

**Minutes of the ERC Meeting
August 27, 2010**

Members present:

Ron Harper, CEO & General Manager, Basin Electric Power Coop, (Council Chairman)
Representative Tom Lockhart (Council Vice Chairman)
Paul Lang – President Western Operations, Arch Coal Inc.
Senator Charles Townsend
Carl Bauer-President, Bauer Consulting, Inc.
Tom Buchanan - Ex officio, UW President
Ingrid Burke - Ex officio, Director, RIENR

Members present on Teleconference

Keith Rattie – Chairman, President, & CEO, Questar Corporation
Rob Wallace – Manager, Government Relations, G.E. Energy

Members absent:

Jim Kleckner – VP of Operations, Anadarko Petroleum Corporation
Maha Mahasanen – Senior Policy Advisor, Hydrogen Energy

Meeting Attendees:

Mark Northam
Mary Byrnes
Ron Surdam
Shanna Dahl
Sarah Schulmeyer
Rob Hurless
Don Roth
Cath Harris
David Mohrbacher
Tim Considine
Felipe Pereira
Mohammad Piri
Rob Ettema
Andrew Hansen
Carol Frost

Welcome and Approval of the Agenda and Minutes

Council Chairman, Ron Harper, opened the meeting at 8:30 a.m.

Tom Lockhart motioned and Carl Bauer seconded that the 6/18/10/10 minutes, and the 8/27/10 agenda be accepted. The motion was passed unanimously. (Minutes - Appendix A) (Agenda – Appendix B)

Update on Carbon Management Institute

Ron Surdam gave an update on the Carbon Management Institute. (Appendix C)

Update on Center for Fundamentals of Subsurface Flow

Director Felipe Pereira gave an update on the Center for Fundamentals of Subsurface Flow. (Appendix D)

President Buchanan addressed several issues of the ERC's request of an audit of SER:

- A UW audit must be approved by the UW Board of Trustees.
- A UW audit is not performed to evaluate and measure whether the expenditure met certain criteria, goals or legislature expectations, but only to determine the accuracy of the expenditure's accounting coding and accounting procedure.
- It is SER's responsibility to address and inform that the ERC have carried out the legislative directives and accomplished the tasks administered to them.
- Buchanan encouraged the ERC to reflect, measure, and report through SER staff to the State these accomplishments and future long term goals rather than look to a UW audit to demonstrate this.
- President Buchanan acknowledged he is, and will continue to be, a strong supporter of SER and has prepared a draft document, "UW's Energy Initiatives: Science and Technology for Wyoming's Future", to communicate the accomplishments and a five year vision for UW to assist in securing Wyoming's energy future. (Appendix H) He requested comments and edits on this draft document from the ERC to Northam or himself by September 3, 2010.

Northam responded with two additional points:

- The Joint Interim Minerals, Business and Economic Development Legislative Committee agenda reflects a plan to report that SER is capturing other monies to create revenue for the state.
- Collaborations with international entities are valuable as with Australia and China, both which SER has initiated and engaged.

Academic Update

Don Roth gave an update on academics. (Appendix I)

Outreach Update

Mary Byrnes gave an update on outreach activities. (Appendix J)

Annual Report

Northam will have a draft to the ERC by September 3, 2010. Northam stated that the annual report to the Joint Minerals Committee would reflect the monies invested in SER, how they were deployed, and the results to inform the Joint Minerals Committee of SER's accomplishments.

Other Business

- The groundbreaking of the ERS building will be November 19, 2010. Chairman Harper will represent the ERC during the ceremony.

Action Items

- Comments on the draft of the President's brochure should be sent to Northam or Buchanan by September 3, 2010.
- Draft of SER Annual Report to the ERC by Northam by September 3, 2010.

A motion to adjourn was made by Tom Lockhart and seconded by Carl Bauer. The motion passed unanimously. The meeting adjourned at 1:30 p.m.

Respectfully Submitted,

Ron Harper, Chairman

APPENDIX A

Drafted Minutes of the ERC Meeting June 18, 2010

Members present:

Representative Tom Lockhart (Council Vice Chairman)
Maha Mahasenan – Senior Policy Advisor, Hydrogen Energy
Jim Kleckner – VP of Operations, Anadarko Petroleum Corporation
Senator Charles Townsend
Rob Wallace – Manager, Government Relations, G.E. Energy
Carl Bauer-Retired, Director National Energy Technology Laboratory

Members present on Teleconference

Ron Harper, CEO & General Manager, Basin Electric Power Coop, (Council Chairman)

Members absent:

Keith Rattie – Chairman, President, & CEO, Questar Corporation
Paul Lang – President Western Operations, Arch Coal Inc.
Tom Buchanan - Ex officio, UW President
Ingrid Burke - Ex officio, Director, RIENR

Meeting Attendees:

Mark Northam
Mary Byrnes
Shanna Dahl
Sarah Schulmeyer
Rob Hurless
Don Roth
K.J. Reddy
Shawn Thorson

Welcome and Approval of the Agenda and Minutes

Council Vice Chairman, Tom Lockhart, opened the meeting at approximately 8:30 a.m. with introductions of each member for new council member, Carl Bauer.

Chairman Ron Harper gave a special thank you to K.J. Reddy, who has served as Associate Director of Academics for the past two years in SER. Mark Northam also gave a special thank you to Reddy.

Ron Harper motioned and Jim Kleckner seconded that the 3/26/10 minutes, and the 6/18/10 agenda be accepted. The motion was passed unanimously. (Minutes - Appendix A) (Agenda – Appendix B)

SER Audit Discussion

The Energy Resource Council is in agreement that since the school is a relatively new entity and unique in its structure within the University of Wyoming, along with entering a new budget biennium, it would be appropriate to request an audit of SER. The benefit would be an independent review past accomplishments to aid with future decisions for the school.

Budget Update-Carbon Management

Shanna Dahl, Associate Director of the Carbon Management Center, gave an update. (Appendix C)

Budget Update

Northam gave an update on the budget. (Appendix D) It was pointed out that in our reporting to the JMC, we should highlight the matching dollars that SER brings in through their Matching Grant Program. Northam will provide a copy of the additional matching funds spreadsheet he is working on to Lockhart and Harper.

Fundraising

Ben Blalock gave an update on fundraising. (Appendix E)

Strategic Planning

- Northam gave an update on the progression of the ERC building.
- Commercialization – It was agreed that a formalized plan for commercialization should be achieved by the August 27, 2010 meeting.

Other Business

- Don Roth, Associate Director of Academics, gave an update which included internship development, development of Capstone courses, and a goal of 50 students in the Energy Resource Science (ERS) degree program in two years, the development of a five year Bachelor/Masters degree paired with a faculty member as a mentor.
- Mary Byrnes, Associate Director of Energy Outreach, gave an update which included The International Advanced Coal Technologies Conference, The Uranium Production Conference, Energy Academies, the efforts with compressed natural gas, and the marketing of the SER Research Centers of Excellence.
- David Mohrbacher, Director of Enhanced Oil Recovery Institute, gave an update which included their mission and goals.

Mahasenan requested Byrnes to provide a statement that could be used when the press may contact ERC members.

Action Items

- Northam to send Lockhart and Harper the additional spreadsheet on matching funds and a draft commercialization plan.
- Byrnes to provide a press release to be used by ERC members contacted by press.
- The August 27, 2010 meeting will be in Laramie.

A motion was made at approximately 1:30 p.m. by Tom Lockhart to end the meeting, and the motion was seconded by Maha Mahasenan. The motion passed unanimously.

Respectfully Submitted,

Tom Lockhart, Vice Chairman

APPENDIX B

Agenda

August 27, 2010 Energy Resource Council Meeting

Hilton Garden Salon F & G

8:00 a.m. – 2:00 p.m.

- 1) Review of minutes from 6/18/10 and 8/27/10 agenda.
- 2) Update on Carbon Management Center – Ron Surdam, Shanna Dahl
- 3) Update on:
 - Center for Fundamentals of Subsurface Flow – Felipe Pereira & Mohammad Piri
 - Center for Energy Economics and Public Policy – Tim Considine
- 4) Report From College of Engineering – Dean Rob Ettema:
 - Chemical/Petroleum Engineering Evolution
 - Proposed new Engineering Research Facility
 - Renovation of the COEAS Building
- 5) Strategic Planning
 - Commercialization of Technology – Wyoming Technology Business Center – Mark Northam
- 6) Update on GE – Bill Gern
- 7) SER Audit Discussion – Mark Northam
- 8) Academic Update – Don Roth
- 9) Outreach Update – Mary Byrnes
- 10) Review of Draft Annual Report – Mark Northam
- 11) Other Business
 - Set 2011 Calendar Meeting Dates
- 12) Future Meetings: November 19, 2010 – Groundbreaking of SER Building and Joint Meeting with the UW BoT

APPENDIX C

August 18, 2010

Carbon Management Institute Update

Director, Ron Surdam began full-time on July 1. Associate Director, Shanna Dahl begun in March. Business Manager, Shauna Bury began the end of June. Contracted Outreach Coordinator, Lynne Boomgaarden began in April. The team is working together to further define the mission and goals of the institute as well to oversee the WY-CUSP project.

WY-CUSP Project Update

Task 1 – Project Management and Planning

PI – Ron Surdam

Task Update

- A monthly meeting with Task Managers was held in the early part of July to share work and discuss milestones and timelines. Currently, all tasks are on time and progressing well.
 - The second quarterly report was prepared and sent to DOE in July.
 - All necessary reporting for the ARRA funding has been prepared and submitted as well.
 - A planning meeting was held with the Director of the UW GIS Center to coordinate integration of project results with NATCARB.
 - A preliminary outreach outline has been created to establish the necessary outreach program to work consistently and efficiently with the land owners, lease holders, pore use owners and the general public regarding all aspects of this Rock Springs Uplift Project. The outreach plan includes working with the local government, DEQ, OGCC, BLM, local schools, local media and other appropriate parties to educate them on the Stratigraphic Test Well, EM, and 3-D seismic shoot.
 - A preliminary communications plan has been prepared. Final adjustments are expected to be made and the plan circulated between task managers, industry partners, and University participants.
 - The permitting process has begun for the Stratigraphic Test Well. Discussions have been held with the OGCC and the DEQ regarding all of the necessary steps to permit the well.
 - We have worked with DOE to apply for an existing \$5 million. This will assist with the rising rig and transportation costs for the well.
 - A Coordinator has been hired to work with task managers and the CMI for publications, presentations and abstracts.
-

Task 2 – Design and construct a Stratigraphic Test Well on the RSU

Task Manager - Baker Hughes Oilfield Operations Inc.

Task Update

- The final contract for Baker Hughes Oilfield Operations, Inc. is being reviewed by the University of Wyoming legal department. Anticipated completion date is August 27, 2010.
- A meeting was held with Randy McSweeney with Baker Hughes to finalize the core.
- Representatives from Baker Hughes have made multiple visits to Laramie to establish good working relationships with the University of Wyoming.

- The Right of Way access permit has been applied for and sent to BLM for the use of the existing Black-Butte haul road.
- A site has been chosen for the stratigraphic test well.
- Once the contract is approved Baker Hughes will solidify the lease of a rig and finalize the well design of the Stratigraphic Test Well.
- The University will be the owner for the Stratigraphic Test Well.

Task 3 – Geophysical characterization of the RSU Test Well site

Task Manager - Subhashis Mallick

Task Update

- The contract with Geokinetics, the company shooting the 3-D Seismic Survey has been completed.
- Geokinetics is currently completing the required EA for the BLM.
- The contract with EMTEK America, Inc. has been signed.
- Supporting personnel has been hired.

Task 4 – Development of Well catalog and borehole risk assessment

Task Manager - Jimm Myers

Task Update

- The review of pending EPA/WDEQ CCS permit requirements relative to boreholes has been completed.
- Most of the supporting personnel has been hired, anticipating that all remaining personnel will be hired with anticipated start dates of late summer, early fall.

Task 5 – Structural and stratigraphic characterization

Task Manager – Erin Campbell - Stone

Task Update

- Existing, available data on the Rock Springs Uplift has been located with plans to review all existing data anticipated, late summer.
- All personnel has been hired.
- Work with Exxon/Mobil has started and plans to continue through the fall.
- A trip is planned in early fall to Anadarko in Denver to utilize existing 2-D and 3-D seismic lines for the well area.

Task 6 – Laboratory measurement of containment – mineralization and brine

Task Manager – John Kaszuba

Task Update

- All personnel has been hired and trained on laboratory equipment.
- Preliminary tests have been run using the equipment.

Task 7 – Design the commercial scale sequestration project and complete performance risk assessment

Task Manager – Zunsheng (John) Jiao

Task Update

- Preliminary work has begun with each of the tasks to expedite the risk assessment as each of the tasks are completed.

Site Characterization of the Highest-Priority Geologic Formations for CO₂ Storage in Wyoming
University of Wyoming, Wyoming State Geological Survey, and Baker-Hughes, Inc.
Project Director: Dr. Ronald C. Surdam

A primary goal of the Wyoming Carbon Underground Storage Project (WY-CUSP), funded by the NETL site characterization program, is to acquire the technical knowledge base required to plan and execute a CO₂ storage demonstration on the Rock Springs Uplift. A three-year Wyoming State Geological Survey (WSGS) study identified the Paleozoic Tensleep/Weber Sandstone and Madison Limestone as the leading clastic and carbonate reservoirs commercial-scale geological CO₂ storage in Wyoming. This inventory also identified the Rock Springs Uplift in southwestern Wyoming as the most promising geological CO₂ storage site in Wyoming.

Preliminary work, including 3D geological models and multiple numerical simulations for a variety of carbon storage scenarios, suggests that the greatest obstacles to designing a commercial scale CO₂ storage facility on the Rock Springs Uplift are 1) uncertainties with regard to 3D geological heterogeneity, especially with respect to structural and depositional variations in the selected CO₂ reservoir units (Weber Sandstone/Madison Limestone stratigraphic sequence; a 1,150 foot thick interval overlain by stacked low permeability sealing lithology), and 2) the management of fluids displaced by the injected CO₂ plume. To acquire the knowledge base to overcome these obstacles, the WY-CUSP team is drilling a stratigraphic test well (~ 14,000 feet) and acquiring a 3D seismic survey over the selected Rock Springs Uplift CO₂ storage site. Integration of the rock/fluid data derived from the test well with seismic attributes, along with utilization of inversion techniques, will enable a much improved 3D characterization of the CO₂ reservoir/seal/fluid system on the Rock Springs Uplift. After data retrieval, analysis, and interpretation, the WY-CUSP team will have an understanding characterized by significant reduction of uncertainty that will accelerate the design and implementation of an optimal CO₂ storage demonstration and a displaced fluid management strategy for the Rock Springs Uplift.

Benefits of the supplemental ARRA funding for Wyoming and adjacent Rocky Mountain states are immense. Since the beginning of the NETL site characterization program, drill rig rates in the Rocky Mountain area have increased from \$15,000/day to \$25,000/day, and are predicted to go higher. The funds originally budgeted for data collection from the stratigraphic test well have rapidly eroded in order to cover the increasing rig costs. The additional funding will salvage the essential data retrieval and allow for expansion of coring, logging tools, and fluid sampling – all vital to building a world-class characterization project that will substantially accelerate the transition from site characterization to CO₂ storage demonstration, and finally to commercial CO₂ sequestration.

The ability to store commercial volumes of CO₂ on the Rock Springs Uplift will be essential to existing coal-fired power plants, the world's largest collection of soda-ash (i.e. trona) facilities, enhanced oil recovery projects, and a new generation of coal-to-chemical plants in southwestern Wyoming.

The WY-CUSP team includes personnel from Baker-Hughes, Inc., Geokinetics and EMTek, Exxon-Mobile, the Wyoming State Geological Survey, and Los Alamos and Lawrence-Livermore National Laboratories; key investigators from the University of Wyoming Geology/Geophysics, and Chemical/Petroleum Engineering departments; and a consultant specializing in state permitting/regulations/communications, and community relations.

Most importantly, the budget addendum to WY-CUSP will provide the means to 1) complete the stratigraphic test well as a microseismic monitoring well (i.e., geophones), 2) design a more robust CO₂ injection, monitoring/verification, and fluid production treatment facility, 3) develop a fluid treatment strategy including the design of an efficient water treatment facility based on new fluid composition data, 4) initiate the permitting process for a CO₂ storage demonstration on the Rock Springs Uplift, 5) establish the uncertainty of WY-CUSP numerical simulations by comparing and contrasting results from FEHM and ECLIPSE simulation packages, 6) accelerate the investigation of available options for sources of CO₂ to support the Rock Springs Uplift storage demonstration; and 7) acquire a substantially enlarged data base from the stratigraphic test well (i.e., expanded core intervals and number of sidewall cores, additional log suites and fluid samples).

Center for Fundamentals of SubSurface Flow (CFSF)

APPENDIX D

Felipe Pereira & Mohammad Piri

The School of energy Resources
University of Wyoming
August 2010

outline

INTRODUCTION

- Mission and other goals
- Establishment of the center
- Areas of emphasis and strength
- What have we done so far?

FIRST REQUEST FOR PROPOSALS (RFP)

FIRST MAJOR EXTERNALLY FUNDED PROJECT

FINAL REMARKS

- Future plan
- Measure of success

Mission

- The center is devoted to the development of **original and fundamental interdisciplinary research in multi-phase flows in porous media**
- It aims at filling the knowledge gaps in the current state-of-the-art experimentation and modeling to ensure present and future **access to subsurface energy resources**

Goals

- Produce highly-trained graduates and scientists for Wyoming's & nation's energy work force
- Attract high-caliber students and first-rate faculty members to UW
- Attract externally-funded projects in harmony with the mission of the center
- Intensify effective and fruitful collaborations with other institutions
- Provide support for young newly-hired faculty, which in turn helps retain valuable scientists at UW

Establishment of the Center

- The formal proposal to establish the center was developed by the founding members in 2009 and reviewed by SER and Old Main
- Approval of various entities at UW was obtained and CFSF was officially established on **January/20/2010**

Founding Members

(In alphabetical Order)

- Alvarado, Vladimir (Dept. of Chemical & Pet. Eng.)
 - Douglas, Craig (Dept. of Mathematics & SER)
 - Furtado, Fredrico (Dept. of Mathematics)
 - Ginting, Victor (Dept. of Mathematics)
 - Goual, Lamia (Dept. of Chemical & Pet. Eng.)
 - Kaszuba, John (Dept. of Geology & Geophysics)
 - Pereira, Felipe (Dept. of Mathematics & SER)
 - Piri, Mohammad (Dept. of Chemical & Pet. Eng.)
 - Qin, Guan (Dept. of Chemical & Pet. Eng. & SER)
 - Towler, Brian (Dept. of Chemical & Pet. Eng.)
 - Yin, Shunde (Dept. of Chemical & Pet. Eng.)
 - Zhang, Ye (Dept. of Geology & Geophysics)
- 12 Faculty members
 - 3 Departments
 - 2 Colleges

Areas of Emphasis

- CO₂ Sequestration
- Tight Gas Reservoirs

Areas of Strength

- Multi-scale modeling of flow in porous media (pore, core, and reservoir scales)
- State-of-the-art experimentation of multi-phase flow in porous media (as well as rock and fluids characterization)
- High performance computing

State-of-the-art Research Facilities

- NCAR-UW Supercomputing Facility
- Three-Phase Flow in Porous Media and Computed Tomography, EnCana Research Laboratory
- CPE Computer Clusters (2 EnCana clusters, about 600 CPUs total, 4 teraFLOPs)
- Hybrid GPU-CPU Cluster in Math (15,360 CUDA cores, Approximately 30 teraFLOPs)
- CPE Hybrid GPU-CPU Cluster (1,920 CUDA cores and expanding, 4 teraFLOPs)

What Have We Done So far?

- Development and release of the first Request for Proposals
- Merit-based review of all the submitted research proposals (13 total)
- Approval of 8 research projects with total approximate dollar amount of \$2.4 million
- Winning a major externally funded research project (DOE share \$1,509,044; UW share \$989,219)

First CFSF

Funding Opportunity

- **\$2.5 million** provided by SER (over three years) was targeted for this notice
- The awards were made for a period of 12 months initially, which can be renewed for a maximum total period of 36 months
- Priority was given to those proposals that used this funding to leverage external grants

First CFSF

Funding Opportunity (Cont'd)

- The PIs were required to focus on fundamentals of multiphase flow in porous media in two topic areas
 - Sequestration of GGI in geologic formations, e.g., deep saline aquifers and oil and gas reservoirs
 - Recovery of natural gas from unconventional reservoirs characterized by low permeability
- The approved projects involve several collaborations among the scientists at the center and outside UW
- These joint CFSF proposals led to development of submission of research proposals to external funding agencies

First Major Externally Funded CFSF Project

- Title: Maximization of permanent trapping of CO₂ and co-contaminants in the highest-porosity formations of RSU: experimentation and multi-scale modeling
- Sponsors: DOE & SER (DOE share \$1,509,044; SER share \$989,219)
- Announced on: August 11, 2010
- CFSF faculty involved:
 - Mohammad Piri (PI)
 - Felipe Pereira
 - Fred Furtado
 - Victor Ginting
 - Lamia Goual
 - Shunde Yin

First Major Externally Funded CFSF Project (Cont'd)

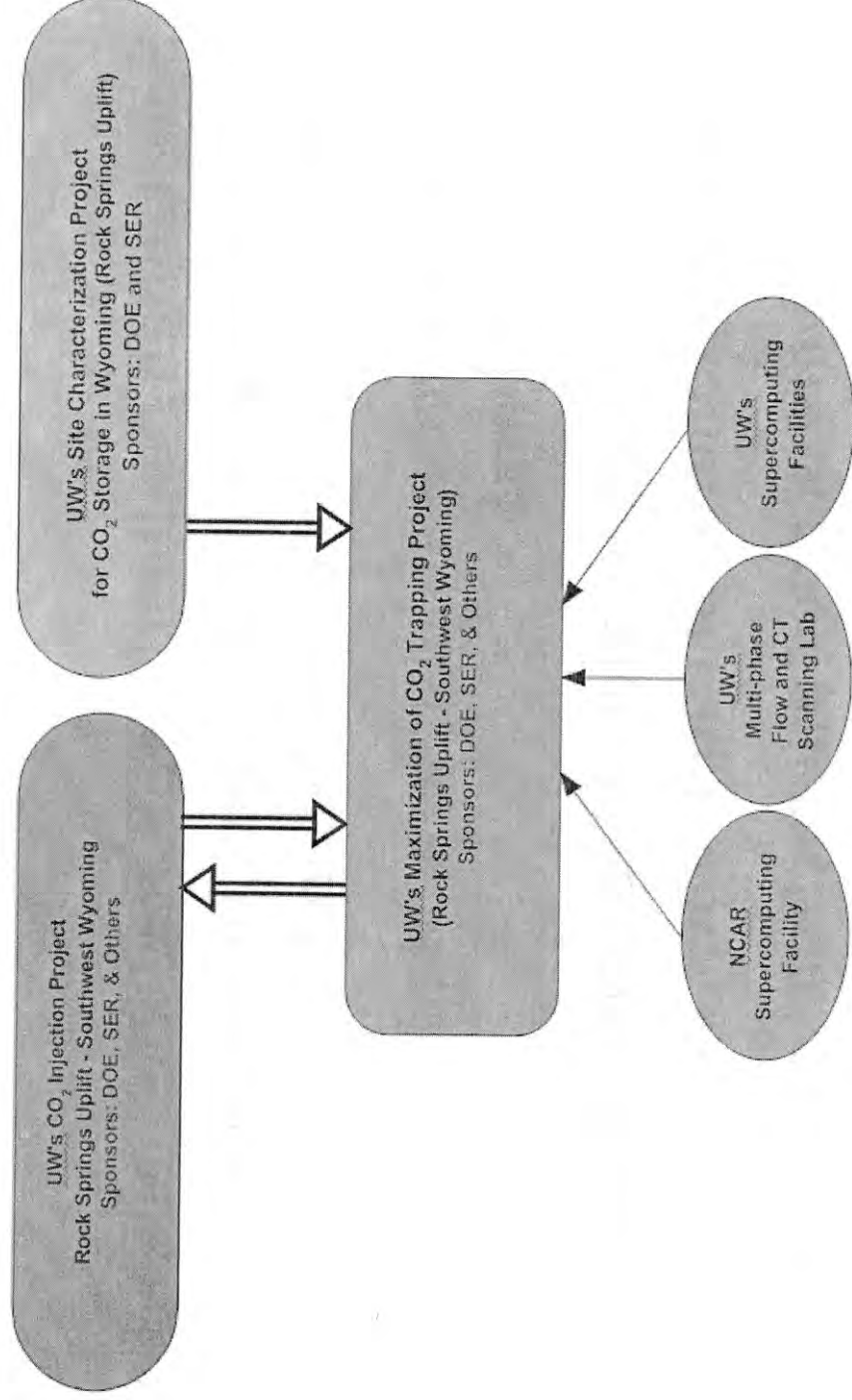
- In an announcement made by Energy Secretary Steven Chu, the DOE awarded a total of 15 projects up to \$21.3 million over three years to help develop the technology and infrastructure to implement large-scale CO₂ storage in different geologic formations across the Nation
- Some of the other institutions funded through this DOE initiative:
 - Stanford University
 - Yale University
 - University of Texas at Austin
 - Columbia University

First Major Externally Funded CFSF Project

(Cont'd)

- SEK's support and management (Dr. Mark Northam)
 - Through all stages of the process
 - Integration with other ongoing projects
- Carbon Management Institute's Support (Dr. Ronald Surdam)

First Major Externally Funded CFSF Project (Cont'd)



Relation with other CO₂ projects at
SER's Carbon Management Institute

Future Plan

- Substantially expand CFSF activities related to tight gas, e.g., establishment of a state-of-the-art tight gas experimental research facility
- Focus on successful implementation of the projects in hand
- Attract additional external funding from funding agencies, donors, oil companies, etc.
- Create a very active “interaction” program with other institutions through visitors, collaborations, seminars, etc.

Measure of Success

- Develop new insight into physics of subsurface flow
- Attract external funding to sustain an active center of excellence
- Increase visibility both nationally and internationally

Acknowledgments

- Provost Myron Allen
- Vice President Bill Gern
- Mark Northam
- Ronald Surdam
- Robert Ettema and Andy Hansen
- Oliver Walter, Farhad Jafari, and Arthur Snoke
- SER Staff (Mary Byrnes, Cath Harris, Sarah Schulmeyer, and Pam Henderson)
- Research Office Staff (Linda Osterman and Farrell Graf)



Center for Energy Economics & Public Policy

APPENDIX E

School of Energy Resources





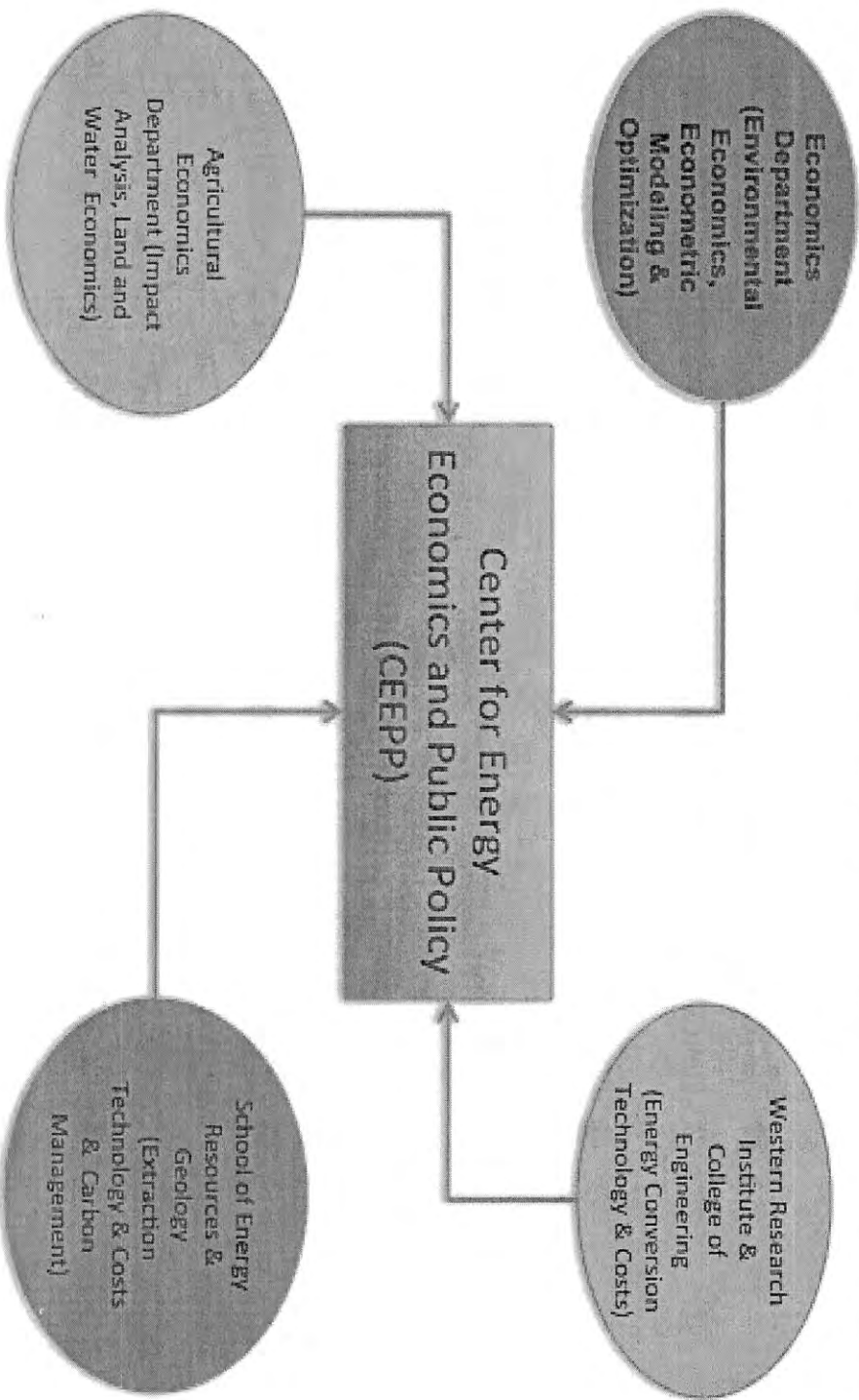
Outline

- Goals
- Vision
- Projects
- Organization
- Collaborations
- Outreach & Communications

Goals, 2010-2012

- **Leverage** assets at the UW to conduct economic analysis of energy markets and technology
- **Collaborate** with other public & private entities
- **Produce** studies of contemporary policy issues affecting energy industries
- **Communicate** these analyses via the worldwide web and major media outlets
- **Generate** external support from the corporate sector

Working Together



Projects, 2010-2012

- Economic and environmental impacts of unconventional natural gas production,
- State and regional analysis of energy policies
- Global value of coal,
- Regional pricing of natural gas,
- Estimating the costs and economics of carbon capture and storage, and
- Assessing the economics of wind power development



Organization

- Center Core
 - Post-doctoral researcher – Edward Manderson
 - Graduate student
- Natural Gas
 - Charles Mason – True Professor of Oil & Gas
 - Graduate student
- Carbon
 - Own Phillips – Associate Dean for Business
 - Klass van't Veld & graduate student
 - Law School faculty
- Wind
 - Robert Godby – former Dept. Head
 - Roger Coupal – Agricultural Economics & graduate student

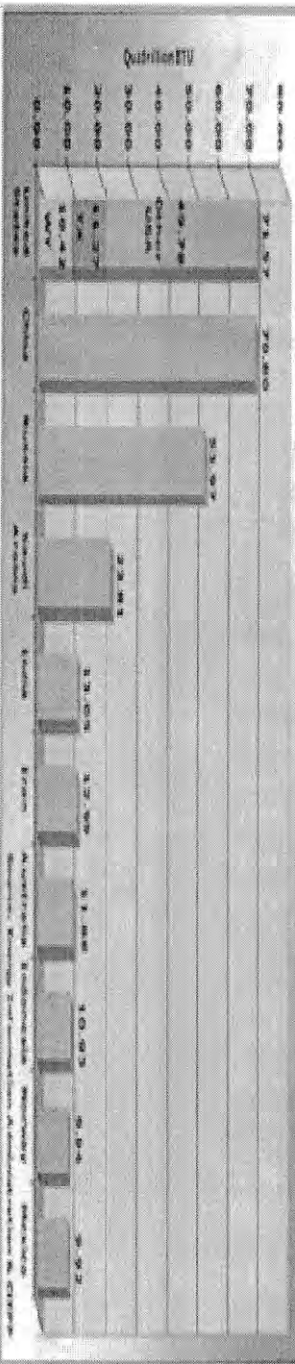
Work Plan

- Accomplished
 - Got the teams in place, research beginning
 - Hired post-doc (Manderson starts Dec. 1)
 - Started website development, now revising
 - Running start with several profile studies
- Near term studies
 - Global coal study – September 2010
 - California’s Energy Future – November 2010
- Research 2010-2012
 - Other three teams
 - Compressed natural gas in transportation

SCHOOL OF ENERGY RESOURCES CENTER FOR ENERGY ECONOMICS AND PUBLIC POLICY

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Wyoming's Top Ten Primary Energy Producers in the World during 2007



Energy Economics & Public Policy

As the nation's second largest energy producer, Wyoming is profoundly affected by developments in world energy markets and by energy policy decisions. Government and industry decision makers need to understand how these forces affect national and international markets and the challenges that lie ahead.

The Center for Energy Economics and Public Policy provides research involving energy markets and policy decisions. Current research involves three specific projects that address key questions for the future of energy in Wyoming.

- Understanding the pricing of natural gas
- Estimating the costs and economics of carbon capture and storage
- Assessing the economics of wind power development
- Economics of unconventional oil and natural gas production
- Regional analysis of greenhouse gas emission control policies
- Coal and interannual economic development

News

- [UWE Professor to Present Powder River Basin Coal Research Work in Washington, D.C.](#)

Articles

- [Environmental Protection and Sustainability Forum](#)
- [Developing Unconventional Gas Coalfields](#)
- [Rocky Mountain Mining Institute Keynote Address](#)
- [Dr. Conditore to Brief U.S. Congress on Shale Gas Production](#)

Events

- [September 15 U.S. Congress Briefing on Shale Gas Production](#)


QUICK LINKS

- Home
- Faculty
- Current Projects
- Supportive Partners
- Working Papers & Reports
- News & Events
- Links to Outside Organizations
- Center for Energy Economics & Public Policy (1 Generation) Director
- ASPE, ASRS
- 1000 E. University Ave. Laramie, WY 82001
- Phone: 307.462.0000
- Fax: 307.462.0001
- Email: ceep@uwyo.edu



A Vision for the Future

- Build a reputation for solid, insightful analysis
- Communicate the findings to a wide audience
 - Web presence will be key
 - Leverage our international presence
- Build collaborative relationships with other schools and institutes
- Secure long term sources of support, working with
 - School of Energy Resources
 - University of Wyoming Foundation

1	 <p><i>Wyoming</i> College of Engineering and Applied Science</p> <p>Facility Development Plan (Positioning the College for the next 50 years)</p>
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2	<p>Presentation Outline</p> <p>UNIVERSITY OF WYOMING</p>
CEAS Facility Planning EIC Meeting, August 27, 2010	<ol style="list-style-type: none"> 1. Plan outline 2. Motivation 3. Priorities 4. Engineering Research Facility* 5. Renovation of "Sawtooth" (Eng Bldg core) 6. Discussion <p>*Main focus of this presentation</p>


3	<p>Plan Outline</p> <p>UNIVERSITY OF WYOMING</p>
CEAS Facility Planning EIC Meeting, August 27, 2010	<p>Immediate term – Upgrade existing space (now)</p> <p>Near-term – Eng. Research Facility (3 yrs)</p> <p>Longer-term – Sawtooth Renovation (5-10yrs)</p>

4

Motivation: Present Facility Inadequate*

UNIVERSITY OF WYOMING

Building lacks space, functionality, heart



General purpose classrooms used by all of UW

Petroleum Eng., Energy Systems Eng. Programs added in '06 and '09

Computer Science Dept added in '02

One floor largely occupied by WYDOT Design Squad

Deteriorated conc., the "Sawtooth"

* To meet expectations for contemporary, national-level engineering programs


ERIC Meeting, August 27, 2010

CEAS Facility Planning

5

Motivation: Present Facility Inadequate

UNIVERSITY OF WYOMING



The "Alamo"

ERIC Meeting, August 27, 2010

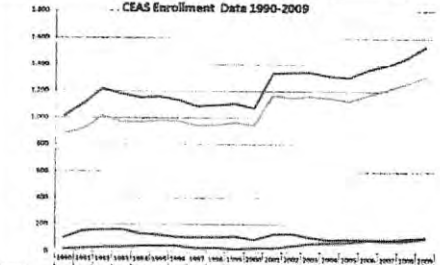
CEAS Facility Planning

6

Motivation: Enrollment Trends (+ve)

UNIVERSITY OF WYOMING

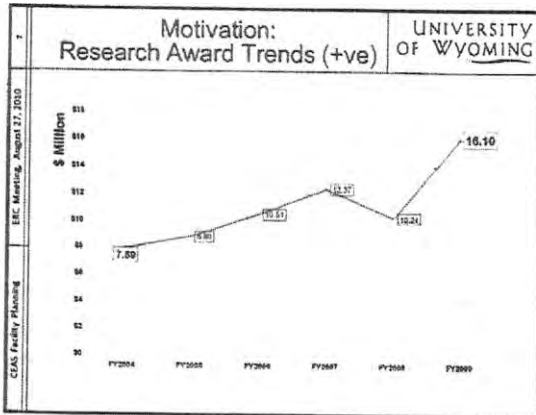
CEAS Enrollment Data 1990-2009



Year	MS	PhD	Undergrad	TOTAL
1990	107	106	568	781
1991	107	106	569	782
1992	108	107	570	785
1993	109	108	571	788
1994	110	109	572	791
1995	111	110	573	794
1996	112	111	574	797
1997	113	112	575	800
1998	114	113	576	803
1999	115	114	577	806
2000	116	115	578	809
2001	117	116	579	812
2002	118	117	580	815
2003	119	118	581	818
2004	120	119	582	821
2005	121	120	583	824
2006	122	121	584	827
2007	123	122	585	830
2008	124	123	586	833
2009	125	124	587	836

ERIC Meeting, August 27, 2010

CEAS Facility Planning



Motivation: Stimulating New Developments UNIVERSITY OF WYOMING

ERIC Meeting, August 27, 2010
CEAS Faculty Planning

- GE-Wyoming High Plains Coal Gasifier, Demonstration Facility (Cheyenne)
- NSF-NCAR, Wyoming Supercomputer (Cheyenne)
- School of Energy Resources (right next door)

New opportunities for research and education

Motivation: Role of Research in Engineering Education UNIVERSITY OF WYOMING

ERIC Meeting, August 27, 2010
CEAS Faculty Planning





UW has highest U.S. university research classification
Carnegie Research/Doctoral Extensive Institution

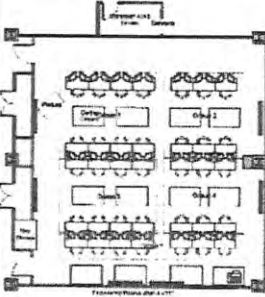

A good engineering education stresses innovation*

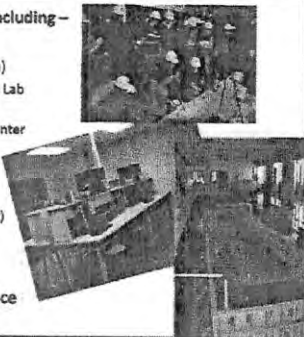
- To innovate usually means going "into the frontier of ignorance," "beyond the textbook" ... and doing research
- Engineering practice often entails conducting and/or evaluating research work done by others


**Wyoming's economic development relies on innovation, not just on reaction to problems*

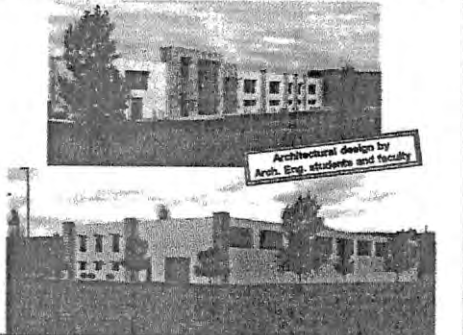
CEAAS Facility Planning EDC Meeting, August 27, 2010	10	Priorities (all high)	UNIVERSITY OF WYOMING
	<ul style="list-style-type: none"> • Upgrade facilities* in the Engineering Building (being done) • Acquire additional space to enable the college to increase its capacity for research and research-related education (<u>pursue an additional building – Eng. Research Facility</u>) • Renovate “Sawtooth” core of Engineering Building to improve teaching facilities and ambience (lay groundwork for renovation) <p><small>*classrooms, labs, offices</small></p>		

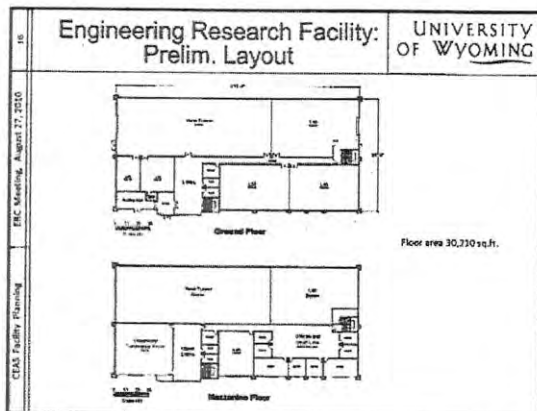
CEAAS Facility Planning EDC Meeting, August 27, 2010	11	Eng Bldg Upgrade: Classroom Renovation	UNIVERSITY OF WYOMING
	<div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%; text-align: center;">  <p>Room 2110</p> </div> <div style="width: 50%; text-align: center;">  <p>Room 2111</p> </div> <div style="width: 50%; text-align: center;">  <p>Room 2112</p> </div> <div style="width: 50%; text-align: center;">  <p>Room 2113</p> </div> </div>		

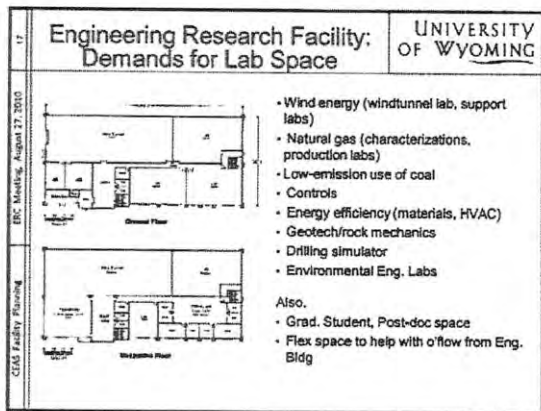
CEAAS Facility Planning EDC Meeting, August 27, 2010	12	Eng. Bldg Renovation: Integrated Simulation Data Room	UNIVERSITY OF WYOMING
	<div style="display: flex;"> <div style="flex: 1;">  </div> <div style="flex: 1; padding-left: 10px;"> <p>Integrated Simulation Data Center (Ercane) in a setting similar to actual data centers provide access to leading exploration and production modeling software: ECLIPSE, PETREL (Schlumberger), plus LANDMARK (Halliburton)</p> <p><i>Ribbon-cutting October 7, 2010</i></p> </div> <div style="flex: 0.5;">  </div> </div>		

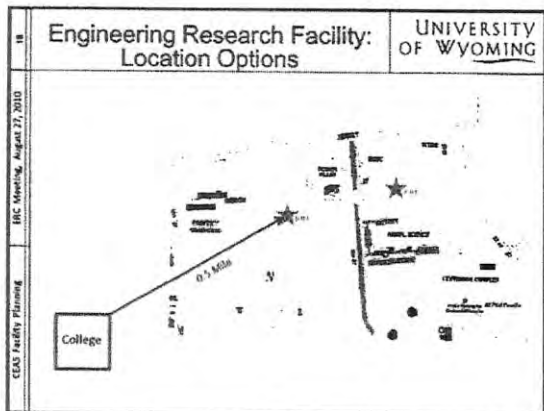
13	ERC Meeting, August 27, 2010	CEAS Facility Planning	Eng Bldg Upgrade: Lab Development	UNIVERSITY OF WYOMING
			<p>Renovations/upgrades, including –</p> <ul style="list-style-type: none">• Water Resources Eng. Lab• Power Systems Lab (<i>Nicholson</i>)• 3-Phase Flow in Porous Media Lab (<i>Encana</i>)• Integrated Simulation Data Center (<i>Encana, Schl. Hal.</i>)• Pump Lab• Rock & Fluids Lab (<i>BP</i>)• Prof. Beach Controls Lab (<i>Pivic</i>)• Structures Lab (<i>Kester</i>) <p>But, Eng. Bldg lacks capacity for more lab space</p>	

14	ERC Meeting, August 27, 2010	CEAS Facility Planning	Engineering Research Facility	UNIVERSITY OF WYOMING
			 <p>Architectural design by Arch. Eng. students and faculty</p>	

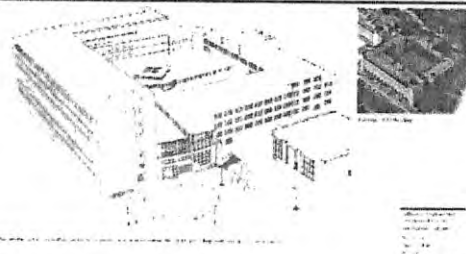
15	ERC Meeting, August 27, 2010	CEAS Facility Planning	Engineering Research Facility	UNIVERSITY OF WYOMING
			 <p>Architectural design by Arch. Eng. students and faculty</p>	







19 ERIC Meeting, August 27, 2010 CEAS Facility Planning	Budget Approach	UNIVERSITY OF WYOMING
	Estimated cost of building: ≤ \$13M Raise 50% from gifts Seek 50% state match from AML Funds	

20 ERIC Meeting, August 27, 2010 CEAS Facility Planning	Longer-term Phase (in 5-10 years): Renovate Sawtooth	UNIVERSITY OF WYOMING
	A New Core for Engineering and Applied Sciences 	

21 ERIC Meeting, August 27, 2010 CEAS Facility Planning	Budget Approach	UNIVERSITY OF WYOMING
	Estimated cost of building: \$25M to \$30M Raise 33% from donations; seek state match 33%; raise bonds . . . approach to be determined	

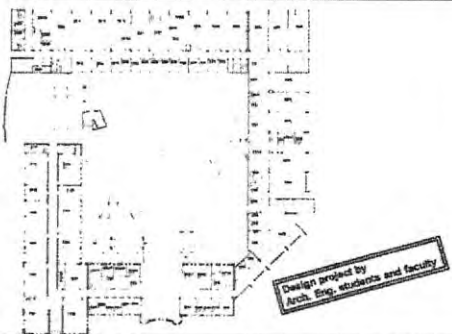
22

Sawtooth Renovation:
Focus, Access, Connectivity

UNIVERSITY
OF WYOMING

ERIC Meeting, August 27, 2010

CEAS Facility Planning



Design project by
Arch, Eng, students and faculty

23

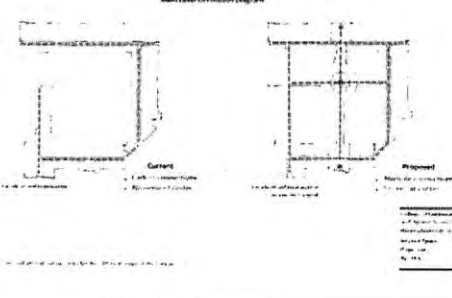
Sawtooth Renovation:
Focus, Access, Connectivity

UNIVERSITY
OF WYOMING

ERIC Meeting, August 27, 2010

CEAS Facility Planning

Main Level Circulation Diagram



Current

Proposed


Notes: See circulation diagram for details.

Scale: 1/8" = 1'-0"

Page: 10

8/27/10

Creating a Professional Atmosphere



and faculty


Notes: See circulation diagram for details.

Scale: 1/8" = 1'-0"

Page: 11

8/27/10

College of Engineering and Applied Science
The Need for Renovation



Design project by
Arch. Eng. students

28	EAC Meeting, August 27, 2010	CEAS Facility Planning	Sawtooth Renovation: Focus, Access, Connectivity	UNIVERSITY OF WYOMING
			Thanks; we're keen to learn your thoughts!	

A proposed name change for the
Department of Chemical and Petroleum Engineering
University of Wyoming

Proposed Name Change

The Department of Chemical and Petroleum Engineering at the University of Wyoming seeks to update its name as the

Department of Energy, Chemical, and Biological Engineering.

A critically important aspect of the proposed name change is that there are no changes accompanying the degree granting programs in the Department. In particular, the Department will still offer ABET accredited B.Sc. degrees in

- **Petroleum Engineering**
- **Chemical Engineering**

The name updating reflects the exciting contemporary trends in chemical and petroleum engineering. The Department believes this change will substantially strengthen both programs by attracting more students to them with an accompanying increase in student diversity. There is national recognition for the need to draw more students into these important and rapidly evolving fields of engineering. The proposed name change also better characterizes the Department's mission and alignment with current industry needs.

Background

Energy: A key component of the proposed name change is to replace the word *petroleum* with *energy*. There is a widespread and growing awareness in the oil and gas industry that the careers of graduates from the Department's petroleum engineering program require a broadened knowledge base and skill-set, encompassing not only oil, but also natural gas, coal-bed methane, and CO₂ sequestration. Contemporary graduates increasingly are expected to be familiar with these topics and the advanced technologies associated with them. The Department's and College's Advisory Boards indicate that, while oil is certainly an important aspect of petroleum engineering, the majority of new US undergraduates in petroleum engineering are expected to work in the natural gas industry. The *energy industry* is a much more appropriate descriptor that encompasses all of these fields.

The word petroleum often conveys a negative connotation (to the general public), as it relates to engineering. Common misperceptions of the petroleum industry include one of being viewed as solely tied to the oil industry, as being old or low-technology, and as comprising a "dirty" or polluting industry. These misperceptions are driven in part by a few highly-visible world events. They are undeserved, and do not recognize the complex sophisticated reality of contemporary oil and gas engineering, as the following points indicate:

- The expertise associated with petroleum engineering is at the center of one of the world's greatest green challenges, the capture and storage of CO₂. The state of Wyoming is a major player in carbon capture research—a unique aspect of *energy engineering*.
- Petroleum engineering is a sophisticated, high-tech branch of engineering. Two of the largest computing clusters at UW are located within the Department's Petroleum Engineering Program. Computational modeling of three-phase flow of oil, gas, and water in porous media is among the most challenging numerical problems of the day.
- Petroleum engineering is rapidly evolving with exciting new technological advancements. Examples include deep water drilling, horizontal drilling, hydraulic fracturing, and carbon capture and storage. Some of these technologies have only emerged in the last decade as a world-wide focus has been directed to energy and the environmental impacts of energy development.

The merits of the prospective name change for petroleum engineering are being discussed at the national scale. For instance, the Society of Petroleum Engineers met this past year and discussed a name change for many of the reasons cited above. In the end, they retained the name because of its international recognition. While energy is an international issue, the Department's focus on undergraduate recruiting is centered on Wyoming and the nation. The potential marketing benefits of the proposed name change to our K-12 youth far outweigh the value of any lost international recognition, and will enhance recruitment of students to the Department's Petroleum Engineering Program.

Biological: Chemical engineering is in the midst of a sustained national movement into the field of biological engineering, a major rapidly developing area driven largely by technological advances related to the ability to quantify, and work with, biology at sub-cell and molecular levels. Indeed, biological engineering articles are beginning to dominate major journals of chemical engineering. UW continues to gain strength in the field of bio-chemical engineering as two full-time faculty members are devoted to this field, and the Department offers an option in Biological Engineering.

Growing evidence shows that biological engineering strongly appeals to students considering an engineering career. For example, Professor David Dandy, a member of the Department's Advisory Board, and Chair of the Department of Chemical and Biological Engineering at Colorado State University (CSU), indicates that his department has doubled its enrollment since it advanced into the area of biological engineering. CSU effectively marketed this focus on a new frontier in chemical engineering by adding the word *biological* to their department name in 2006. Finally, the evidence indicates bio-chemical engineering has increased appeal to prospective women students. Increasing the number of women engineering students is a significant goal for the Department and College; presently only 16% of the College's engineering undergraduates are women.

Consultative Steps

Recognizing that several constituencies have close interest in the quality of its programs, the Department has taken the following consultative steps regarding the program name change:

- Over the past year, a series of informal conversations with employers of the Department's graduates.

- Informal discussions with students (present and prospective).
- A faculty retreat in early April 2010 produced three important outcomes. First, recognizing the growing importance of natural gas engineering, the Department has elected to strengthen the curricula of natural gas engineering. Second, similar recognition was given to biological engineering. Third, the Department developed, and strongly endorsed, the proposed name change.

The level of enthusiasm for the proposed name change was truly remarkable among the faculty. Moreover, Joe Leimkuhler, a prominent national figure in petroleum engineering and Chairman of the Department's Advisory Board, attended our faculty retreat and was also an ardent supporter of the name change. Joe is the manager of Offshore Well Delivery for Shell and a past President of the American Association of Drilling Engineers.

- During its April 2010 meeting, the Department's Advisory Board strongly supported the proposed Department name change as well as the commitment to natural gas engineering. The Board includes senior engineers from a range of oil and gas companies including Shell, BP, Williams, and Ultra. Additional support was voiced for the Department's advance into biological engineering.
- At its April 2010 meeting, the College's National Advisory Board voted unanimously in favor of the the proposed new name for the Department. The level of Board support was such that the Board asked that the meeting's Minutes read "enthusiastically support the proposed adjustments and name change." Board members from the oil-and-gas industry included Eric Marsh of Encana, and Dick Agee of Wapiti Energy.

The proposed name change is consistent with a national movement in chemical and petroleum engineering, as changes in program content, name, or presentation are underway. Peer programs of petroleum engineering are adjusting to reflect a broadened focus on oil and gas engineering, and energy engineering generally, for example at the Universities of Kansas, Oklahoma, and Calgary. Stanford's Department of Energy Resource Engineering houses its MS and Ph.D. degrees in petroleum engineering.

Peer programs of chemical engineering have also contemporized their curricula and name to reflect the importance of biological engineering. For example, the Universities of California-Berkeley, Penn State, Ohio State, Cornell, and Houston, among others, now have a Department of Chemical and Biomolecular Engineering. In a press release by the University of California-Berkeley, justification for the change was noted with the statement: "This new name more accurately represents the scope of current teaching and research in the department." The rationale provided succinctly sums up the driving force behind the proposed name change at UW.

APPENDIX H

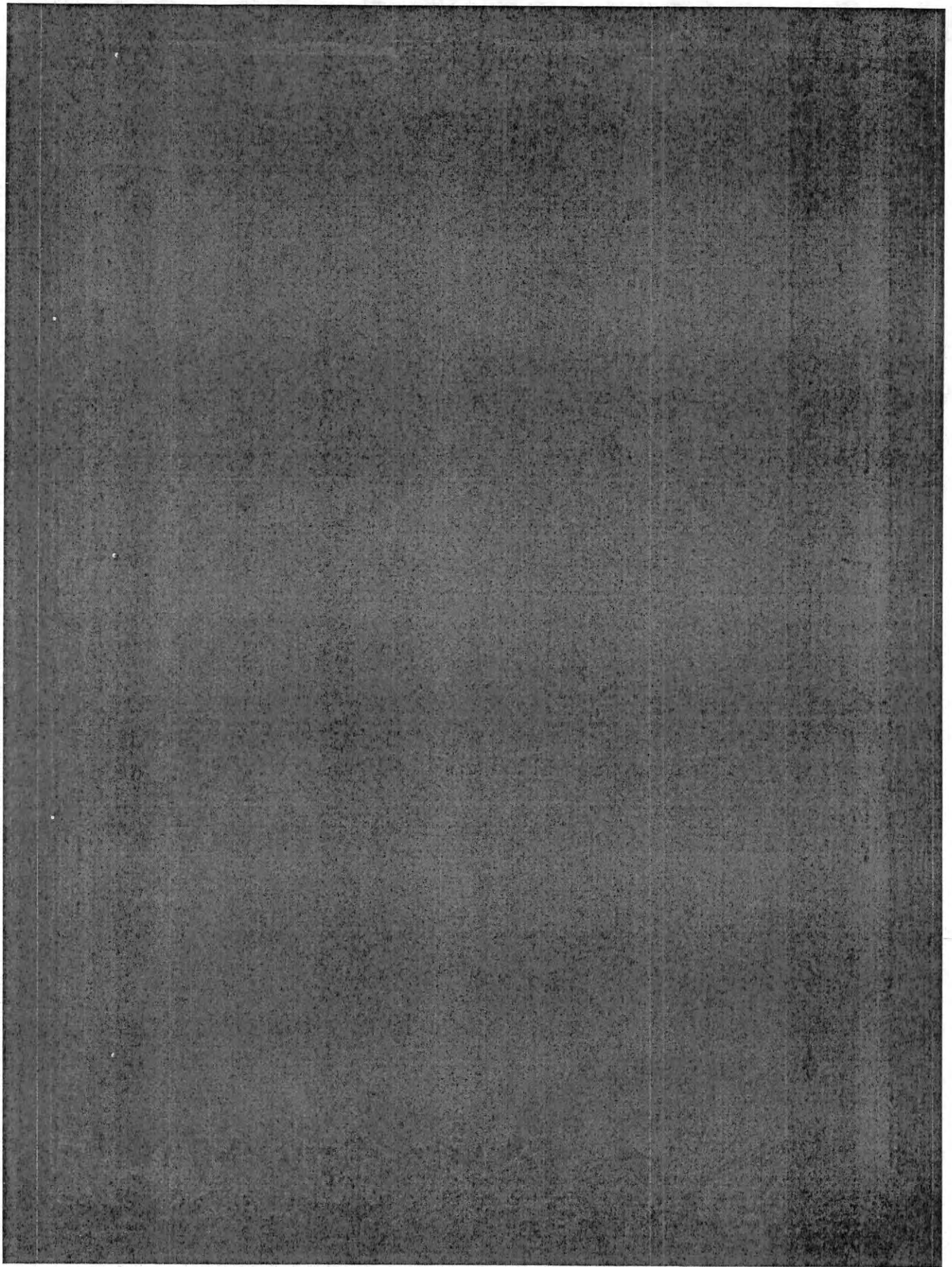


UNIVERSITY OF WYOMING

UW'S ENERGY INITIATIVES:
Science and Technology
For Wyoming's Future

DRAFT





UNIVERSITY OF WYOMING'S ENERGY INITIATIVES: SCIENCE AND TECHNOLOGY FOR WYOMING'S FUTURE

INTRODUCTION

As Wyoming's only accredited, four-year research university, the University of Wyoming accepts a special responsibility to invest in activities that help build a sound, long-term economic future of the state. The state legislature provided the means to raise energy-related scholarship to new levels effort in 2005, when they established the School of Energy Resources. Since that time, UW has challenged itself to build a broad base of expertise across the institution to become one of the world's premier centers of expertise in energy-related science, technology, policy, and economics.

This brief document summarizes progress in four areas:

- ▶ Development of new areas of interdisciplinary, energy-related research and scholarship;
- ▶ Preparation of a professional workforce;
- ▶ Infusion of new financial and in-kind resources; and
- ▶ Contributions to Wyoming's economic development

DEVELOPMENT OF NEW AREAS OF INTERDISCIPLINARY ENERGY-RELATED RESEARCH AND SCHOLARSHIP

EXPANSION OF FACULTY EXPERTISE AND COLLABORATION

The original legislation creating the UW School of Energy Resources provided funding for 12 distinguished professorships to attract faculty members who have achieved international recognition for their teaching and research in fields related to energy. These positions would in turn advance UW's teaching and research missions and support the ongoing recruitment of junior faculty members. Initially, the emphasis was to hire faculty with expertise in the areas related to: oil and gas, coal, coalbed natural gas, renewable energy resources, and the economics of energy resources.

Since 2006, all 12 positions have been filled with professionals with expertise from myriad disciplines critical to the energy industry.

DR. PO CHEN, ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS

Ph.D. in seismology, University of Southern California

Dr. Chen, a computational seismologist, is focused on the development and applications of advanced seismic-imaging techniques for oil and gas exploration, carbon sequestration, and analysis of the origin and dynamics of the Earth. Recent advances in parallel-computing technology have made possible new seismic-imaging techniques with much higher resolution than conventional techniques.





**DR. TIMOTHY CONSIDINE,
PROFESSOR OF ECONOMICS AND FINANCE**

Ph.D. in natural resource economics, Cornell University

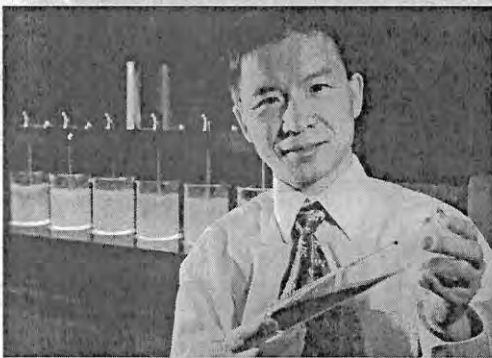
Dr. Considine's research focuses on applied economic and econometric analysis of policy and planning issues facing energy industries. His goal is to understand the broad socioeconomic and policy forces affecting primary fuel markets, including coal, natural gas, petroleum, nuclear energy, wind, solar, and emerging renewable energies. His research includes the impact of Powder River Basin coal and the prospects and economic impacts of developing unconventional natural gas.



**DR. CRAIG DOUGLAS,
PROFESSOR OF MATHEMATICS**

Ph.D. in computer science, Yale University

Dr. Douglas is working in the field of high-performance computing using highly parallel computers. He uses remote-sensor networks to create numerical simulations that reveal symbiotic relationships among the sensor-provided data; the mathematical, computational, and physical or chemical models of the basic problem; and the visualization and steering of the simulation.



**DR. MAOHONG FAN, ASSOCIATE PROFESSOR
OF CHEMICAL AND PETROLEUM ENGINEERING**

Ph.D. in chemical engineering, Osaka University; Ph.D. in mechanical engineering, Iowa State University; Ph.D. in environmental engineering, Chinese Academy of Sciences

Dr. Fan's research expertise includes applications of nanostructure materials and combined nano-bio technologies in chemical and environmental engineering as well as fossil-fuel-based energy production. Dr. Fan is interested in the identification and removal of pollutants in water, wastewater, and air. He is also involved in the development of green-chemical manufacturing.



**DR. KRISTINA HUFFORD, ASSISTANT PROFESSOR
OF LAND RECLAMATION/RESTORATION
ECOLOGIST**

Ph.D. in botany, University of Georgia

Dr. Hufford's major research interests include plant molecular genetics, ecology of native plant communities and ecosystems, and restoration of disturbed plant communities. In 1999, she was named winner of a GCA Award in tropical botany for her research on mating systems and genetic diversity in tropical trees. She conducted her field research in Panama at the Smithsonian Tropical Research Institute.

DR. JOHN KASZUBA, ASSOCIATE PROFESSOR OF GEOLOGY AND GEOPHYSICS

Ph.D. in geochemistry, Colorado School of Mines

Dr. Kaszuba is a geochemist specializing in subsurface interactions. He joined the University of Wyoming after 10 years as a research scientist at Los Alamos National Laboratory. He is a recognized expert in geologic carbon sequestration.



DR. SUBHASHIS MALLICK, PROFESSOR OF GEOLOGY AND GEOPHYSICS

Ph.D. in geology and geophysics, University of Hawaii

Dr. Mallick is a theoretical seismologist specializing in seismic waveform modeling, inversion, and anisotropy. He is developing a waveform inversion algorithm for anisotropic viscoelastic media. His work includes combining seismic inversion with electromagnetic inversion and the application of this methodology in time-lapse monitoring of carbon sequestration aquifers.



DR. BRUCE PARKINSON, PROFESSOR OF CHEMISTRY

Ph.D. in chemistry, California Institute of Technology

Dr. Parkinson's energy-related research projects are concerned with the conversion of solar energy directly to electricity and fuels. Dr. Parkinson investigates new types of solar cells that may reduce the cost of photovoltaic electricity. In addition, he is working to discover and develop novel materials that can produce hydrogen and oxygen directly from sunlight and water. Hydrogen is a clean-burning, renewable fuel that can be used for transportation, heat, and energy generation.



DR. FELIPE PEREIRA, PROFESSOR OF MATHEMATICS

Ph.D. in applied mathematics, SUNY-Stony Brook University

Dr. Pereira is making his mark in the world of Applied Mathematics by modeling the flow of oil and natural gas in underground reservoirs—information needed for the efficient extraction of these precious resources. Dr. Pereira is also applying this data to determine how best to inject and sequester carbon dioxide beneath the Earth's surface to reduce its contribution to climate change.

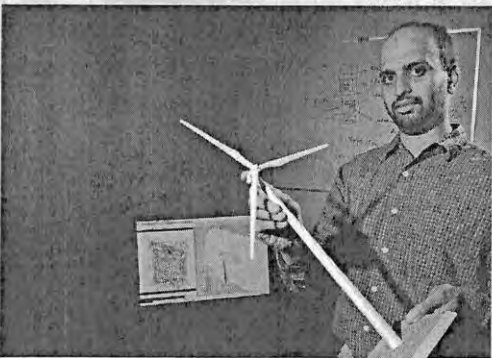




DR. GUAN QIN, ASSOCIATE PROFESSOR OF CHEMICAL AND PETROLEUM ENGINEERING

Ph.D. in petroleum engineering, University of Wyoming

With collaborations across multiple disciplines, Dr. Qin's research portfolio has centered on the applications of advanced mathematical tools and computing technology in modeling and simulating subsurface fluid flows. His research interests cover the following broad areas: reservoir modeling; reservoir simulations; reconfigurable computing; and data center and data integration.



DR. JAY SITARIMAN, ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

Ph.D. in aerospace engineering, University of Maryland

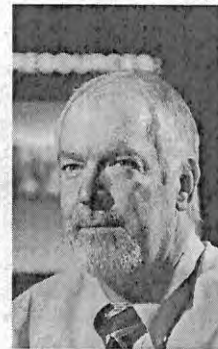
Dr. Sitariman is interested in the development of parallel and scalable overset, grid-based Computational Fluid Dynamics (CFD) methods and their application to interesting physical problems with moving bodies and aeroelasticity. In the context of CFD methods, he explores various concepts such as methods for grid generation/deformation, algorithms for overset domain connectivity, dynamic-solution-based mesh adaptation, and higher-order schemes.

In addition, the School of Energy Resources boasts leadership also featuring academic emphases from diverse disciplines related to energy.

DR. MARK NORTHAM, DIRECTOR

Ph.D. in organic geochemistry, University at Texas at Austin

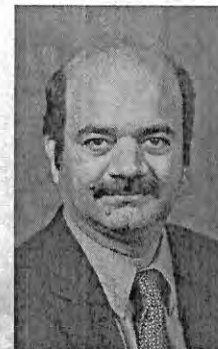
Dr. Northam brings broad energy research, operations, and administration experience to the School of Energy Resources and the University of Wyoming. His expertise includes energy exploration and development, basin analysis, organic geochemistry, and carbon management. Prior to joining UW, Dr. Northam worked in the energy industry for more than 20 years with Exxon Mobil, Mobil, and Saudi Aramco, both domestically and internationally.



DR. KATTA JAYARAM (KJ) REDDY, PROFESSOR OF RENEWABLE RESOURCES AND ASSOCIATE DIRECTOR OF ACADEMICS

Ph.D. in environmental quality, Colorado State University

Dr. Reddy is an internationally recognized scientist for his research on the capture and mineralization of anthropogenic carbon dioxide, arsenic removal from water, and coal-bed methane energy. He has also worked extensively with energy areas, including surface-coal mining, coal power plants, and the uranium and oil shale industries. Dr. Reddy has published extensively in national and international journals and holds one U.S. patent.



**DR. DON ROTH,
PROFESSOR OF MOLECULAR BIOLOGY AND ASSOCIATION DIRECTOR**

Ph.D. in microbiology, Virginia Polytechnic Institute and State University

Dr. Roth's areas of research specialization is virus host interactions. Dr. Roth has also served as dean of the UW Graduate School. Today, in addition to his role as associate director of the School of Energy Resources, he is director of the Biomedical Sciences Graduate Program. He has authored more than forty peer-reviewed journal articles and holds three U.S. patents.



However, the expertise in energy related research and scholarship is not limited to the positions located in the School of Energy Resources. There is a depth and breadth of excellence in energy related scholarship across all of UW's academic colleges. Below are brief descriptions of a sampling of these faculty and their research specialties:

**MR. DENNIS STICKLEY,
VISITING PROFESSOR OF LAW**

J.D., University of Wyoming, L.L.M. University of Utah

Dr. Stickley specializes in oil and gas law and economics, and works to foster collaboration between energy, environment, and natural resource experts. He teaches oil and gas law, energy law and policy, and insurance law.

**DR. LAWRENCE J. MACDONNELL,
PROFESSOR OF LAW**

*J.D., University of Denver College of Law, PhD,
Colorado School of Mines*

Dr. MacDonnell teaches water rights, public lands, and natural resource law. His expertise is on water, natural resources, and the environment, particularly in the area of environmental sustainability. He has authored more than forty journal articles, books and book chapters.

**DR. VICTOR GINTING,
ASSISTANT PROFESSOR OF MATHEMATICS**

PhD, Texas A&M University

Dr. Ginting specializes in the mathematical and numerical aspects of multiscale phenomena in applications including porous media. Together with UW researchers Craig Douglas, Fred Furtado, Felipe Pereira and Mohmammad Piri he is involved in developing a high-performance tool for the simulation of carbon dioxide injection into deep saline aquifers.

**DR. DEBASHIS DUTTA,
ASSISTANT PROFESSOR OF CHEMISTRY**

PhD, University of Notre Dame

Dr. Dutta's research involves the design of micro- and nano-fluidic instrumentation. The applications of this work include design of microfluidic fuel cell devices with improved power generation capability.

DR. JINKE TANG, PROFESSOR OF PHYSICS

PhD, Iowa State University

Dr. Tang's research specialty is in the area of experimental condensed matter physics and materials science. One area of application is the magnetic and electronic transport properties of nonstructured oxides and thin films. A second area is in novel thermoelectric materials that can be used for energy conversion, for example, generating electricity from car exhaust, waste heat, and geothermal energy. His group also works on energy efficient white light emitting diodes that may eventually replace incandescent and fluorescent light bulbs.

**DR. CHARLES F. MASON, PROFESSOR
OF ECONOMICS AND FINANCE**

PhD, University of California, Berkeley

Dr. Mason has a long-standing interest in resource economics, especially exploration and extraction of non-renewable resources and issues regarding common-property resources, particularly those that are renewable. He holds the H.A. "Dave" True Chair in Petroleum and Natural Gas Economics.

DR. OWEN R. PHILLIPS, PROFESSOR OF ECONOMICS AND FINANCE

PhD, Stanford University

Dr. Phillips' field of expertise is in the area of industrial organization. He has been a member of the Enhanced Oil Recovery Institute since 2006, and has published on the economics of enhanced oil recovery, and CO₂ demand for this process.

DR. KLAAS T. VAN'T VELD, ASSISTANT PROFESSOR OF ECONOMICS AND FINANCE

PhD, University of California, Berkeley

Dr. Van't Veld specializes in environmental and natural resource economics. He is a participant in the Big Sky Carbon Sequestration Partnership and has written about the effect of rising carbon prices on carbon management strategies.

MR. THOMAS FOULKE, RESEARCH SCIENTIST, AGRICULTURAL AND APPLIED ECONOMICS

M.S., Agricultural Economics and Water Resources, University of Wyoming

Mr. Foulke specializes in energy feasibility and economics, community economic development and enterprise costs and returns. He maintains the Wyoming Economic Atlas along with Drs. Taylor and Coupal. He has written on the economic impact of uranium production in Wyoming, undertaken feasibility studies of siting advanced coal gasification plants in Wyoming, and provided the economic analysis for the feasibility of growing feedstock for biofuels in Wyoming.

DR. ROGER COUPAL, PROFESSOR OF AGRICULTURAL AND APPLIED ECONOMICS

PhD, Washington State University

Dr. Coupal studies natural resource policy and community development. His objective is to provide educational opportunities for students, community groups and public officials engaged in policy issues that reside in the nexus of community development and natural resource policy.

DR. MATT ANDERSON, ASSISTANT PROFESSOR OF AGRICULTURAL AND APPLIED ECONOMICS

PhD, University of California, Davis

Dr. Anderson's research interests include economics of natural resources and applied econometrics. He is currently involved in research to understand disruption and recovery of ecological structures and functioning for restoration of disturbed Wyoming ecosystems.

DR. PAUL HELLER, PROFESSOR OF GEOLOGY

PhD, University of Arizona

Dr. Heller specializes in sedimentation and tectonics, particularly the sedimentary response to tectonic, climatic and sea level changes over various time scales. These processes lead to the formation of reservoirs, traps, and seals for hydrocarbons and also create environments for geologic storage of carbon dioxide. Dr. Heller's applied research is funded by various energy companies and the Clean Coal Task Force.

DR. JAMES D. MYERS, PROFESSOR OF GEOLOGY

PhD, Johns Hopkins University

Dr. Myers is director of the Wyoming Carbon Capture and Storage Technology Institute, a professional training institute funded by the Department of Energy. He also teaches courses in energy resources to university students, public school teachers and university professors. Current research includes the development of protocols for cataloging well bores and other artificial penetrations within areas targeted for geologic storage of carbon dioxide; these projects are funded by the Department of Energy and by the Clean Coal Task Force.

DR. ERIN CAMPBELL-STONE, ASSOCIATE LECTURER OF GEOLOGY

PhD, University of Wyoming

Dr. Campbell-Stone is a structural geologist whose current research includes surface and subsurface structural evaluation of potential sites for geologic sequestration of carbon dioxide, both at the Moxa Arch and Rock Springs Uplift in southwestern Wyoming.

She provides structure contour maps, creates three-dimensional models of the fault networks within sealing horizons, determines fault offsets, predicts fracture density and fracture orientations to generate complete three-dimensional geologic models.

DR. CAROL D. FROST, PROFESSOR OF GEOLOGY AND TEMPORARY VICE PRESIDENT OF SPECIAL PROJECTS

PhD, Cambridge University

Dr. Frost applies isotopic tracers to understand the evolution of the continental crust, including problems related to energy and the environment. Her work includes fingerprinting coalbed natural gas produced waters using Sr and C isotopic compositions to monitor changes in groundwater hydrology that result from dewatering during coal bed methane production or from surface mining activity and to trace these waters following discharge at the surface. She also led a multi-investigator carbon sequestration site characterization study of the Moxa Arch, Wyoming, and secured several additional institutional research contracts related to geologic carbon sequestration for the School of Energy Resources.

DR. CARRICK EGGLESTON, PROFESSOR OF GEOLOGY

PhD, Stanford University

Dr. Eggleston is an environmental geochemist who studies mineral-water interface chemistry, geomicrobiology, and photoelectrochemistry. His work on sunlight-driven oxidation of water on iron oxide photocatalytic films by chemical vapor deposition, and on strontium titanite films with the capability of photoelectrochemically reducing carbonate species to formate and methanol, contribute to the better utilization of solar energy.

MR. MILTON E. GEIGER, ASSOCIATE EXTENSION EDUCATOR

M.S. University of Wyoming

Mr. Geiger is the Energy Extension Coordinator for the Cooperative Extension Service. He has studied the effects of national climate change legislation on oil, gas, coal and wind energy production in Wyoming.

DR. NORM MORROW, PROFESSOR OF PETROLEUM ENGINEERING

PhD, University of Leeds

Dr. Morrow specializes in hydrocarbon recovery and oil recovery by spontaneous imbibition and water flooding, including oil, brine, rock interactions, surface chemistry of adsorption and wetting, and multiphase flow in porous media. He holds the Wold Chair at the University of Wyoming.

DR. MOHAMMAD PIRI, ASSISTANT PROFESSOR OF PETROLEUM ENGINEERING

PhD, Imperial College, London

Dr. Piri's research focuses on multiphase flow in porous media with applications to oil and gas recovery, pore-scale modeling of displacement processes, two- and three-phase relative permeabilities, wettability, and geologic CO₂ sequestration.

DR. VLADIMIR ALVARADO, ASSISTANT PROFESSOR OF PETROLEUM ENGINEERING

PhD, University of Minnesota

Dr. Alvarado's research focuses on enhanced oil recovery activities, especially on understanding the low mechanisms for the development of enhanced oil recovery in order to create robust reservoir simulation models. Recently he has been involved in Department of Energy funded geologic sequestration studies, collaborating with faculty in the Department of Geology and Geophysics.

DR. WENYONG WANG, ASSISTANT PROFESSOR OF PHYSICS

PhD, Yale University

Dr. Wang's research interest is in the fabrication and characterization of nanoscale electronic devices. Current projects include fabrication and charge transport characterization of self-assembled molecular junctions, spin-dependent transport study of novel magnetoelectronic devices, characterization of nanoscale conductors, and electrical characterization of organic conductors and semiconductors. He is the principal investigator on a recent \$2.4 million award from the Department of Energy-EPSCoR program. Dr. Wang and six co-PIs will develop quantum dot-sensitized solar cells based on ternary metal oxide nanowires.

ENERGY RESEARCH FACILITIES

ENERGY RESOURCE CENTER

The Energy Resource Center, planned for the northwest corner for the UW campus, will provide a dynamic high tech facility that will enable real and virtual collaboration that will greatly enhance UW advanced energy-related teaching, research, and outreach missions. The center will serve as the home for the School of Energy Resources, the Enhanced Oil Recovery Institute, and visiting collaborators. It will also provide a home for student majoring in Energy Resource Science and graduate students. It will serve as a portal to energy programs at UW, including the interdisciplinary centers of excellence.

Supported by funds made available by the Wyoming State Legislature and industry leaders, construction on the new facility is scheduled to begin in spring 2011.

WYOMING RESTORATION AND RECLAMATION CENTER

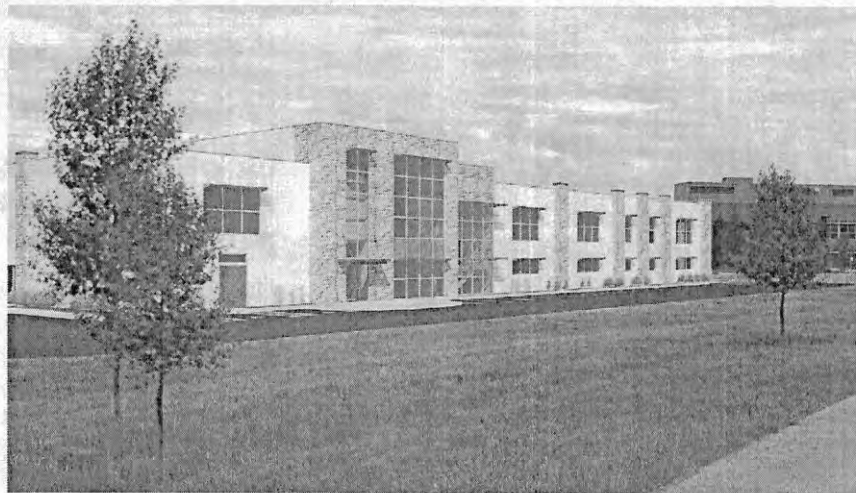
The Wyoming Reclamation and Restoration Center (WRRC) is an interdisciplinary research center housed within the College of Agriculture and works closely with the School of Energy Resources. Its mission is to:

- ▶ Train students to facilitate land reclamation and restoration projects based on applied and theoretical ecological principles.
- ▶ Develop best management practices in reclamation of disturbed lands.
- ▶ Provide extension and outreach to clientele seeking practical solutions for restoring, reclaiming, or rehabilitating disturbed lands.

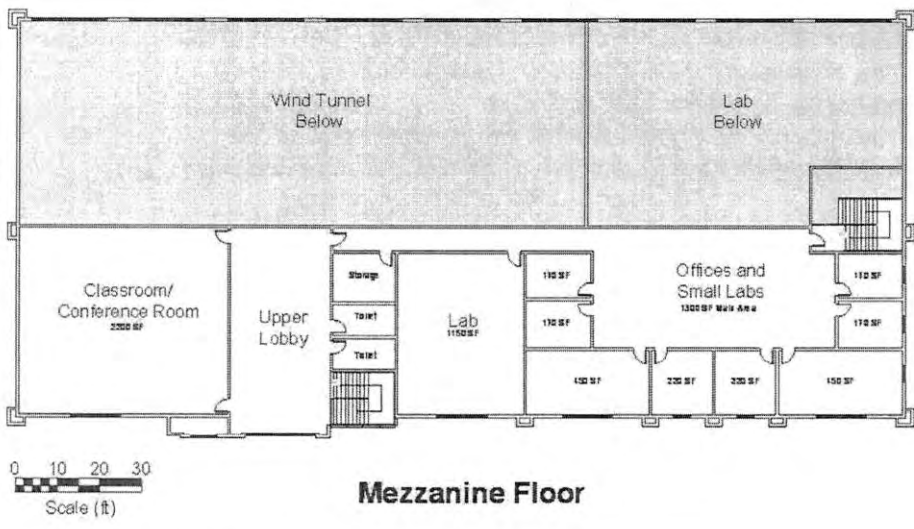
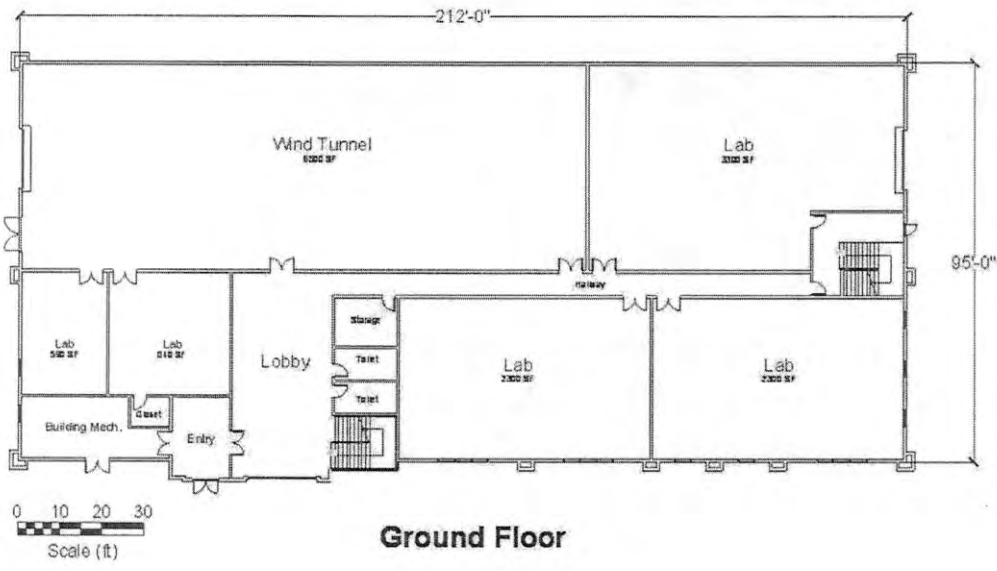
ENGINEERING RESEARCH LABORATORY

A planned Engineering Research Laboratory will house laboratories focused on selected aspects of natural gas, wind, coal, oil and energy efficiency. The facility will provide the necessary environment for experiments in areas including:

- ▶ Wind energy (including a wind tunnel and other labs)
- ▶ Natural gas engineering (a characterization lab and a production lab)
- ▶ Energy efficiency for buildings (materials, HVAC)
- ▶ Geotechnical/rock mechanics
- ▶ Low emission use of coal
- ▶ Control systems
- ▶ Drilling simulator (largely for instruction use)
- ▶ Internal combustion engines (for research and instruction)



View of the front of the Engineering Research Laboratory (rendition drawing)



Draft floor plan of Engineering Research Laboratory

ENHANCED OIL RECOVERY INSTITUTE

The Enhanced Oil Recovery Institute resides in the School of Energy Resources and is funded by the Wyoming State Legislature. It employs scientists and engineers to provide research and information that will promote the recovery of Wyoming's stranded oil. It assists Wyoming operators with their enhanced oil recovery (EOR) projects by applying existing techniques and creating new knowledge when necessary, helping to maximize the economic potential and minimize the risk of EOR projects, facilitating testing, evaluation, and documentation of EOR recommendations in real-world settings, and transferring information to Wyoming producers through partnerships and conducting workshops and conferences.



Encana Three-Phase Flow Laboratory in action. Graduate student Morteza Akbarabadi and Dr. Mohammad Piri discuss flow experiments with supercritical CO₂. A CT scanner is at the horizontal orientation with a heated core-holder held by a vertical positioning system in the middle. The scanner is used to characterize three-phase flow in rock cores at reservoir conditions.

ENCANA THREE-PHASE FLOW LABORATORY

The Encana Three-Phase Flow Laboratory houses a CT scanner that provides 3-D images of rock-fluid experiments at a variety of temperatures and pressures to characterize three-phase flow in rock cores at reservoir conditions. The facility, overseen by Dr. Mohammad Piri, has been fully operational since 2008.

Although the Encana Three-Phase Flow Laboratory is primarily a research facility, there are opportunities for undergraduates to gain exposure to the research performed in the lab:

- ▶ Every semester, Dr. Piri takes students in PETE 4310 (Enhanced Oil Recovery) and PETE 4340 (Petroleum Economics) to visit the lab in order to connect the material discussed in class to the research work in the lab.
- ▶ Students involved in UW undergraduate research summer experiences perform work in the Laboratory. A current program is through the National Science Foundation using a grant coordinated through the UW Math Department.
- ▶ Dr. Piri hosts various visits coordinated by School of Energy Resources (SER), Summer Research Apprentice Program (SRAP), and the College of Engineering and Applied Science.

PREPARATION OF A PROFESSIONAL WORKFORCE

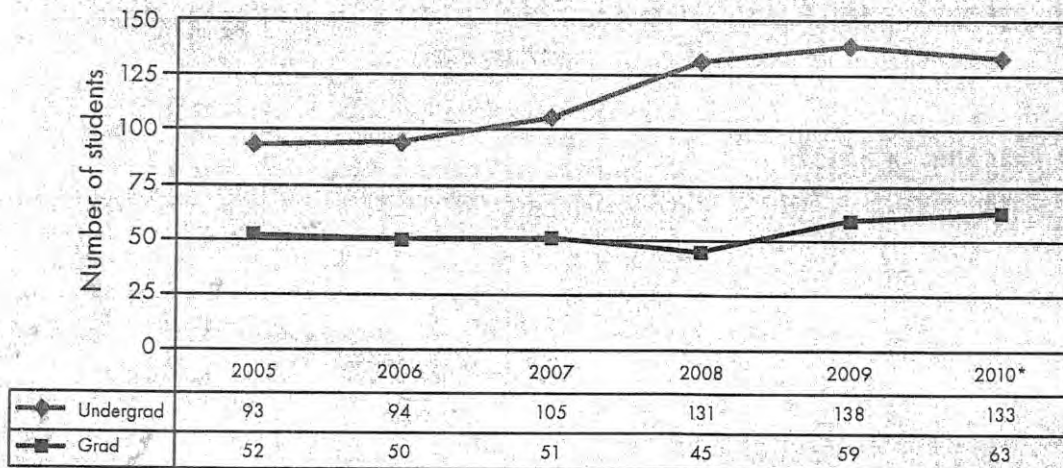
NEW AND EXPANDED ACADEMIC PROGRAMS

Since the establishment of the School of Energy Resources in 2005, UW has experienced a growth in student interest which may be gauged by the increase in enrollments in several key degree programs. Below is described the growth in undergraduate and graduate enrollments in the Department of Geology and Geophysics, a department with a long-standing reputation for excellence in teaching and research. In addition, there is a review the growth in the recently re-established undergraduate program in Petroleum Engineering and continued strength in the graduate Petroleum Engineering degree programs. Finally, the student interest in two new degree programs, Energy Resource Science and Energy Systems Engineering, is noted.

GEOLOGY AND GEOPHYSICS

In the past, the number of undergraduate students enrolled in degree programs in Geology and Geophysics have tended to rise and fall with the price of energy. The recent rise in undergraduate majors despite a recent decline from peak energy prices (from 93 in 2005 to 138 in 2009), suggests that UW may have overcome this roller-coaster pattern and can expect continuing high enrollments in this high quality program. Graduate student numbers, which are less affected by energy prices, have seen a noticeable increase from 45 in 2008 to 63 in 2010.

Department of Geology and Geophysics
Primary and Secondary Majors



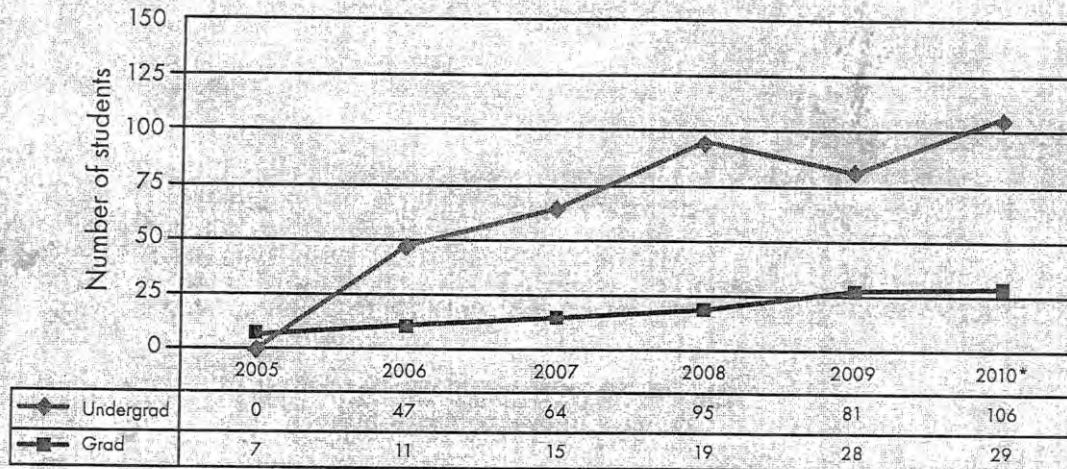
Fall semesters

*Fall 2010 preliminary data as of Day 1.

PETROLEUM ENGINEERING

The undergraduate program in Petroleum Engineering was re-established in 2006, and the blue line on the graph illustrates the tremendous student interest in the B.S. degree in Petroleum Engineering, which currently has over 100 majors. The graduate program also has experienced steady growth to nearly 30 students in 2010.

**Petroleum Engineering
Primary and Secondary Majors**



Fall semesters

*Fall 2010 preliminary data as of Day 1.

ENERGY RESOURCE SCIENCE

This undergraduate program administered by the School of Energy Resources first accepted students in fall 2009 and already there are 24 students majoring in the program. The goal of the Energy Resource Science degree program is to prepare students for the role of energy project manager, professionals who understand numerous disciplines and are able to bring together geologists, engineers, economists, business executives, environmental scientists, and others to plan and carry out successful, large-scale energy projects. The program focuses on the skills required to solve complex energy-related problems and the communicate solutions to a wide range of audiences.

ENERGY SYSTEMS ENGINEERING

This undergraduate program in the College of Engineering & Applied Science has attracted great interest and has 51 undergraduates enrolled as of the start of the 2010 fall semester. This degree program is designed to train engineers in traditional energy technologies and in alternative and environmentally-friendly energy conversion systems. The degree includes training in the environmental, legal, political, economic, and ethical aspects of new energy projects as well as in thermal, fluids, and energy conversion sciences.

NEW TEACHING RESOURCES

ENCANA INTEGRATED SIMULATION DATA CENTER

The Encana Integrated Simulation Data Center (ISDC), more commonly referred to as the Reservoir Simulation Lab, is approaching final completion. This remarkable facility will afford the opportunity for Chemical and Petroleum Engineering to teach a “next generation” series of courses related to reservoir simulation, drilling, and production of natural gas.

Extensive reservoir modeling software packages from Halliburton and Schlumberger have been donated to UW to support the lab. The department expects to make extensive use of the software as it builds up expertise in the use of the lab. A period of a several years will be needed to develop the level of instructional expertise needed to fully utilize ISDC.



Entrance sign and interior view of the Encana Integrated Simulation Data Center.

UNIT OPERATIONS LAB

The Unit Operations Laboratory is scheduled for a major renovation, enabled substantially from \$500K in Encana funds and additional support from ConocoPhillips. The renovation will commence upon completion of ISDC, and after renovation of Chemical and Petroleum Engineering's Interfacial Surface Science Laboratory, scheduled to be upgraded this coming academic year. The Unit Operations Laboratory is used primarily for undergraduate instruction, though it also is used for some research purposes.

Some renovation work associated with laboratories in the Engineering Building may be slowed somewhat during the coming year by extensive efforts to renovate classrooms in the building. This classroom renovation is facilitated by an infusion of stimulus funds made available to the university through the American Recovery and Reinvestment Action of 2009. An added benefit of stimulus funding is the expected renovation of two research labs and an upgrade to a student computer/study lab, all within the department.

OUTREACH PROGRAMS

WYOMING CARBON CAPTURE AND SEQUESTRATION TECHNOLOGY INSTITUTE

James D. Myers, professor of geology and geophysics, was recently awarded \$995,000 from the U.S. Department of Energy to develop the Wyoming Carbon Capture and Sequestration (CCS) Technology Institute (WCTI) at UW. This institute will implement training and technology transfer in Wyoming and the Rocky Mountain region. The WCTI will utilize an industry-wide model to train a professional workforce; provide pathways for graduates and professionals from allied fields; and create a vehicle for communicating regional CCS knowledge and technology within the growing industry. His award is matched by \$990,000 in AML funds allocated by the Wyoming state legislature for carbon sequestration.

Dr. Myers' award is one of seven selected by the DOE to advance the United States in its position as the leader in technology for addressing climate change and for developing near-zero emission technologies to significantly reduce carbon dioxide (CO₂) emissions from power plants. Other institutions receiving funding include the University of Illinois, Environmental Outreach and Stewardship Alliance (Seattle, WA), New Mexico Institute of Mining and Technology, Petroleum Technology Transfer Council (Tulsa, OK), Southern States Energy Board (SSEB), and The University of Texas at Austin.

PROGRAMMING THROUGH THE SCHOOL OF ENERGY RESOURCES

One of the original charges to the School of Energy Resources was to provide outreach and service to Wyoming through venues providing the engagement of ideas, sharing of knowledge, and discovering knowledge gaps. Since its inception, the school has been committed to delivering immediate and accessible opportunities for collaboration and exploration of issues critical to a sustainable and secure energy system.

Examples of the conferences and workshops the School of Energy Resources has offered to date include:

- ▶ The 2010 International Advanced Coal Technologies Conference
- ▶ A Forum on the Future of Uranium Production in Wyoming
- ▶ Energy Resources and Produced Water Reclamation Conference
- ▶ Finding the Balance Conference (a public discussion of carbon energy resources and the climate)
- ▶ Wyoming Pipeline Conference

- ▶ Transmission Conference of Wyoming, Utah, Colorado, and New Mexico
- ▶ The Energy Economic Summit
- ▶ The annual Carbon Dioxide Conference
- ▶ The annual Stroock Forum

While the primary audience for these programs has been Wyoming's energy stakeholders, they have generated interest and enthusiasm from national and international participants.

Upcoming topics to be addressed in the coming year are:

- ▶ Alternate uses of traditional fuels – compressed natural gas in transportation
- ▶ Energy economics and public policy
- ▶ Carbon sequestration from a landowner's perspective
- ▶ Energy in the media
- ▶ Hydraulic fracturing
- ▶ Commercialization of technology

INFUSION OF NEW FINANCIAL RESOURCES: STATE, PRIVATE, AND RESEARCH

The University of Wyoming's tremendous strides in energy research and education would not be possible if not for the support of the State of Wyoming and the commitment of private and public partners. The infusion of resources has allowed UW to expand its curricular offerings; research into areas critical to the economy of the state; and develop partnerships that will change the face of education and research at UW.

STATE SUPPORT

The State of Wyoming has made led the way with a significant investment in energy research and education at the University of Wyoming. Since 2004, the State has committed \$228,559,582 to energy related programs at UW. This does not include the funding committed to the State matching program, which is discussed below.

ENHANCED OIL RECOVERY COMMISSION

2005-06 Appropriation (created - 2004)	\$2,411,500
200-08 Appropriation	\$6,110,825
2009-10 Appropriation	\$6,110,825
2011-12 Appropriation	\$5,854,823
Total	\$20,487,973

CLEAN COAL TECHNOLOGY FUND

2007 Appropriation	\$2,500,000
2008 Appropriation	\$3,800,000
2009 Appropriation	\$10,613,047
2010 Appropriation	\$14,000,000
Total	\$30,913,047

SCHOOL OF ENERGY RESOURCES (OPERATIONAL FUNDING)

2007-08 Appropriation (Enacted 2006 Session, amended by 2007)	\$12,071,997
2009-10 Appropriation	\$17,420,565
2011-12 Appropriation	\$17,400,000
Total	\$46,892,562

WYOMING RECLAMATION AND RESTORATION CENTER

2009-11 Appropriation	\$2,000,000
2011-12 Appropriation	\$ 666,000
Total	\$ 2,666,000

CO2 SEQUESTRATION (CARBON MANAGEMENT)

2009 Appropriation	\$ 8,000,000
2010 Appropriation	\$45,000,000
Total	53,000,000

HIGH PLAINS GASIFICATION-ADVANCED TECHNOLOGY CENTER (PARTNERSHIP WITH GENERAL ELECTRIC)

2008 Appropriation	\$20,000,000
2009 Appropriation	\$30,000,000
Total	\$50,000,000

NCAR WYOMING SUPERCOMPUTING CENTER (PARTNERSHIP WITH THE NATIONAL SCIENCE FOUNDATION)

2007 (Wyoming Business Council)	\$20,000,000
2007 (UW)	\$ 1,000,000
2008 (UW)	\$ 1,000,000
2011-12 (UW)	\$ 1,000,000
Total	\$23,000,000

URANIUM RECOVERY

2009-11 Appropriation	\$ 1,600,000
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PRIVATE SUPPORT AND STATE MATCHING FUNDS

Bolstered by the leadership of the State of Wyoming, the UW Foundation has successfully cultivated financial gifts for energy related programs from a number of new sources, primarily energy corporations that heretofore were an untapped source of support. Many of these gifts were matched dollar for dollar through the state matching program for endowed gifts or academic facilities challenge gifts, established by the Wyoming State Legislature in 2001 and 2006, respectively.

The focus of the gifts have been to the emerging School of Energy Resources, but contributions made to the College of Engineering & Applied Science and the Department of Geology and Geophysics have further enhanced the energy research and education in these key areas.

FACILITY GIFTS FOR THE SCHOOL OF ENERGY RESOURCES

DONOR	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
EnCana	\$ 10,000,000	\$ 5,000,000	\$ 5,000,000
Shell	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000
BP America	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000
Peabody	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000
Arch Coal	\$ 1,500,000	\$ 750,000	\$ 750,000
Marathon	\$ 500,000	\$ 250,000	\$ 250,000
ConocoPhillips	\$ 340,000	\$ 170,000	\$ 170,000
Questar	\$ 360,000	\$ 180,000	\$ 180,000
Pete and Anne Mounsey	\$ 200,000	\$ 100,000	\$ 100,000
TOTAL	\$ 24,900,000	\$ 12,450,000	\$ 12,450,000

ENDOWED GIFTS FOR THE UW SCHOOL OF ENERGY RESOURCES

DONOR	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
Jim Nielson	\$ 10,598,261	\$ 5,299,131	\$ 5,299,131
Anadarko	\$ 3,000,000	\$ 1,500,000	\$ 1,500,000
Ultra Petroleum	\$ 2,000,000	\$ 1,000,000	\$ 1,000,000
Arch Coal	\$ 1,500,000	\$ 750,000	\$ 750,000
Marathon	\$ 160,000	\$ 80,000	\$ 80,000
TOTAL	\$ 17,258,261	\$ 8,629,131	\$ 8,629,131

FACILITY GIFTS FOR THE UW COLLEGE OF ENGINEERING & APPLIED SCIENCE

DONOR	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
EnCana	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000
BP America	\$ 2,000,000	\$ 1,000,000	\$ 1,000,000
TOTAL	\$ 6,000,000	\$ 3,000,000	\$ 3,000,000

ENDOWED GIFTS FOR THE UW COLLEGE OF ENGINEERING & APPLIED SCIENCE

DONOR	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
Marathon	\$ 670,000	\$ 335,000	\$ 335,000
Tom and Darlis Fuller	\$ 200,000	\$ 100,000	\$ 100,000
ConocoPhillips	\$ 180,000	\$ 90,000	\$ 90,000
TOTAL	\$ 1,050,000	\$ 525,000	\$ 525,000

NON-ENDOWED GIFTS FOR THE COLLEGE OF ENGINEERING & APPLIED SCIENCE

DONOR	TOTAL FUNDS	PLEDGES/GIFTS
BP America	\$ 2,000,000	\$ 2,000,000
Ellis Family Foundation	\$ 140,000	\$ 140,000
ConocoPhillips	\$ 75,000	\$ 75,000
Baker Hughes	\$ 50,000	\$ 50,000
Chevron	\$ 34,800	\$ 34,800
TOTAL	\$ 2,299,800	\$ 2,299,800

ENDOWED GIFTS FOR GEOLOGY AND GEOPHYSICS

DONOR	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
Marathon	\$ 670,000	\$ 335,000	\$ 335,000
TOTAL	\$ 670,000	\$ 335,000	\$ 335,000

NON-ENDOWED GIFTS FOR GEOLOGY AND GEOPHYSICS

DONOR	TOTAL FUNDS	PLEDGES/GIFTS
ConocoPhillips	\$ 125,000	\$ 125,000
EnCana	\$ 90,000	\$ 90,000
Chevron	\$ 50,000	\$ 50,000
ConocoPhillips	\$ 42,000	\$ 42,000
BP America	\$ 12,000	\$ 12,000
ExxonMobil	\$ 15,000	\$ 15,000
GX Technology	\$ 5,000	\$ 5,000
TOTAL	\$ 339,000	\$ 339,000

TOTAL GIFTS

	TOTAL FUNDS	PLEDGES/GIFTS	STATE MATCHING FUNDS
Facility Gifts	\$ 30,900,000	\$ 15,450,000	\$ 15,450,000
Endowment Gifts	\$ 19,078,261	\$ 9,539,131	\$ 9,539,131
Non-endowed Gifts	\$ 2,668,838	\$ 2,668,838	
TOTAL	\$ 52,647,099	\$ 27,657,968	\$ 24,989,131

School of Energy Resources:	\$42,288,299
College of Engineering & Applied Science:	\$ 9,349,800
Geology and Geophysics:	\$ 1,009,000
TOTAL	\$52,647,099

What isn't reflected in the tables above or in the totals provided are the gifts-in-kind. While unable to always attribute a dollar amount to the gift, the donation of state-of-the-art software or software licensing provides essential resources for faculty and students in their teaching, research, and educational experiences. The impact of gifts-in-kind cannot be undervalued.

SCHLUMBERGER

School of Energy Resources:	Three-year license/maintenance agreement of ECLIPSE software for the Enhanced Oil Recovery Institute
College of Engineering & Applied Science:	One-year license/maintenance agreement for EnCana Reservoir Simulation Lab
Geology and Geophysics:	Gift-in-kind software for Geology and Geophysics

HALLIBURTON

School of Energy Resources:	Three-year license/maintenance agreement of Landmark software for the Enhanced Oil Recovery Institute
College of Engineering & Applied Science:	Two-year license/maintenance agreement for EnCana Reservoir Simulation Lab
Geology and Geophysics:	Gift-in-kind software for Geology and Geophysics

BAKER HUGHES

College of Engineering & Applied Science:	Gift-in-kind of X-Ray Diffractometer for Chemical and Petroleum Engineering
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RESEARCH FUNDING

A measure of the quality and significance of UW's research and scholarship in the areas of energy science is the number and value of research grants and contracts secured by UW faculty. In the years since the founding of the School of Energy Resources (2005-2010), energy-related awards were received from the following:

- ▶ State of Wyoming energy-related research contracts—**\$113.9 million**
- ▶ National Science Foundation—**\$15.2 million**
- ▶ U.S. Department of Energy—**\$13.3 million**
- ▶ Industry related awards—**\$5.1 million**
- ▶ Federal agencies that have come to UW investigators via other agencies, institutes, or universities—**\$2.8 million**
- ▶ Miscellaneous research contracts—**\$107,000**

The dollars amounts demonstrate UW's excellence in this arena, but equally notable is the large number of faculty members engaged in this research as principal investigators and co-principal investigators and the array of departments they represent, from Petroleum and Chemical Engineering, Geology and Geophysics, Mathematics, Chemistry, Physics, and Renewable Resources, to Economics and Finance and the American Heritage Center. Clearly, the vision of collaborative energy research and scholarship with participation from across the university has been achieved.

CONTRIBUTIONS TO WYOMING'S ECONOMIC DEVELOPMENT

The fundamental way in which the University of Wyoming contributes to the economic development of the state is by the academic preparation of students and its research and technology-transfer activities in areas relevant to Wyoming, energy being primary among them. However, as UW's investment in energy related education and research has gained international recognition, a number of partnerships have emerged that support both the university's teaching and research missions but also contribute to Wyoming's economic development.

NCAR-WYOMING SUPERCOMPUTER CENTER

Science relies more than ever on computing power to help improve our understanding and broaden our knowledge of the world and how our activities are affecting its natural balance. Computers have helped us see the processes that churn in stars, visualize future climate on Earth and calculate the paths of hurricanes.

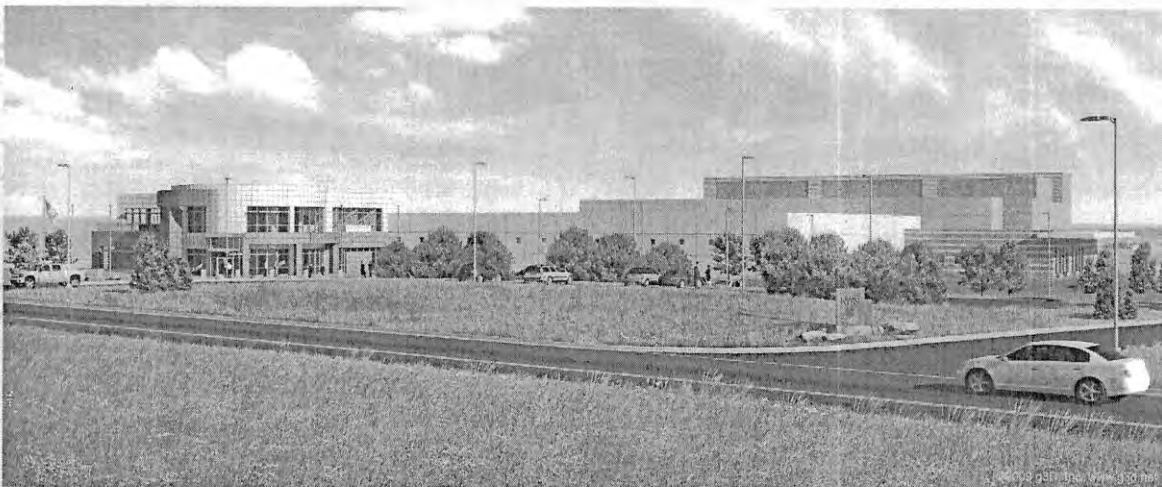
The NCAR Mesa Laboratory in Colorado has housed NCAR's computing resources, spanning a history that dates back to one of the first supercomputers, the Cray 1A. While a standard cell phone today has more computing power than it did, the Mesa Laboratory is now home to one of the world's fastest and most powerful supercomputers dedicated to geoscience research. But computing power and cooling requirements have outgrown the facility's capacity, and a new facility that can accommodate future expansion is needed.

The NCAR-Wyoming Supercomputing Center (NWSC) will not just meet NCAR's needs but help establish Wyoming as a leader in the advancement of scientific knowledge, education, and service through high-performance computing.

There are many other advantages for UW and the State of Wyoming, including the diversification of the state's economy and the enhancement of energy research. The center also figures to aid UW's mission to attract top-flight scientists, researchers and other faculty to the Cowboy State.

The supercomputing facility will be constructed in Cheyenne and will be located in the North Range Business Park (NRBP). The business park comprises 625 acres of land, and includes the Wal-Mart automatic distribution center. The NRBP is adjacent to the intersection of Interstates 25 and 80.

Construction of the facility began in spring 2010 with a tentative finish date of August 2011.



Artist rendering of NCAR-Wyoming Supercomputer Center

HIGH PLANS GASIFICATION CENTER

The state of Wyoming's only four-year institution of higher education is working with one of the world's leading suppliers of power generation and energy delivery techniques to develop a small-scale gasification research and technology center that will allow UW and GE researchers to develop advanced coal gasification technology solutions for Powder River Basin and other Wyoming coals.

As the annual provider of about 40 percent of the United States' coal, Wyoming is uniquely positioned in the nation's energy landscape and has vast coal reserves capable of supporting a substantial portion of the nation's energy needs.

The facility will be owned and operated by UW. GE Energy will be the center's primary lessee for the initial post-construction term of operation, but UW, as well as other entities, may also conduct research under specified terms and conditions.

Laramie County, Wyoming, was selected as home for the HPG-ATC following a request for proposals that generated 15 proposals in nine Wyoming counties.

The HPG-ATC is expected to complete the Front End Engineering & Design (FEED) phase of the project in the fourth quarter of 2010. As the design progressed, an opportunity has arisen to make technology enhancements to the facility, these would include adding technologies to expand the commercial viability of powder river basin coal in a carbon constrained environment. The HPG-ATC Governance Board has approved the additional schedule shift necessary to allow these enhancements to be finalized in the FEED.

These changes will mean that the Design Build Request for Proposals (RFP) would be issued early in the first quarter of 2011. Construction is planned for the second quarter of 2012, with commissioning approximately 2 years later. Through FY09 and FY10, project expenditures amount are forecasted to be approximately \$10 million to complete site selection, prepare permitting materials, and advance substantial portions of facility engineering and design. As most of the expenditures are eligible for cost true-up (50:50 share), each partner (GE Energy and UW) will split a majority of these costs.

WYOMING CARBON UNDERGROUND STORAGE PROJECT (WY-CUSP)

Underground storage of carbon dioxide will be required to meet the goals of reducing greenhouse gas emissions while continuing to utilize the state and the nations' fossil fuel resources. UW and Wyoming State Geological Survey (WSGS) researchers have determined that large amounts of carbon dioxide can be sequestered in Wyoming's sedimentary basins. Currently, two major geological structures, the Moxa Arch and the Rock Springs Uplift—both in southwestern Wyoming—are the subject of intense examination because of the size of these structures and their potential carbon dioxide storage capacity.

In the summer of 2009, the Wyoming Carbon Sequestration Steering Committee was appointed by Governor Dave Freudenthal and UW President Tom Buchanan to oversee sequestration research in Wyoming. The success of this research is optimized by integrating the science and engineering teams with the key state agencies (Oil and Gas Conservation Commission, Wyoming Department of Environmental Quality, State Engineers Office), the Wyoming State Legislature, industrial partners, and other stakeholders.

There are an increasing number of carbon sequestration research endeavors occurring at UW, but the flagship project is WY-CUSP. The objective is to demonstrate sub-commercial feasibility of sequestration at the Rock Springs Uplift site. UW received an initial award from the U.S. Department of Energy for \$4.975 million, which was augmented in 2010 by an additional \$5 million. These funds are augmented with \$6.3 million in AML funds, \$2.2 million committed by industry, and another \$3.4 million in-kind from industry. The total project budget for the initial geologic site characterization phase now stands at \$16.9 million. An additional \$45 million in AML funds during the 2010 Budget Session was allocated in order that WY-CUSP may proceed toward a field demonstration of carbon dioxide sequestration and will continue to leverage federal and private funding.

The table below describes three institutional-level, collaborative geologic carbon sequestration research projects currently underway at UW:

TITLE	SOURCE	BUDGET	
1	Moxa Arch Site Characterization 9/1/08-8/31/10	DOE CDA (in-kind match)	DOE \$2.38M Cost-share \$0.82
2	"CO ₂ Sequestration in Depleted Compartmentalized Gas Fields— the Key to Deploying the Clean Coal Technology in the Powder River Basin, Wyoming" 1/1/10-12/31/12	(WSGS/UW)— Clean Coal Technology Fund (AML match)	CCTF \$0.5M Cost-share \$0.5M
3	"Site Characterization of the Highest-Priority Geologic Formations for CO ₂ Storage in Wyoming" (WY-CUSP)	DOE Award (AML \$6.3M + in-kind match)	DOE \$4.98M+ 5M Cost-share \$11.9M

APPENDIX I

Major SER Academic Initiatives

Overarching goals: Establish a cohesive, complementary and synergistic energy focus across UW; Promote an academic culture of competition, performance, urgency, innovation and accountability; Advance understanding of convergent nature of energy science, engineering, economics, policy, and natural resources; Clarify the focus, structure and function of the ERS degree.

1. Faculty

- 12 SER Distinguished faculty allocated in 2006; eleven positions filled via a competitive, international search process
- Five adjunct SER positions, two current visiting faculty
- Biannual performance planning and review
- SER faculty workshops
 - Intellectual property management and commercialization processes
 - Effective inquiry based teaching principles and interdisciplinary course design

2. Undergraduate ERS (Energy Resource Science) program. Establish competencies, skill sets and attributes to position graduates for long term competitive success in the workforce; ensure rigor, maximize performance and accountability; increase collaboration with UW colleges.

- Status:
 - 2009 – first year; 9 majors
 - Fall 2010 – 23 majors: 3 seniors, 6 juniors, 8 sophomores, 6 freshmen; 18 males; 5 females
 - 2012 projections: 50-75 majors
 - Aggressive 2010 regional recruitment plan including brochure
- Overarching concept - Energy Asset Management
 - Demanding, rigorous and relevant - preparation for sustained competitive success in dynamic, complex and rapidly changing energy industry
 - Workforce ready – multidisciplinary knowledge and enabling skills (entrepreneurship, communication, leadership, resilience, perseverance, work ethic, creative problem solving; able to make connections, work in teams and able to effectively function at boundaries of knowledge, able to lead change and innovation).
 - Interdisciplinary perspective – connecting diverse disciplines, identifying patterns and novel approaches, and finding creative, economically viable solutions to complex problems.
 - Public and private sector partnerships; inter-institutional and global collaborations

- Capstone course
 - Authentic energy asset management experience including technological, engineering, scientific, economic, natural resource and policy impacts on exploration, development and production, valuation & appraisal, decision making through asset life cycle, understanding resourcing, and risk weighted investment returns.
 - Research experiences – critical to learn creative problem solving, entrepreneurship, critical analysis, communication.
 - Internships, Inter-institutional and International opportunities
 - Defined expectations and responsibilities, focused on student learning outcomes and mutual benefit; contribution to workforce ready graduates, career planning
 - University of Queensland (Brisbane, Australia)
 - Northwest University (Xian, China)
 - University of Utah
 - New & modified courses
 - Applied Math 1,2, 3
 - Thermodynamics
 - Service opportunities
 - SER Energy Academies
- 3. Graduate program development**
- 4yr + 1yr BS/MS degree programs
 - 2 yr professional masters degree program
 - Executive Energy certificates/MBA
- 4. Innovative fellowships**
- Not traditional scholarships; but linked to performance requirement and learning outcomes
 - Nielsen Energy Fellowship promoting recruitment of women and minorities
 - Nielsen Excellence Fellowship in Energy Studies recognizing outstanding performance and potential for junior and seniors.
 - Anadarko Fellowships
 - Junior level, tenure track faculty
 - Senior level graduate students
 - Junior and senior undergraduates.
 - Ultra Petroleum Visiting Chair in Energy Resources
 - Participate in capstone course
 - Colloquium
 - Research collaborations
 - External funding
- 5. Energy Education & SER Energy Academies**
- K12 student awareness, understanding of energy-water arena; building the career pipeline.

- In-service teacher professional development in energy; inquiry based pedagogy
- Parent & community engagement in student learning outcomes
- Activities- using graduate students as K12 student mentors
 - Summer programs for teachers, students/parents
 - Research apprenticeships for teachers and HS students
 - Demonstrations & tours at UW, field trips to private sector locations
 - In class inquiry based lesson plans
 - Internet based learning and distance delivery
 - Development of resource materials in carbon management, coal gasification, renewable energy, water and uranium.
 - Interactions with community colleges, regional and international partnerships
 - Legislative Days
 - Community programs
 - WY science fair coordination/participation

6. Graduate Assistantship allocations – currently 52 allocated across UW

- Annual competitive grant process

APPENDIX J

School of Energy Resources – Outreach Report
August 27, 2010

I. Upcoming Events:

- A. Distinguished Speakers Series - Energy Economics
- B. Hydraulic Fracturing Forum - May/June 2011
- C. Coal Bed Methane – Produced Water –Spring 2011
- D. International Advanced Coal Conference - Follow up for 2011 (China/UQ)
- E. Carbon Sequestration events with Carbon Mgt Institute
 - a. Partnership Conference
 - b. Landowner’s perspective

II. Recent Events:

- A. International Advanced Coal Technologies Conference – June 23/24, 210
 - 200 hundred attended - 6 countries were represented
 - 2 days of presentations with an opening general session discussion of international interest and importance of solving for coal’s CO2 emissions;
 - Proceedings: <http://www.advancedcoalconference.com/>
 - OUTCOME: Summary Report in progress – September 17, 2010
 - ✓ Faculty & student exchange agreement;
 - ✓ SER will share CCTF RFP with UQ and Mark Davies (Aus. National Low Emissions Coal R&D Program). Goal is to coordinate funding that might lead to international collaboration on common issues;
 - ✓ Mark Davies offered an exchange of project proposals (ours and his) for cross review purposes. Also offered to discuss other ways to collaborate on funding projects;
 - ✓ Dr. Zhu, Shaanxi Provincial Development and Reform Commission offered (unsolicited) matching funds to support Chinese research in conjunction with either UW, UQ or both up to the full amount of the CCTF;
 - ✓ Dr. Zhu offered to host the 2011 International Conference.

B. Uranium Forum - August 4, 2010

- Public forum on In-Situ Recovery of uranium in Wyoming in follow-up to the 2009 General Session budget footnote to provide members of the public and industry an opportunity to learn about this process:
 - ✓ Attendance: 281
 - ✓ Video proceedings and program information is accessible at <http://www.uwyo.edu/ser/uraniumforum>
 - ✓ Summary – September 17, 2010

C. In-Reach Lunch with Old Main: Aug 10, 2010

- ✓ Attendance: 27

III. Immediate Events –

A. CNG for Vehicles Coalition – August 30/31

B. Global Competition for Energy – Implications for Wyoming and the World (International Studies & SER)

- Sept 7: Jackson
- Sept 8: Riverton
- Sept 9: Rock Springs

C. Joint Minerals Meeting - Sept 20

D. Groundbreaking Energy Resource Center - Nov 19

IV. Unified Look/Branding/Mission Support - A United Front

- New SER Logo
- Center of Excellence Logos & Brochures
- COE Messaging/Mission Papers – Identifying Issues for UW Communications Plan, Media and Institution
- Website
- Video

Review of SER Outreach Major Events - Partners – Attendance and Costs
August 2009– August 2010

	Event	Date	Partner	Attendance	Cost
A	Transmission Forum - Denver	August 2009	PUCs of WY, CO, NM, AZ & NREL	175	\$4,001
B	Uranium – Research Workshop – Cheyenne	September 2009	Response to Legislation – 2009	100	\$14,482
C	Western States Energy & Environment Symposium – Jackson	October 2009	Response to Legislation - 2009	300	\$309,421
D	Global Competition for Energy – Sheridan/Casper/Cody/Laramie – on going	October 2009 December 2009 April 2010	International Studies	60 75 65 76 276	\$6,000*
E	Energy Resources & Produced Water	May 2010	ENR	325	\$48,000*
F	International Advanced Coal Technologies Conference	June 2010	University of Queensland	200	\$95,000*
G	Uranium Public Forum	August 2010	Response to Legislation – 2009	281	\$50,000* (*estimate)

Distinguished Speakers:

Speaker	Date	Attendance
Tim Carr	January 2010	98
Christine Economides	April 2010	35

In Reach Lunches:

College	Date	Attendance
College of Business	September 2009	28
College of Ag	September 2009	35
College of Ed	October 2009	26
College Law (Public inc)	November 2009	110
College of A & S - ENR	January 2010	100
Old Main	August 2010	27
Total to Date:		326

