry out large-scale research and development to solve energy-related challenges. Featuring a world-class facility to investigate flow in porous media in oil and gas reservoirs, it will initially host studies and projects to improve understanding in porous media, unconventional reservoir production and coal conversion. The facility—a \$50 million public-private investment—is due for completion in 2016.

OUR GOALS

By the end of 2016, the College of Engineering and Applied Science seeks to accomplish the following:

- Add six new faculty members, targeting growth in petroleum engineering and other energy fields as a priority
- Provide 30 additional engineering and applied science undergraduate scholarships
- Extend existing research programs within the fields of water resource management and primary energy conversion
- Make significant investments in new research infrastructure (equipment, facilities and people) for an expenditure of around \$3 million
- Establish seed funding mechanism to attract external grant and award funding for research

By 2020, the College of Engineering and Applied Science seeks to accomplish the following:

- Increase undergraduate enrollment from 1,400 to 1,800
- Double the number of doctoral candidates to 30
- Double the number of financial awards and scholarships
- Establish research centers of excellence in at least four critical areas of engineering and applied science consistent with creating economic impact to the state

IN PROGRESS

On a sunny, chilly day in Laramie, the High Bay Research Facility broke ground March 9, 2015. The High Bay Research Facility is funded by \$37.2 million in state dollars and \$16.3 million in private contributions, with an additional \$9.2 million in private gifts for research equipment. The private funds have been invested by UW's most significant corporate partnerships with Hess Corp., Halliburton, ExxonMobil, Ultra Petroleum, Marathon Oil Co., Shell, Baker Hughes and Arch Coal Inc. The Legislature has matched these gifts with a \$15 million appropriation to complete funding to build the High Bay Research Facility—with construction expected to be completed in summer 2016.

“The university already is a world leader in this field of study, and this new facility will allow us to make even bigger advances in an area of great importance to Wyoming’s economy and the nation’s energy future,” UW President Dick McGinity says. This facility will host fundamental research on critical aspects of unconventional reservoir characterization and development. Over the long term, it will accommodate other large-scale experimental configurations in a semi-industrial setting. In the 2014 Wyoming legislative session, the governor and the Legislature set aside \$10.5 million to match industry investments for technology and equipment for the High Bay Research Facility.

INDUSTRY PARTNERS

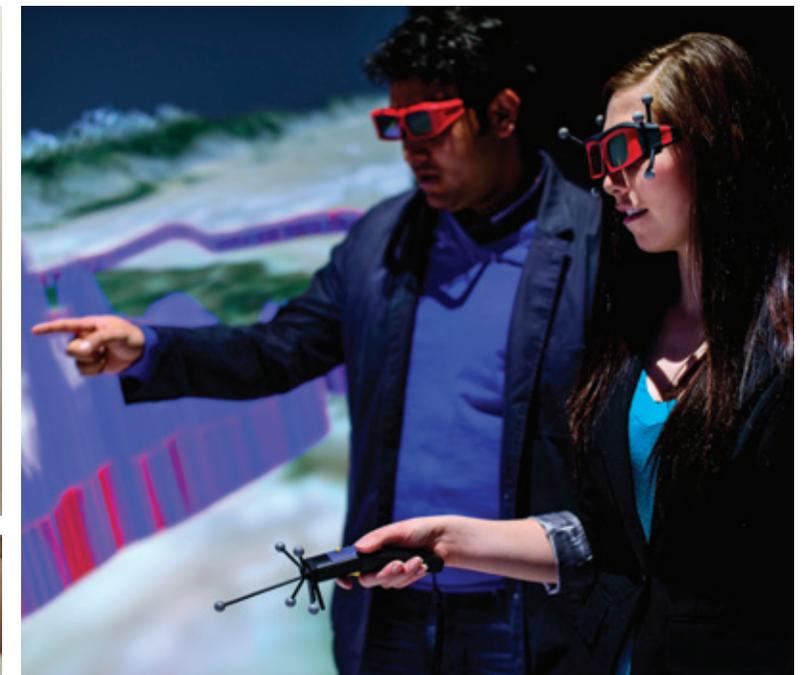


BUILDING RELATIONSHIPS

Innovation and creativity are some of the advantages for industry partners who join with UW. A collaborative relationship provides opportunities to accomplish goals that neither party could achieve alone.

Wyoming's Legislature has invested millions in new capital building projects to jump-start the Tier-1 Engineering Initiative, with more investments to follow. But the contributions of industry partners are equally important, especially considering the state's willingness to match funding from industry dollar-for-dollar.

In recent years, UW has directed resources toward strategic hires in targeted areas of excellence, which has produced robust petroleum engineering, geohydrology, material science and scientific computing research groups. Since 2006, the state has invested nearly \$10 million per year through the School of Energy Resources to provide nationally competitive undergraduate and graduate instruction in energy-related disciplines. This measure has helped support outreach to Wyoming's energy industries and companies.



MEET THE TASK FORCE



TOM BOTTS (CO-CHAIR)

B.S. Civil Engineering '77 | University of Wyoming
Executive Vice President, Global Manufacturing (Retired)
– Royal Dutch Shell

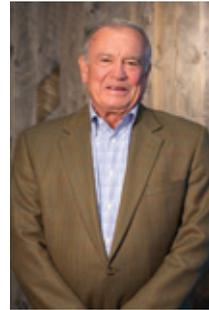
Tom Botts was appointed executive vice president for Shell's Global Manufacturing portfolio in March 2009, having previously led Shell's exploration and production business in Europe. He is currently a director on the boards of EnPro Industries and Wood Group.



GREG HILL (CO-CHAIR)

B.S. Mechanical Engineering '83 | University of Wyoming
President and Chief Operating Officer, Exploration and Production – Hess Corp.

Greg Hill is the president and chief operating officer of Hess Corp., a global exploration and production company based in Houston, Texas. He joined Hess in 2009, after spending 25 years at Shell in various senior management positions.



DICK AGEE

B.S. Petroleum Engineering '65;
M.S. Petroleum Engineering '68 |
University of Wyoming
Founder and Chairman
– Wapiti Energy, LLC

Dick Agee is founder and chairman of Wapiti Energy, LLC and Bayou Well Holdings Company, LLC. He has more than 45 years of engineering, management, and entrepreneurial experience in both the domestic and international oil and gas industry.



DAVE BOSTROM

B.S. Civil Engineering '68; M.S. Civil Engineering '69 |
University of Wyoming
President – Bostrom Enterprises; former president – UW Board of Trustees

Dave Bostrom owns Bostrom Enterprises LLC in Worland, Wyo. He earned both bachelor's and master's degrees in civil engineering from UW and is former president of the Board of Trustees.



BRIG. GEN. PAT BURNS

B.S. Mechanical Engineering '73 |
University of Wyoming
Retired Brigadier General – Director of Installations & Mission Support, Headquarters Air Combat Command
Retired Vice President – Mortenson Construction Federal Contracting Group

Following a 35-year career in the Air Force and seven years in major construction, Pat Burns is the current chair of the College of Engineering and Applied Sciences National Advisory Board.



CHAD DEATON

B.S. Geology '76 |
University of Wyoming
Chairman and CEO
– Baker Hughes Inc. (Retired)

Chad Deaton is the retired executive chairman of Baker Hughes Inc. He served as chairman of the board and chief executive officer for seven years starting in 2004 and has been instrumental in the growth of Baker Hughes's global business. He joined Baker Hughes from Hanover Compressor Company, where he was chief executive officer from 2002 to 2004.



DAVE FREUDENTHAL

J.D. '80 | University of Wyoming
Fmr. UW Guest Professor of Energy, Law, and Economics
Fmr. Wyoming Governor
Senior Counsel, Crowell and Moring

Former Wyoming Gov. Dave Freudenthal served as a UW distinguished visiting professor of law for three semesters. He served two terms as Wyoming's 31st governor. He now is senior counsel at the law firm of Crowell and Moring, focusing on energy and natural resources.



PAUL LANG

B.S. Mining Engineering '83 | Missouri University of Science and Technology
President and Chief Operating Officer - Arch Coal, Inc.

Paul Lang is president and chief operating officer of Arch Coal, Inc. He holds a degree from the Advanced Management program at Harvard Business School. He joined Arch Coal's Board of Directors in 2014 and serves on the management board of Knight Hawk Coal Company, as well as the Board of Advanced Emissions Solutions, Inc.



TOM LOCKHART

B.S. Electrical Engineering '57 |
University of Wyoming
Wyoming State Representative –
Natrona County, H.D. 57

Tom Lockhart has been a member of the Wyoming State House of Representatives since 2000. Lockhart previously spent most of his career in northwestern states and Wyoming, retiring in 1998 as PacifiCorp/Pacific Power's Wyoming vice president and PacifiCorp's vice president of engineering.



ERIC MARSH

B.S. Petroleum Engineering '82 |
University of Wyoming
President and CEO
– Vine Oil and Gas LP

Eric Marsh has been in the oil and gas industry for more than 30 years with senior and executive management positions with Questar and Encana. He is the president and CEO of Vine Oil and Gas, a private energy company with assets in northern Louisiana.



PHIL NICHOLAS

J.D. '79 | University of Wyoming
Attorney – Nicholas & Tangeman, LLC
Wyoming State Senator
– Albany County, S.D. 10

Phil Nicholas received his law degree from the University of Wyoming. After graduating in 1979, he served for two years as an assistant attorney general for the state of Wyoming. Nicholas entered into general practice in Laramie in 1982.



“ The ultimate outcome is world-class students, world-class research in several niche areas, and jobs and economic development for Wyoming. ”

- Greg Hill, President, Hess Corp.





“When ever-increasing levels of private giving are combined with significant state funding, the result is truly transformational for our university.”

-Ben Blalock, UW Foundation president/CEO



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 UNIVERSITY OF WYOMING