

**Minutes of the UW Energy Resource Council
September 5, 2008**

Members present:

Ron Harper – CEO & General Manager, Basin Electric Power Coop, (Council Chairman)
Representative Tom Lockhart (Council Vice Chairman)
Senator Charles Townsend
Tom Stroock - CEO, Alpha Development Corp; former US Ambassador
Tom Buchanan - Ex officio, UW President
Ingrid Burke - Ex officio, Director, RIENR
Keith Rattie – Chairman, President & CEO, Questar Corporation
Paul Lang – President Western Operations, Arch Coal Inc.
Rob Wallace – Manager, Government Relations, G.E. Energy

Members absent:

Bobby Shackouls – Chairman, Burlington Resources Inc. (retired)

Meeting Attendees:

Mark Northam
Rob Hurless
K J Reddy
Christopher Spooner
Cath Harris
Pam Henderson
Sarah Schulmeyer
Bill Gern
Myron Allen

Welcome and Approval of the Agenda and Minutes

Chairman Ron Harper called the meeting to order at 8:30 am. Keith Rattie motioned and Tom Lockhart seconded the May 23 minutes be accepted. Tom Lockhart made a motion to accept the agenda, and Paul Lang seconded it. The motion was passed unanimously. (Minutes Appendix A) (Agenda – Appendix B)

Update on Fundraising

Chris Spooner gave an update on fundraising highlighting funds for the Center. Fundraising – Appendix C)

Update on GE

Ron Harper called for the ERC to go into executive session due to proprietary information about the GE project.

Update on Faculty/Staff Hires

Northam gave an update on the faculty hires. Ten positions are confirmed as filled. (Appendix – D) Northam foresees the need for four to eight more faculty positions and this will be addressed with deans and proposed to legislature next year.

Chairman Harper requested a timeline for putting a plan together for the positions. It is listed below:

- Drafted strategy for ERC at November 14 meeting
- ERC approved drafted copy to Myron Allen by January 13, 2009 for Deans Retreat
- Final copy for ERC at March 20, 2009 meeting
- Final to UW President Buchanan by April 1, 2009

Harper requested the strategy plan for additional SER Faculty positions be an agenda item for the November 14 meeting. Keith Rattie pointed out the importance of being focused on positions that can teach a strong energy curriculum for a solid enrollment to be a priority.

Update on Wind Center

Professor Jonathan Naughton from Mechanical Engineering gave an update on the Wind Energy Center. (Appendix-E) Discussion on Wind Energy led to the following conclusions:

- There are difficulties with keeping up with manufacturing demands
- There is a deficiency in getting it to market and storage issues
- There is a need for more interaction with utility companies

The Council requested Naughton's contact information is sent to them.

Update on Annual Report

The 2008 Annual Report will be available on the UW SER website once it is in its final copy at www.uwyo.edu/ser. Referring people to the website was determined to be the best way to make others aware of what is occurring in SER.

Northam gave an update on the proposal for establishing a uranium research center within the School of Energy Resources set forth in the Fifty Ninth Legislature Budget Session which is due to the JMC by October 1, 2008. Two areas of focus are:

- An improved and cost effective way to recover uranium
- Focus on restoration and ground water issues

Update on Matching Grant Funds

Northam gave an update on matching grant funds. (MGF - Appendix F)

Chairman Harper asked if there was a way to measure the return for the funds granted. Northam stated it was still too early to tell, but one measurement would be to look at the research funding captured, and that proposals submitted have grown by 53 % over the first year. Average leverage of state funds is 3-to-1.

Update on Financial Report

An update on FY 2009 expenses YTD was covered. (Appendix G) Northam will provide an updated detailed FY09-10 budget.

A discussion arose about the difficulty of using federal (AML) funds. Senator Townsend stated that some tweaking needed to be done of how legislature issued both federal and states funds for SER to avoid some of these.

Update on Curriculum and Industry Survey

The ERS degree program is about to be submitted for approval and will be available at the November 14 ERC meeting for the ERC to discuss.

The ERC were enthusiastic about the industry survey which is about to go out surveying what type of classes and experience in graduating UW students energy industry leaders would like to hire. Discussion about whether the survey should be administered on-line or in hard copy arose. Keith Rattie brought up the idea that it would be helpful if the survey could be categorized by coal, gas, etc.

Strategic Direction

The ERC determined that they would like to meet for a half day to discuss how they can be more constructive and beneficial in helping to guide the SER in the next two years. The outcome is:

- Chairman Harper will work Mark Northam on setting a date and place for the meeting
- Possibly enlisting an outside facilitator to aid in the process

Other Business

Northam introduced several items:

- “Energy Innovation”: Dr. Lester’s speech from the National Governor’s Association meeting in Washington, D.C., and the need for a new national energy curriculum.
- NBC’s request for involvement from SER to contribute ideas for an energy segment on TWC

Future Meetings

The ERC will meet with the UW Board of Trustees for a morning session on November 14, 2008. The ERC agreed on the below meeting dates for 2009 in Laramie.

- March 20, 2009
- May 29, 2009
- August 28, 2009
- November 13, 2009

Action Items

- Northam will put together a drafted strategy for 4-8 more SER faculty positions to be presented to the ERC at the November 14, 2008 meeting.
- Jonathan Naughton’s contact information is sent to ERC.
- Northam will provide an updated two year budget for FY09 – FY10.
- Northam will provide ideas for “metrics for success” in measuring the MGF.
- Rob Hurless will provide the ERC with a copy of Dr. Lester’s speech, “Energy Innovation”.
- The updated 2009 ERC meeting calendar will be sent out.

A motion was made by Tom Lockhart to adjourn the ERC meeting at approximately 12:00 p.m. and Keith Rattie seconded it.

Respectfully Submitted

Ron Harper, Chairman

Appendix A

Drafted Minutes of the UW Energy Resource Council May 23, 2008

Members present:

Representative Tom Lockhart (Council Vice Chairman)
Keith Rattie – Chairman, President & CEO, Questar Corporation
Bobby Shackouls – Chairman, Burlington Resources Inc. (retired)
Paul Lang – President Western Operations, Arch Coal Inc.
Rob Wallace – Manager, Government Relations, G.E. Energy

Members absent:

Ron Harper – CEO & General Manager, Basin Electric Power Coop, (Council Chairman)
Senator Charles Townsend
Tom Stroock - CEO, Alpha Development Corp; former US Ambassador
Tom Buchanan - Ex officio, UW President
Harold Bergman - Ex officio, Director, RIENR

Meeting Attendees:

Mark Northam
Rob Hurless
K J Reddy
Christopher Spooner
Ben Blalock
Pam Henderson
Sarah Schulmeyer
Bill Gern

Welcome and Approval of the Agenda and Minutes

Vice Chairman Tom Lockhart called the meeting to order at 9:05 am. Paul Lang motioned and Bobby Shackouls seconded the March 14, 2008 minutes, the March 14 executive session minutes, and the May 23 agenda be accepted. The motion was passed unanimously. (Minutes Appendix A) (Agenda – Appendix B)

Update on Fundraising

Ben Blalock gave an update on fundraising highlighting funds for the Center. A major push was made in Houston recently with ConocoPhillips, Ultra, and Anadarko. (Fundraising – Appendix C)

Update on Faculty/Staff Hires

Northam gave an update on the faculty hires. Seven positions are confirmed as filled. Northam hopes all ERC can meet new hires at our September 5 meeting. Northam explained three focus areas with hiring faculty. They are:

- A contribution in maximizing recovery of known energy resources.
- A contribution in clean coal technologies.
- A contribution in alternative and renewable energy.

Northam gave an update on the search for a Business Manager, which has resulted in the hiring of David Mornes. (Appendix D).

Update on Matching Grant Funds

Northam gave an update on matching grant funds. (MGF - Appendix E)

Update on Financial Report

Northam gave an update of monies left unspent. \$2 million will be rolled over into the FY09-10 budget. Northam will send an update to the ERC by May 31.

GE Update

Bill Gern gave an update on the GE project. Bob Ballard has been hired as the Project Manager, who brings a tremendous background to the job.

Other Business

Northam had three areas to address:

- Queensland CO2 conference: Northam stated there were two collaborative areas between University of Queensland and UW: collaboration between the University Queensland and UW on the upcoming clean coal offering, and between Clean Coal Research Centers at both organizations.
- A desire among Community Colleges to have an affiliation with SER: Western Wyoming College, Casper Community College, and Gillette College would like to have an affiliation with SER. ConocoPhillips may contribute the funds to make it work.
- Northam is responding to continued interest in SER by speaking at: the WMA annual conference, the Wyoming Infrastructure Authority's Board meeting, NextGen Energy Council Board meeting, and the Western Business Roundtable. Northam and Reddy also recently met with the Nature Conservancy. They would like to have WCC working with them each summer and form a more formal working relationship with the Wyoming Reclamation Research Center.

Bill Gern wanted to update the ERC about UW Professor Mohammad Piri's work with NCAR's new technology, "Blue Fire" as a complement to the EnCana lab. Dr. Piri will now be able to model oil movement on NCAR's existing supercomputer.

Future Meetings

The next ERC meeting will be on Friday, September 5, 2008 in Laramie including:

- A September 4 bar-b-q for SER faculty and ERC to meet.
- A September 5 ERC & CCTF meeting
- A September 6 Football Game in the Presidents Box for a game between UW and Air Force. Please RSVP

Randall Luthi be in Laramie at the same time for any ERC interactions.

Action Items

Northam will submit to the ERC:

- An update on year end financials.
- An updated mission strategy for faculty hiring and research centers.

- A position paper on “Why the Coal Industry Would Benefit from Working with University of Wyoming’s, School of Energy Resources.”

A motion was made by Chairman Lockhart and seconded by Keith Rattie to adjourn the ERC meeting at approximately 10:15 a.m.

Respectfully Submitted

Representative Lockhart, Vice Chairman

Appendix B

Agenda September 5, 2008 Energy Resource Council Meeting

- 1) Introduction of Indy Burke, Director of ENR, by UW President Tom Buchanan
- 2) Review of minutes from 5/23/08 and 9/5/08 agenda.
- 3) Update on Fundraising
- 4) Executive Session: Update on GE and NCAR
- 5) Update on Wind Energy Center (Jonathan Naughton will be here about 10:00)
- 6) Discussion of faculty and staff recruiting
- 7) Minerals Committee Annual Report - Discussion
 - a. Annual Report
 - b. Uranium Program at UW
 - c. Discussion on additional faculty positions
- 8) Update on Matching Grant Funds
- 9) Financial Report
- 10) Update on SER curriculum and industry survey
- 11) Discussion of Strategic Direction
- 12) Other Business – Energy Innovation
- 13) Upcoming meetings - November 14 - Joint meeting with Board of Trustees, Laramie
Approval of proposed 2009 meetings

Facility Gifts for the UW School of Energy Resources

Donor	Total Funds	Pledges/Gifts	Wyoming State Match	Notes
EnCana	\$ 10,000,000	\$ 5,000,000	\$ 5,000,000	Create the SER Center.
Shell	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000	Create the SER Center.
BP America	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000	Create the SER Center.
Marathon	\$ 500,000	\$ 250,000	\$ 250,000	Create the Marathon Interdisciplinary Fossil Fuel Research Lab in the SER Center.
ConocoPhillips	\$ 340,000	\$ 170,000	\$ 170,000	Create the ConocoPhillips Reservoir Characterization Collaboratory in the SER Center.
Questar	\$ 60,000	\$ 30,000	\$ 30,000	Create the SER Center.
Total	\$ 18,900,000	\$ 9,450,000	\$ 9,450,000	

Endowment Gifts for the UW School of Energy Resources

Donor	Total Funds	Pledges/Gifts	Wyoming State Match	Notes
Jim Nielson	\$ 10,598,261	\$ 5,299,131	\$ 5,299,131	Income from the state match is available to SER Director for general support.
Marathon	\$ 160,000	\$ 80,000	\$ 80,000	Create support of the Marathon Interdisciplinary Fossil Fuel Research Lab.
Total	\$ 10,758,261	\$ 5,379,131	\$ 5,379,131	

Gifts-in-Kind for UW School of Energy Resources Research and Teaching Centers

Donor	Total In-kind	Notes
Schlumberger	\$ 26,318,500	Three-year license/maintenance agreement of ECLIPSE software for EORI.
Halliburton	\$ 5,502,059	Three-year license/maintenance agreement of Landmark software for EORI.
Total	\$ 31,820,559	

Endowment Gifts for the College of Engineering and Applied Science

Donor	Total Funds	Pledges/Gifts	Wyoming State Match	Notes
Marathon	\$ 670,000	\$ 335,000	\$ 335,000	Create the Marathon Student Experience Excellence Fund.
Tom and Darlis Fuller	\$ 200,000	\$ 100,000	\$ 100,000	Create the Fuller Petroleum Engineering Excellence Fund
ConocoPhillips	\$ 180,000	\$ 90,000	\$ 90,000	Create ConocoPhillips Petroleum and Chemical Engineering Excellence Fund.
Total	\$ 1,050,000	\$ 525,000	\$ 525,000	

Non-Endowed Gifts for the College of Engineering and Applied Science

Donor	Total Funds	Pledges/Gifts	Notes
Baker Hughes	\$ 150,000	\$ 150,000	Gift-in-kind of X-Ray Diffractometer for chemical and petroleum engineering.
Ellis Family Foundation	\$ 140,000	\$ 140,000	Create the F.E. Tut & Diane Ellis Scholarship
ConocoPhillips	\$ 75,000	\$ 75,000	Continue support of petroleum and chemical engineering technology and facilities needs.
Baker Hughes	\$ 50,000	\$ 50,000	Current technology and facility upgrades for chemical and petroleum engineering.
Total	\$ 415,000	\$ 415,000	

Facility Gifts for the College of Engineering and Applied Science

Donor	Total Funds	Pledges/Gifts	Wyoming State Match
EnCana	\$ 4,000,000	\$ 2,000,000	\$ 2,000,000
BP America	\$ 2,000,000	\$ 2,000,000	\$ -
BP America	\$ 2,000,000	\$ 1,000,000	\$ 1,000,000
			Create new petroleum engineering reservoir simulation lab in the College of Engineering. Create new Wind Research Center. Create new petroleum engineering rock and fluids lab in the College of Engineering.
Total	\$ 8,000,000	\$ 5,000,000	\$ 3,000,000

Endowment Gifts for Geology & Geophysics

Donor	Total Funds	Pledges/Gifts	Wyoming State Match
Marathon	\$ 670,000	\$ 335,000	\$ 335,000
			Create the Marathon Geophysical Field Excellence Fund.
Total	\$ 670,000	\$ 335,000	\$ 335,000

Non-Endowed Gifts for Geology & Geophysics

Donor	Total Funds	Pledges/Gifts	Wyoming State Match
ConocoPhillips	\$ 125,000	\$ 125,000	\$ -
ConocoPhillips	\$ 40,000	\$ 40,000	\$ -
EnCana	\$ 90,000	\$ 90,000	\$ -
			Provide new support of graduate student field studies. Continue support of the Fall Semester Rocky Mountain Field Trip. Support of students in the Geology and Geophysics Department.
Total	\$ 255,000	\$ 255,000	\$ -

Total Funds Raised

	Total Funds	Pledges/Gifts	Wyoming State Match
Miscellaneous	\$ 101,750	\$ 51,750	\$ 50,000
TOTAL	\$ 71,970,570	\$ 53,231,440	\$ 18,739,131
Facility Gifts	\$ 26,900,000	\$ 14,450,000	\$ 12,450,000
Endowment Gifts	\$ 12,578,261	\$ 6,289,131	\$ 6,289,131
Cash Gifts	\$ 671,750	\$ 671,750	\$ -
Gifts-in-Kind	\$ 31,820,559	\$ 31,820,559	\$ -
SER \$	61,478,820	\$ 46,649,690	\$ 14,829,131
CAES \$	9,465,000	\$ 5,940,000	\$ 3,525,000

University of Wyoming School of Energy Resources

Major Corporate Prospects

Gift Commitments Received:

EnCana Oil & Gas, Inc. (\$7 million)
BP America, Inc. (\$5 million)
Jim Nielson (\$5 million)
Shell Oil Company (\$2 million)
Marathon Oil Company (\$1 million)
ConocoPhillips (\$500,000)
Questar (\$30,000)
Schlumberger (software \$26.3 million)
Halliburton (software \$5.5 million)

SER Center: \$18.9 million w/state match
SER Endowments: \$10.7 million w/state match
PE Program: \$9.5 million w/state match
G&G Program: \$925,000 w/state match
In-Kind: \$31.8 million

Initial Conversations Underway:

Anadarko Petroleum Corporation
(finalizing gift)
Ultra Petroleum (awaiting a BLM ruling)

Proposed Next Prospects:

Oil and Gas:

Apache
Chevron
Citation Oil and Gas Corp.
Devon Energy Corporation
EOG Resources
Exxon Mobil
Forest Oil
J.M. Huber Corp.
Merit Energy Co.
MidAmerican Energy Holding Co.
Williams Production Company
XTO Energy, Inc.
Yates Petroleum

Coal:

Arch Coal, Inc.
Consol Energy
Peabody
Rio Tinto Energy America

Transportation:

Burlington Northern Santa Fe
Union Pacific

Other Prospects:

Alpha Development Corp.
Anschutz Company
Baker Hughes
Basin Electric and Basin Coop.
Bill Barrett Corp.
Cabot Oil & Gas Corp.
Cogema Mining, Inc.
DKRW
FMC Corp.
Foundation Coal West
GE Energy
Kiewit Mining Group
Kinder Morgan
Lance Oil and Gas Co.
Nabors Drilling USA
Nerd Gas
Pathfinder Mines Corp.
Pennaco Energy, Inc.
Pittsburg and Midway Coal
Power Resources, Inc.
Siemens
Sinclair
True Oil
U.S Energy Corp.
Westport Oil & Gas Co.
Wold Oil Properties
Wyodak Resources

Appendix D

SCHOOL OF ENERGY RESOURCES FACULTY HIRES

In 2006 the Wyoming State Legislature allocated 12 new positions for energy teaching and research to the University of Wyoming. The following is a status on the hiring and advertising of these positions. All of the positions are jointly appointed by the School of Energy Resources and the appropriate academic departments in the Colleges of Arts and Sciences, the College of Engineering and Applied Sciences, and the College of Business.

Math: **Felipe Pereira – SER Professor of Mathematics**

Before joining the UW faculty in January 2008, Dr. Felipe Pereira was a professor of Computational and Applied Mathematics at the State University of Rio de Janeiro, where he has served as department chair and chair of the graduate program. In addition, he has served as a member of the Advisory Board of the Brazilian NSF. Since earning his PhD (SUNY-Stony Brook) in 1990, Dr. Pereira has worked on applications of mathematics to enhanced oil recovery, and specifically with collaborators across the world has investigated multiphase flow in multi-scale heterogeneous petroleum reservoirs using both high-resolution numerical simulations and mathematical analysis. Most recently he has worked on the development of models and numerical simulations for flow in fractured reservoirs.

Craig Douglas – SER Professor of Mathematics

Dr. Craig Douglas comes to UW from the University of Kentucky and Yale University. He holds an A.B. in mathematics from the University of Chicago and an M.S., M.Phil., and Ph.D. in computer science from Yale University. He has worked at IBM's Thomas J. Watson Research Center in Yorktown Heights, New York. His research interests include simulating contaminant transport, wildland fires, combustion, and ocean circulation using dynamic data-driven techniques. He is best known for his work in multigrid methods. He has run MGNet, a repository for information related to multigrid, multilevel, multiscale, aggregation, defect correction, and domain decomposition methods, since its inception in 1991.

Geophysics: **Subhashis Mallick – SER Professor of Geophysics**

Dr. Subhashis Mallick has more than 20 years of experience in industry, and comes to UW from Chevron Energy Technology in Houston where he is a Senior Research Scientist. He holds a Ph.D. in Geology and Geophysics from the University of Hawaii. He is a first-rate computational seismologist, with a strong record of developing new approaches to addressing high-profile problems of interest to industry, including reservoir characterization and 4D seismology. His research interests include time-lapse monitoring of petroleum and CO₂ sequestered reservoirs, development of new 3D pre-stack

waveform inversion techniques, and seismic anisotropy and rock physics modeling. He will join the faculty as a full professor in August 2008.

Po Chen – SER Assistant Professor of Geophysics

Dr. Po Chen is a theoretical/computational seismologist without peer. He holds a Ph.D. in Seismology from the University of Southern California. His expertise is of impressive breadth, encompassing theoretical seismology and high-performance computing. His principal research interests involve Earth imaging at a variety of scales. He has developed computationally intensive new imaging techniques, including full 3D waveform tomography and 3D pre-stack depth migration. He has worked on earthquake rupture dynamics and seismic hazards and has a strong interest in focusing on energy-related issues, including 4D imaging of sequestered CO₂. He also will make an immediate and long-term impact at the new NCAR facility as an expert in high-performance computing and also will produce first-rate science with that facility. Dr. Chen joined the UW faculty in April 2008 as an assistant professor.

Geochemistry: John Kaszuba – SER Associate Professor of Geochemistry

Dr. John Kaszuba is currently a geochemist and principal investigator at the Los Alamos National Laboratory. He holds a Ph.D. in Geochemistry from the Colorado School of Mines. His research has established a high pressure/high temperature hydrothermal laboratory capable of evaluating multiphase fluid-rock reactions. Dr. Kaszuba's laboratory has produced seminal experimental papers regarding supercritical carbon dioxide reaction processes in brine aquifers, with implications for geologic sequestration of carbon. Current research focuses on integrated laboratory and computational approaches for multiphase fluid-rock interaction and evolution in crustal systems; contact metamorphism; quartz and carbonate veins and textures; redox equilibria in crustal-scale (deep) aquifers; and mass and energy transfer in the crust.

Chemistry: Bruce Parkinson – SER Professor of Chemistry

Dr. Bruce Parkinson is an internationally recognized photoelectrochemist who leads a research group at Colorado State University that investigates novel methods to harness solar energy. A professor at CSU since 1991, Parkinson was a research chemist for DuPont Central Research and Development from 1985-1991. Before that, he was a senior scientist at the Solar Energy Research Institute for four years. He received a B.S. degree (1972) in chemistry at Iowa State University, and earned a Ph.D. in chemistry (1977) at California Institute of Technology. He is the author of more than 140 publications in professional journals, and holds four U.S. patents. With his expertise, Parkinson elevates UW to the international forefront of solar energy and photovoltaic research. He will leave his current position at CSU to join to become a full professor at UW in August.

**Chemical &
Petroleum
Engineering:**

Maohong Fan – SER Associate Professor of Chemical Engineering

Dr. Maohong Fan comes to UW from Georgia Institute of Technology. His current research interests include applications of nanostructured materials and combined nano-bio technologies in chemical and environmental engineering as well as energy production; identification and removal of contaminants in water and wastewater, and pollutants in air; development of green chemical manufacturing processes and environmental sensors; production and separation of chemicals from biorenewable resources; and characterization and utilization of waste materials. He fulfills editorial responsibilities for several international chemical and environmental engineering journals, has edited and/or authored 10 books, chapters and journals' special issues, and has published more than 70 journal papers.

Dr. Fan received his doctoral degrees from the Chinese Academy of Sciences in 1997, Iowa State University in 2000, and Osaka University in 2003. He has led and worked on many projects in the areas of energy production, its resultant environmental issues, and green chemical synthesis processes. His support has derived from various domestic and international scientific research entities such as the U.S. DOE and EPA, Research Institute of Innovative Technology for Earth/NEDO in Japan, UNDP, and Beijing Science and Technology Commission in China.

Guan Qin – SER Associate Professor of Petroleum Engineering

Dr. Guan Qin comes to UW from Texas A&M University where he has held the position of Assistant VP for Research and Director for Research at Institute for Scientific Computation (ISC) since 2004. At TAMU, his main focus has been on developing global research collaboration and industry outreach. Among other accomplishments, he has raised significant industry funding to support TAMU's China-US Relations Conference Series. Prior to joining TAMU, Dr. Qin had more than 12 years of industry research experience with Exxon Mobil, Mobil, and China National Petroleum Corporation. His research expertise includes the application of advanced scientific computing technology to reservoir modeling, numerical simulation, and basin modeling.

Dr. Qin earned a B.E. degree in Engineering Mechanics at Tsinghua University, and an M.E. degree in petroleum engineering at China Research Institute of Petroleum Exploration & Development (RIPED), both in Beijing, China. He earned his Ph.D. degree in Petroleum Engineering at the University of Wyoming in 1995.

Economics & Finance:

Timothy Considine – SER Professor of Energy Economics

Dr. Timothy Considine comes to UW from Penn State University where he is a Professor of Natural Resource Economics. His research on petroleum market analysis has been published in the top economic journals, and The Cato Institute recently published his paper exploring management policy issues facing the U.S Strategic Petroleum Reserve. In fact, the U.S. Department of Energy's Office of the Strategic Petroleum Reserve currently uses his econometric model of world crude oil markets to estimate the market impacts of various management policies.

During Dr. Considine's 26 years of professional experience, he has been awarded major professional honors including a Gilbert White Fellowship at Resources for the Future and a Lucent Technology Industrial Ecology Fellowship. Prior to joining Penn State in 1986,

Dr. Considine worked as an Economist at Bank of America, and as the lead analyst for natural gas deregulation at the U.S Congressional Budget Office. He earned a B.A. with Honors in Economics from Loyola University of Chicago, an M.S. in Agricultural Economics from Purdue University and a Ph.D. in Natural Resource Economics from Cornell University.

These hires are of the highest caliber and bring a great deal of expertise to our energy-related teaching and research initiatives.

In addition, two searches are currently active for similar positions in:

- Wind energy (Assistant/Associate Professor in Mechanical/Electrical Engineering; offer under consideration)
- Land Reclamation and Restoration Ecologist (Assistant/Associate Professor in Renewable Resources – College of Agriculture; initial offer declined, to be re-advertised in fall 2008.)

We are currently considering several options for filling the remaining position, which we expect to advertise starting in the fall of 2008.

Appendix E

Wind Energy Research Center

Strategic Plan

Overview

This document provides a strategic plan for the Wind Energy Research Center. The origin and current expertise of the center are first given followed by opportunities that currently exist in the area. The vision of the center is then communicated and a path to realizing that vision is drawn. Finally, a discussion of how this plan fits within the larger visions of the departments, the college, and the university is provided.

Strategic Plan Context

WERC Origin and Expertise

In September of 2007, the University of Wyoming received a generous gift from BP America of which \$2000k was designated for wind energy research. This gift was a result of ongoing wind energy research at UW and BP's desire to invest more in the wind energy area. As a result of this gift, the Wind Energy Research Center was proposed and it officially became a center in December 2007.

Wind Energy Opportunities

The wind energy industry is a rapidly expanding industry. The 11.6 GW produced by wind turbines currently accounts for just over 1% of the U.S. electrical power.¹ The government recently released a report that considered what would be needed to produce 20% of the U.S. electricity needs by the year 2030.¹ This would require over 300 GW of wind-produced electricity requiring 16 GW per year by the end of the period.¹ Compared to the record-setting 5.2 GW installed in the U.S. last year, this represents a significant increase. In addition, the reliability and efficiency of these turbines also needs to increase.

Despite the predicted growth rate, wind energy is still far from a mature field. The 20% scenario actually includes an increase in performance and reliability.² There are many areas of wind energy technology that require further investigation, several of which are shown in Figure 1. If a significant amount of investment in research is realized, the potential of that research to affect wind turbines installed in the near future (next 10 years) is significant.³

¹ 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply, DOE/CO-102008-2567, May 2008, http://www.20percentwind.org/20percent_wind_energy_report_05-11-08_wk.pdf

² O'Connell, R. et al., "20 Percent Wind Energy Penetration in the United States: A Technical Analysis of the Energy Resource," Overland Park, KS: Black and Veatch, 2007, pp. 1-1,1-2.

³ 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply, DOE/CO-102008-2567, May 2008, pp. 23.

workforce for industry. Signs that the federal government may be investing in wind energy in the future are evident from the recent workshops that the Department of Energy (DOE) has been hosting on which several WERC members have served. Industry interest in university-based research is also increasing due to our recent experiences with BP and General Electric.

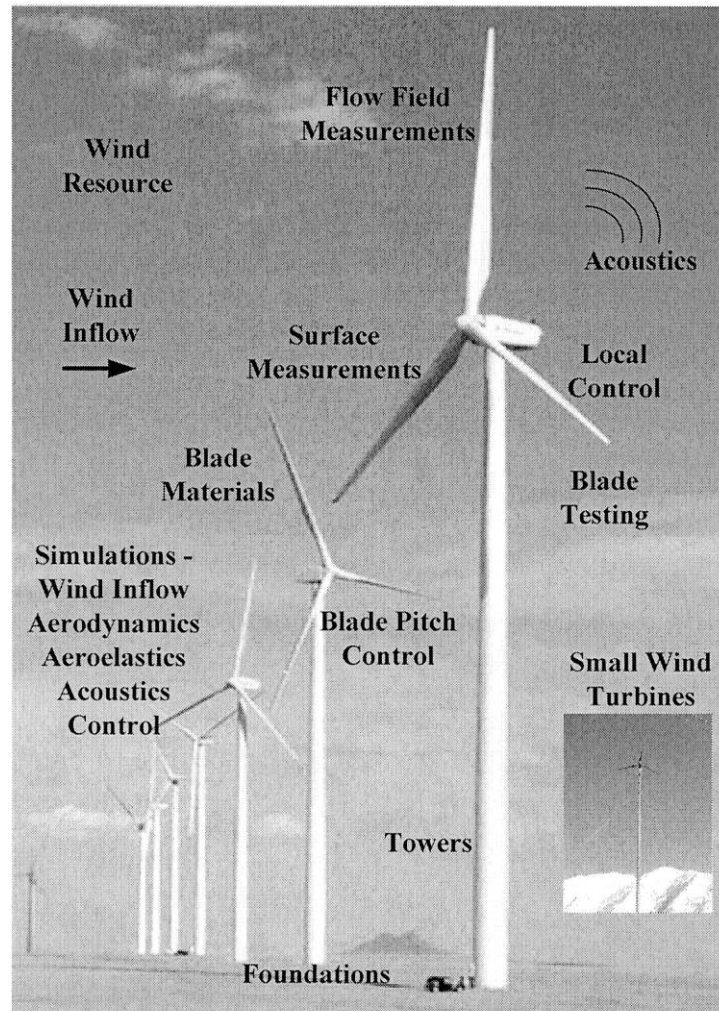


Figure 1 – Example areas of research needed to improve reliability, performance, and lifetime of wind energy systems.

Past Wind Energy Research, Education, and Service

Wind energy is not a new topic of research at the University of Wyoming. A review of alternative energy programs by the College of Engineering and Applied Science (CEAS) in 2007 revealed several groups working in wind or related areas. Thus the Wind Energy Research Center will be built upon this solid foundation. Table 1 provides a brief summary of the research areas that have been investigated in the past. A number of graduate students have graduated from these programs and some are now working in the wind energy industry in various capacities.

In addition to the research that has been performed at UW, there have also been specific courses related to wind energy that have been offered in the past. An undergraduate course in Alternative Energy Sources and Applications offered by the Mechanical and

Architectural Engineering Departments includes a section on wind energy, and the Electrical and Computer Engineering Department plans a course on wind turbine dynamics next year. With the perceived need, an increase in the coursework in wind energy and related areas is warranted.

Some limited outreach activities have occurred in the past. An example is a wind energy component of the Energy Summer Institute offered by the School of Energy Resources that has been put together by Scott Morton from the Mechanical Engineering Department. Clearly, outreach is an area that has to expand in partnership with outreach organizations within UW.

Table 1– A selection of current and past wind energy research areas at the University of Wyoming.

Dr. M. Balas	Wind turbine control
Dr. T. Parish	Wind resource modeling
Drs. W. Lindberg, T. Parish, R. Kelly, and J. Naughton	Wind inflow modeling
S. Morton	Small wind turbine development
Dr. D. Mavriplis	Helicopter rotor simulations
Dr. D. Walrath	Bend/twist coupling aeroelastics
Drs. W. Lindberg, and J. Naughton	Unsteady aerodynamics of pitching airfoils

Summary

The University of Wyoming is uniquely positioned to establish an internationally recognized wind energy program. The University is located near the “wind basket” of the U.S., the Great Plains, and is in proximity to many of the government laboratories that will be important to wind energy development including the National Renewable Energy Laboratory (NREL), the National Wind Technology Center (NWTC), Sandia National Laboratories, and the National Center for Atmospheric Research (NCAR). By one estimate, Wyoming will be one of the larger producers with greater than 10 GW installed in the state by 2030. ***The great need, the timing, UW’s location, the existing expertise, the initial monetary support, and the support of the administration all suggest that this center could become a leading research institution in the global wind energy effort.***

Vision

The vision of WERC is to establish an internationally-recognized program for conducting wind-energy-related research and education and to collaborate with other groups at UW to provide service to the state and the nation. This center will provide the experimental and computational capabilities as well as intellectual resources to carry out internationally-unique research that will aid in the nation’s goal of enhancing energy security while reducing energy-related environmental impact. No one institution can address all areas of wind energy research, so the Center will strategically partner with other academic institutions, federal

laboratories, and companies with complementary capabilities. Coupled with this research mission will be the commitment to produce a part of the workforce necessary to the large-scale penetration of wind into the energy market.

Approach

To realize this vision, WERC must take a four thrust approach:

1. further develop our research efforts and make the Center internationally recognized in our areas of expertise,
2. develop a set of research facilities and instrumentation needed to support the research efforts,
3. develop a curriculum to support the research efforts and to provide qualified graduates for the wind energy industry, and
4. collaborate with outreach entities at UW to develop an effective outreach program.

It is important the first three efforts be developed together as the absence of any one will severely limit the Center's ability to reach its goals. In addition, the fourth item is important to address so that the benefits of wind can be realized at both the local, national, and global levels. Each of these efforts is described briefly below.

Research Expertise

The University has had several researchers working in wind energy over the last decade. The first thrust will consider how to develop these limited efforts into larger, more focused efforts. To enable this, faculty of the center will have access to funds to support graduate students and post-doctoral students to capitalize upon our past efforts and to develop new directions. To complement our existing faculty complement, the center will seek to engage faculty that can contribute to the center in a real way. As part of this effort, the center is in the process of hiring a faculty member in wind energy to add complementary capability to that which already exists within the center. To increase the visibility of the center, faculty will be encouraged to have their students present their research at wind energy related conferences.

Facilities

Due to the lack of funding in the wind energy area, the facilities and instrumentation used to carry out wind energy related work have been obtained through efforts outside the wind energy area. As such, the resources are not always optimum for carrying out the Center's planned activities. In addition to lacking sufficient space and equipment, the labs are scattered across the college and ***lack the integrating capability necessary for laboratory and field test***. To address these shortcomings, the Center seeks to identify a facility where the activities necessary to support the interdisciplinary research inherent to the wind energy field. The location of this facility will have the competing interests of having the facility located near campus, but with the ability to support laboratory and field tests. A vision for the collaborative center's components is shown in Figure 2. Note that some of the laboratories would stay in their current location, some would be relocated saving space,⁴ and some would be new laboratory facilities.

⁴ The existing wind tunnel laboratory is scheduled to be demolished in the next few years.

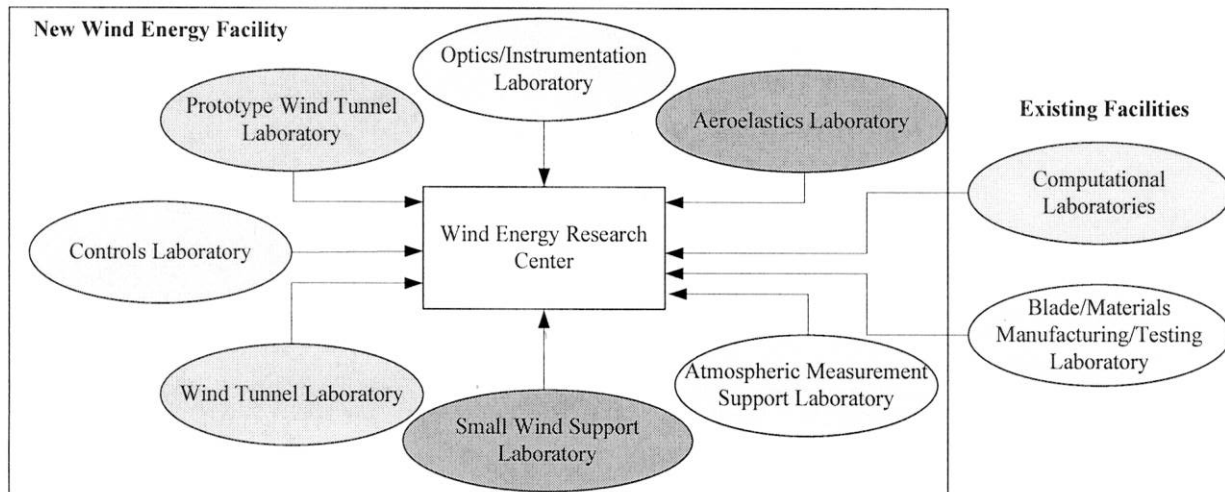


Figure 2 – Wind Energy Research Center facilities.

Education

It has become clear that the wind energy industry has a need for qualified personnel to allow for the rapid expansion of the industry.^{5,6} A workforce with diverse levels of training is needed, including 2-year technicians with an A.S. degree, 4-year engineers and scientists with a B.S. degree, and engineering/science graduates with M.S. and Ph.D. degrees. Like other energy technology, the wind energy field is interdisciplinary by nature. However, it is clear from past efforts that wind energy is closely coupled to the resource (i.e. the wind), and thus an integrated education approach that includes knowledge of the atmosphere is critical. Current plans are to offer an undergraduate wind/solar course that allows for a greater depth in wind energy than is possible with current offerings. This course would be part of a larger Energy Systems Engineering degree that is being discussed by the College of Engineering and Applied Science (CEAS) and the School for Energy Resources (SER). In addition to undergraduate programs, there is a critical need for graduate programs related to Wind Energy.⁶ The Center is looking into offering an interdisciplinary M.S. degree in Wind Energy that will include topics from Mechanical Engineering, Electrical Engineering, and Atmospheric Science. The focus of this program would be to provide a workforce to industry in this area. Offering part or all of this program on-line and/or with other contributing institutions is being considered. In addition, the Center will utilize M.S. and Ph.D. students to conduct research for specific programs that will result in the development of the group that will lay the foundation for the next generation of wind turbines. Finally, we will coordinate with the Wyoming community colleges to support their efforts at training students in the wind energy field. It is hoped that addressing education at all three of these levels will excite a diverse range of domestic students about the opportunities in the wind energy field.

Outreach

The number of inquiries to the center indicates that there is a large need for outreach. This outreach may take many forms:

⁵ Several conversations with personnel from BP and GE have made this point obvious.

⁶ 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply, DOE/CO-102008-2567, May 2008, pp 70-72, http://www.20percentwind.org/20percent_wind_energy_report_05-11-08_wk.pdf.

1. helping landowners with wind farm possibilities,
2. helping companies that want to locate wind plants or manufacturing facilities in the state,
3. helping homeowners that want to power their houses with wind energy, and
4. exciting high school students about the possibility of wind energy.

This is clearly an area where we will coordinate with other groups on campus that work in the outreach area.

Fit with the Department, College, and University Plans

The Wind Energy Research Center Strategic Plan has been developed considering the Universities current and new Academic Plans.^{7,8} Rather than considering the University, Colleges, Departments, and the School for Energy Resources separately, the Center's alignment in a general sense will be addressed here.

First, it is anticipated the Center will leverage our unique depths in the areas of Mechanical Engineering, Electrical Engineering, and Atmospheric Science relevant to wind energy that already exist. Future faculty added and a larger graduate program will only enhance the well-established research areas that make up the Center. The proposed curriculum will only require the addition of two courses at the graduate level and one modified at the undergraduate level. The existing courses that will be part of the graduate curriculum are underutilized, and thus this program will serve the individual departments in this sense. Building depth in the area of wind energy makes sense from the perspective of the State and Albany County since this is likely to be a large industry in the State.

Second, the Center's efforts falls across several of the areas of distinction called for in AP II. Most evident is the Center's involvement with an important energy source that has historically been under-developed. Thus, the center's development falls within the Energy Science and Technology development area and the mission of the School for Energy Resources. The center will also rely heavily on computational methods that are at the cutting edge of computational capability. Finally, the wind resource side of wind energy provides excellent ties with NCAR and the new NCAR supercomputing facility.

Third, the Center will provide a center of excellence from which high quality graduate students and faculty can be recruited. The proposed education program would be unique and is anticipated to attract a number of students from across the country. Graduates from that program would become critical to the wind energy industry and doctoral students would go on to establish programs at other universities. Such a program would reflect well on the University, SER, CEAS, and the individual departments and faculty.

Finally, the Center will provide a focal point for the development of the wind energy business in Wyoming. It is already a well-funded center, and promises to continue as such. The educational programs offered by the Center in alliance with several departments and SER will provide another source of energy-related graduates. Both the education and research initiatives will enhance the visibility of the departments, CEAS, and SER in the wind energy field. With the critical importance of wind energy to the nation and the Great Plains, such visibility should not be underestimated.

As is evident here, the strategic plan of the Wind Energy Research Center fits well within the plans at all levels within the University. This alignment should facilitate the development of the Center as it grows.

⁷ Academic Plan II, 2004-2009

⁸ Creation of the Future 2, Access, Excellence, Leadership

Appendix 1 - WERC Personnel

The founding faculty of the Wind Energy Research Center are

1. Mark Balas, Professor, Electrical and Computer Engineering,
2. William R. Lindberg, Professor Emeritus, Mechanical Engineering,
3. Dimitri Mavriplis, Professor of Mechanical Engineering,
4. Scott Morton, Senior Research Scientist, Mechanical Engineering,
5. Jonathan W. Naughton, Associate Professor, Mechanical Engineering,
6. Thomas R. Parish, Professor of Atmospheric Science, and
7. David E. Walrath, Professor, Mechanical Engineering.

These faculty members were selected due to their past work in the wind energy area. It is expected that several additional faculty will be associated with the Center in the near future, including a newly hired professor.

Appendix 2 - WERC Facilities

Current Facilities

University of Wyoming Aeronautical Laboratories (UWAL)

Over the past ten years, a fluid dynamics research program has been developed with the assistance of a significant monetary investment by the College of Engineering and Applied Science and the University. The existing University of Wyoming Aeronautical Laboratories (UWAL) facilities consists of three laboratories: the wind-tunnel 2200 sq. ft. laboratory that houses the 2' x 2' low speed wind tunnel and a 1.5 inch free jet, the 1000 sq. ft small wind tunnel laboratory that houses the variable pressure gradient wind tunnel, and the 800 sq. ft. optics and instrumentation laboratory. The laboratory currently supports ~ \$250 k/yr of federally-supported research. In addition to standard pressure and temperature measurement equipment and programmable data acquisition capability, several high-quality instrumentation systems have been acquired by UWAL including a Particle Image Velocimetry (PIV) system, a Laser Doppler Anemometer (LDA) system, an 8 channel Hot-Wire Anemometry (HWA) system, high-speed pressure transducers, a high-speed data acquisition and filtering system, and a unique wall shear stress measurement system.

The wind tunnel laboratories have the instrumentation necessary for providing high quality fluid measurements for better understanding the complex fluid physics associated with wind turbine flows. However, the existing wind tunnel facilities have significant limitation in size, flow quality, and types of instrumentation that can be used in them.

The laboratory is currently pursuing basic fluid dynamics studies including the control of base flows, jet flows, and sensor/actuator development and characterization. Of most relevance to the proposed center are the recent work in wind inflow modeling done in conjunction with atmospheric science and oscillating airfoil work focused on flutter control.

Composite Materials Laboratories

An important aspect of wind-turbine performance is turbine-blade design, for which blade material is substantial consideration. New composite materials hold promise for improved blade performance. Composite materials fabrication and testing research has been ongoing here at UW since the 1970's. During that period, facilities and equipment for both fabricating and testing continuous fiber-reinforced composite materials have been acquired. The material testing laboratory is equipped to load specimens with very small forces to a maximum of 100 kips. Auxiliary facilities for installation of strain gages and data acquisition equipment are available to provide measurement of force, displacement, strain, and temperature. The college

has a complete machine shop capable of manufacturing complex test fixtures and cutting specimens as required.

Servo-hydraulic test equipment include an MTS 312 (5,000 lb force/2 in. stroke), Instron 1321 (biaxial 20,000 lb force/4 in. stroke, 10,000 in-lb torque/90 deg. Rotation), Instron 1332 (55,000 lb force/4 in. stroke), and an Instron 1334 (110,000 lb force/6 in. stroke) testing machines. Fixtures for performing most standard composite material mechanical tests are regularly used in the laboratory. All tests can be performed at elevated or sub-ambient temperatures using environmental chambers installed within the test machines. Long-term durability test capability (creep and fatigue) is also available.

Fabrication facilities include laboratories dedicated to fabrication and processing of fiber-reinforced polymer matrix composite materials. Approximately 4500 ft² are dedicated for this purpose, including approximately 500 ft² in a specially ventilated laboratory dedicated to prepreg layup and thermoset polymer processing. An additional 1200 ft² of space is available for special projects. These facilities house specialized pieces of processing equipment, including hydraulic heated latex presses (Wabash 40 ton 18 inch square platens and Ludlum 300 ton press, 36 by 54 inch platens), an autoclave (air or inert gas electrically heated 23 inch diameter by 30 inches long, 200 psi maximum), pressclaves/flat autoclaves (33 inches square 1 inch height and two 15 inches square, 1-1/2 inches height), a filament winder (Composite Machines CNC controlled 2-axis winder, 15 inch maximum mandrel radius, 13 feet maximum length), and a thermoplastic matrix pultrusion system (UW developed thermoplastic matrix pultrusion system including resin extrusion and fiber coating). Various air-circulating and vacuum ovens are also available. Specialized tooling is often designed and built in the College Machine Shops.

Distributed Wind Test Facility

Existing work on distributed wind has been done in various laboratories in the College of Engineering and Applied Science and at the Small Wind Test Site on the Monolith Ranch south of Laramie. The site has a tower for a single wind turbine of approximately 2 kW rated power and an associated meteorological tower to obtain hub height meteorological data. An instrument trailer is sited near a stock well with a mechanical water pumping windmill, a submersible pump, and a stock water tank with an insulated heated section. A data collection trailer is situated near the well site. Data is collected with a Campbell Scientific data logging system and transmitted to the Engineering Building at the University of Wyoming through an RF link. Control of the turbines is done with a programmable logic controller.

High Altitude Computational Fluid Dynamics Laboratory

Computational methods can be expected to play a decisive role in future wind energy research, analysis and design. The High Altitude Computational Fluid Dynamics (CFD) laboratory in the department of Mechanical Engineering at the University of Wyoming is entering its sixth year of operation. The lab currently supports several postdoctoral researchers and PhD graduate students, and houses a parallel computer cluster comprising 96 cpu cores. The CFD lab has been involved in researching and developing state-of-the-art techniques in computational aerodynamics analysis and design, as well as techniques for aeroelasticity, principally for fixed wing aircraft. More recently, the lab has been funded to develop a high fidelity aerodynamic analysis capability for comprehensive rotorcraft simulations by the US Army. The rotorcraft simulation capability developed under this effort will serve as the basis for a wind turbine aerodynamic, aeroelastic, and aeroservoelastic simulation capability.

Atmospheric Resource Prediction Facility

Atmospheric mesoscale modeling is a tool that enables wind resource mapping over scales that are now approaching 1-km horizontal resolution. Work will be conducted with the Weather and Research Forecasting (WRF) model in simulating the wind resource for the western United States with emphasis on the Wyoming wind potential. WRF has been shown to successfully capture fine-scale details of the atmospheric boundary layer and the influence of topography on the airflow. The model can be run in a real-time mode and when initialized with fine-scale operational models is thought to offer the most detailed examination of wind potential in Wyoming to date. Efforts are currently underway at establishing a climatological record of wind using output from the WRF simulations. Comparison with high-resolution output from operational numerical models will also be made. A goal will be to refine wind potential maps for Wyoming. In addition, efforts will be made to validate wind forecasts from WRF so as to allow first estimates in wind resource forecasting for current or newly-proposed sites.

Research is currently performed on existing computational facilities within the Department of atmospheric science.

Desired Facilities

Although several of the laboratories already exist within the College of Engineering and Applied Science, co-location of these labs within a Center facility will facilitate the interdisciplinary nature of wind energy research. Modern lab space that will provide a productive workspace for students and faculty and be a place where we are proud to show our visitors what we do will be a critical anchoring element of the center.

New Aerodynamics Laboratories

Although UWAL's students and instrumentation are world class, its facilities are not. In addition, the largest of the three laboratories is cited for demolition in the near future. A high-quality, closed return wind tunnel is mandatory for carrying out the type of work envisioned for the center. A large laboratory to contain this tunnel and provide room for carrying out experiments will be the largest component of a new WERC facility. In addition to this facility, smaller aerodynamic facilities would be located nearby for prototype testing and easy access to instrumentation systems. To support the work carried out in this facility, a full-time technician is desired.

Controls Laboratory

Controls comprise a critical component of the larger wind turbines now favored by industry. Most utility-scale turbines have rudimentary control capability for blade pitch and generator torque commands already in place, but the potential for substantial improvement with advanced control is already recognized.

A Wind Energy Control Laboratory will need to interface closely with the Aerodynamics Laboratories to gather experimental data and process it for on-line control experiments in flow regulation and aeroservoelasticity. The major resource need would be appropriate real-time data input-output collection and processing capability, such as a D-Space system, which also has the ability to download and run MatLab/Simulink generated control algorithms in closed loop with on-going aero-experiments. In addition, several computer workstations nearby would allow for students and faculty in the Control Laboratory to develop and modify control algorithms in-place and process data via model reduction techniques from large-scale computational models available off-line.

At present, no such facility is available at the University of Wyoming. Current research is in development and numerical testing of new turbine control ideas using off-line computational facilities at UW and at the National Renewable Energy Laboratory in Golden, CO. None of these facilities can accommodate the level of experimentation and hardware-in-the-loop control testing necessary for handling advanced aeroservoelasticity mitigation and flow control development.

Composite Materials and Aeroelastics Laboratories

Currently available equipment provides a good start to the experimental study of aeroelastically designed blades. No immediate plans for moving these existing facilities to a new WERC facility is envisioned. However, controls for the servo-hydraulic testing machines are becoming dated and will need to be updated. Additional accelerometer sensors and data acquisition capability must be acquired to monitor blade displacement and dynamic displacement/rotation modes in candidate blade designs. For fabrication of more complex layups, CNC prepreg pattern cutting equipment is needed.

In addition, laboratory space for blade fabrication and aeroelastic testing are required. Small wind turbine blades will be fabricated for distributed wind and wind tunnel testing applications. Characterization of the blade aeroelastics will be conducted in both an aeroelastics laboratory and in the wind tunnel facility as well as in field tests.

High Altitude Computational Fluid Dynamics Laboratory

The expansion of the computational effort into the wind energy area will require an expansion of the current computer cluster and associated housing space for the new hardware. This lab space need not be co-located with the WERC facility, since it can be accessed over the internet. However, workspace in the new WERC facility for graduate students is desired. In order to rapidly process wind-turbine analysis applications, and to interface effectively with the experimental and analytical sides of the institute, a CFD application specialist devoted to wind turbine applications will be required, in addition to specialized grid generation and visualization software.

Atmospheric Resource Prediction Facility

Although there are no plans for a large facility as part of the new WERC facility, access to computational resources described as part of an associated computational laboratory will be used. As with the High Altitude Computational Fluid Dynamics Laboratory, workspace with computer workstations located in the new facility is desired.

Distributed Wind Test Facility

The Small Wind Test Site has room for expansion and, with upgrades to the instrumentation and tower facilities, has the potential to be an outstanding small wind experimental site and possibly a certification facility for small wind turbines. Facilities for direct connection to the power grid would greatly enhance the capabilities of the site. A renewable energy class has developed preliminary plans for expanding and upgrading the Small Wind Test Site. This test site need not be co-located with the WERC facility, but an enhanced facility is a critical need for the center. A small laboratory at the site for building and testing small wind systems is a necessity.

Atmospheric Measurement Laboratory

A laboratory for developing and testing of new atmospheric measurement systems would be a beneficial addition to WERC. This laboratory could be located with the distributed wind test facility or the main WERC facility. Proximity to a location where such a system could be tested is probably most important. A laboratory capable of optical system development and testing would be needed.

Appendix 3 - WERC Interactions

With the size of WERC in terms of faculty and resources, it is recognized that collaborations with other institutions is necessary. To that end, WERC has been developing relationships with other institutions that could play key roles as partners and funding sources in the future.

Other Academic Institutions

The faculty of WERC are developing direct relationships with several academic institutions that offer complementary capability to WERC's expertise. Some of the more advanced relationships are given here.

Boise State

Dr. John Gardner has a background in machinery and robotics. He is currently pursuing work in gear boxes and storage methods. Both of these areas are critical technology areas for wind where we have limited expertise

University of Florida

Dr. Lou Cattafesta has a background in fluid dynamics and controls. He is currently working in the aero-acoustics of wind turbine blades. Dr. Mark Sheplak works in pressure and shear stress sensors as well as aeroacoustics.

University of Western Ontario

Dr. Horia Hangan is the director of the Boundary Layer Wind Tunnel and has extensive experience with Wind Engineering for buildings and bridges. He is currently investigating flat back airfoils for wind turbine applications. Access to these very large wind tunnels is a very good asset.

Federal Laboratories

Federal laboratories represent both collaborative and funding possibilities. Several laboratories key to wind energy are located in close proximity to UW.

National Renewable Energy Laboratory (NREL)

The faculty of WERC have long ties with the National Wind Technology Center (NWTC) and some of our former students work at the wind site. Their expertise and facilities are an asset that we can certainly benefit from. They have the capability to test large wind turbines and have developed simulation codes. They represent the longest running wind energy research initiative in the country. With a change in the political climate, wind energy research is likely to receive better funding and NREL will become a potential funding source.

Sandia National Laboratory

Sandia has a small group working on wind energy. In contrast to NWTC, Sandia focuses on large scale computations and wind turbine control. As with NREL, they promise to both a collaborator and potential funding source.

National Center for Atmospheric Research (NCAR)

NCAR's work obviously has direct impact on the ability to model wind energy resources. Close ties for both modeling and measurement of the wind field associated with wind turbines are desired as this is an area where we have solid expertise.

Industry

Industry is currently leading the research and development effort in the US. Collaboration with industry provides funding resources, expertise, and ensures relevance of the Center's work to the wind energy industry.

BP Alternative Energy

BP is primarily responsible for the existence of the center as they were the first to make a large gift to wind at UW. This initial gift and the research that will be funded by it serve to allow the center to raise its profile. After meeting in Houston and Laramie this past year, collaboration is just beginning with BP personnel in Houston, California, and London.

General Electric

GE is the largest builder of wind turbines in the US. Three visits and a telecom with GE wind have taken place. Collaborative work with GE is expected to start later this year. GE extensive expertise and resources promise to make this relationship highly beneficial to the center.

Sandecker Renewables

Sandecker is a small startup from Cheyenne Wyoming working on self contained wind systems (both production and storage). It appears that they will be a funding source for our distributed wind program.

Siemens

Initial contact with Siemens has been made. They have just recently opened an office in Boulder, CO and a meeting in September 2008 is planned.

Consortia

There are several University/Federal Lab/Industry consortia that are being developed. We are talking to two of them: the Center for Research and Education in Wind (CREW) and the Lone Star Wind Alliance (LSWA). CREW is made up of three Colorado Universities (CU,

CSU and CSM) and NREL, and LSWA is made up of several Texas Universities. Both of these collaborations seek to be industry funded through corporate memberships.

Appendix F

School of Energy Resources Matching Grant Fund August 2008

FY 2008

Agreed to Provide Matching Funds-Waiting for Approval from External Organization

PI	External Organization	Proposal	MGF Funds	External Funds	Total Funds
Alvarado, Vladimir	American Chemical Society	Dynamics of solid-stabilized emulsions in porous media	\$50,000	\$50,000	\$100,000
Piri, Mohammad	DOE/EPSCoR	Tight Gas Reservoirs: Experimentation & Modeling of Hysteresis & its Implications for Gas Recovery	\$100,000	\$1,194,000	\$1,294,000
Zhang, Ye	DOE Basic Energy Science	Evaluation of Model uncertainty in CO2 Sequestration in Deep Aquifers	\$82,450	\$82,450	\$164,900
Eggleston, Carrick	Petroleum Research Fund	Optimization of Inexpensive Semiconductors for Solar Carbon Fixation	\$50,000	\$100,000	\$150,000
Johnson, Patrick*	Fossil Fuel Program NETL DOE	Energy from Organic Waste Degradation Using Biological Fuel Cells	\$100,000	\$150,000	\$250,000
Lee, Long	National Science Foundation	Transport Mechanisms for Multi-phase Micro-fluids on Structured Solid Surfaces	\$48,183	\$172,465	\$220,648
Garrison, Jean	Japan Foundation Grant & Institute for Global Environmental Strategies	Energy Security & Climate Security in Asia: Implications for U.S. Foreign Policy	\$38,231	\$300,000	\$338,231
Sullivan, B. Patrick*	Department of Energy	Highly Oxidizing Ligand-to-Metal Charge Transfer Excited States for Solar Energy Conversion	\$88,000	\$345,000	\$433,000
Montague, Derek*	Wyoming DEQ, Bureau of Land Management, U.S. Forest Service, & EPA	Upper Green River Basin Ozone Monitoring Study	\$97,952	\$97,952	\$195,904
Tang, Jinke	Department of Energy	Investigating energy transfer in novel Ce3+ & Cr3+ co-doped phosphors & their applications in white light emitting diodes	\$90,000	\$600,000	\$690,000
Moss, Justin	Whitney Benefits	Sustainability of Straight Vegetable Oil & Biodiesel Fuel Production for Wyoming: Development, Production, Use & Education	\$22,850	\$48,750	\$71,600
Chamberlain, Kevin	Department of Energy & Cameco Inc.	Long-term study to assess the utility of Pb isotope analyses for improved monitoring of aquifer interactions in the in-situ U industry	\$60,000	\$60,000	\$120,000
Jun, Sukky	Department of Energy Office of Basic Energy Science	Environment-Dependent Instability of Organic-Based Framework Materials	\$38,587	\$180,000	\$218,587
Johnson, Patrick	Department of Energy Biomass Program	Immobilized enzyme systems for conversion of woody biomass for butanol production	\$100,000	\$500,000	\$600,000
Andersen, Matt	Bureau of Land Management, Wyoming Wildlife & Natural Resource Trust, Anadarko Petroleum Corp, Questar Exploration & Production Co.	Reclamation Costs, Bonding Systems, & the Probability of Reclamation in Wyoming's Oil & Gas Industry	\$44,552	\$32,076	\$76,628
Parkinson, Bruce	Center for Revolutionary Solar Photoconversion	Optimizing Cu2ZnSnS4-based Photovoltaic Devices: An Approach to Inexpensive & Scalable Thin Films & Fundamental Studies of their Semiconducting Properties	\$25,000	\$75,000	\$100,000
FY08 Subtotal			\$1,035,805	\$3,987,693	\$5,023,498
# Proposals			16		

*Received verbal approval

FY 2008

Funding from External Organization Received & MGF Funds Paid

PI	External Organization	Proposal	MGF Funds	External Funds	Total Funds
Beck, Jeffrey	Wyoming Wildlife & Natural Resource Trust and USDI Bureau of Land Management	Identifying Disturbance Mechanisms Influencing Habitat Selection by Elk in Natural Gas Development Fields	\$60,000	\$461,500	\$521,500
Chamberlain, Kevin	Cameco, Inc.	Pilot Study to Assess the Utility of Pb Isotope Analyses for Improved Monitoring of Aquifer Interactions in the In-situ U Mining Industry	\$5,000	\$5,000	\$10,000
Norton, Jay	Anadarko, BP, Encana, Questar, Western Sustainable Agriculture Research & Education Program, UW AES Competitive Grants Program, USDA-NRI Soil Processes Program	Effects of Natural Gas Well Development & Reclamation Activities on Topsoil Properties	\$40,000	\$40,000	\$80,000
Beck, Jeffrey	Anadarko Petroleum Corporation	Identifying Habitats for Greater sage-Grouse Population Persistence within the Atlantic Rim, Wyoming Coalbed Methane Field	\$40,000	\$150,000	\$190,000
Argyle, Morris	Jupiter Oxygen	Mercury Removal from Flue Gas Derived from Oxygen Combustion of Coal	\$25,000	\$25,000	\$50,000
Kauffman, Matthew	Wyoming Wildlife & Natural Resource Trust, Wyoming Game & Fish, Wildlife Heritage Foundation of Wyoming	Identifying mule deer migration routes to and from the Pinedale Anticline Project Area	\$45,000	\$45,000	\$90,000
FY08 Paid			\$215,000	\$726,500	\$851,500
# Paid Proposals			6		

**School of Energy Resources
Matching Grant Fund
August 2008**

FY 2008			
Funding from External Organization Denied			
PI	External Organization	Proposal	MGF Funds
Naughton, Jonathan	National Science Foundation	Aerodynamics & Control of Wind Turbines	\$100,000
Debashis, Dutta	American Chemical Society	Characterization of Sodium Silicate Derived Polymer Electrolyte Membrane Structures for Microchip based Portable Fuel Cells	\$50,000
Piri, Mohammad	Research Partnership to Secure Energy for America	Recovery of Heavy Oil Using Supercritical Water: Experimentation & Modeling	\$100,000
Stahl, Peter	Office of Surface Mining	Environmental Heterogeneity in Reclaimed Soils to Enhance Diversity of Reestablished Plant Communities	\$57,917
Lyng, Gregory	National Science Foundation	Analysis & Computation of Spectral Stability in Combustion, Gas Dynamics, & Porous Media	\$41,236
Zhou, Jing	American Chemical Society	Atomic-scale understanding & tuning of chemical reactivity of ceria-based metal catalysts toward water-gas shift reaction	\$50,000
Carrapa, Barbara	American Chemical Society	Dynamics of deformation & basin development during Sevier & Laramide orogeny	\$50,000
Sullivan, B. Patrick	NSF SGER Program	Linear Delocalized Metal-to-Ligand Charge Transfer Excited States Based on Carbonyl Acceptors	\$43,000
Denzer, Anthony	U.S. Green Building Council	Real-Time Cross-Disciplinary Distance Collaboration for Green Building Design	\$18,434
Goual, Lamia	REPSOL	Kinetics of Heavy Organic Deposition & Precipitation Onsets in Crude Oil Flow Systems	\$72,000
			FY08 Denied
			# Denied Proposals
			10
Total # Proposals			32

FY 2007					
Funding from External Organization Received & MGF Funds Paid					
PI	Organization	Proposal	MGF Funds	External Funds	Total Funds
Campbell-Stone, Erin	Wyoming NASA Space Grant	Fault Seal on Low-Angle Normal Faults	\$15,000	\$15,000	\$30,000
Heller, Paul	American Chemical Society	Shapes, Scales, & Spacings of Channel-belt Sand Bodies in Avulsion-dominated Alluvial Basins	\$50,000	\$100,000	\$150,000
Piri, Mohammad	Total E&P UK PLC	Three-Phase Relative Permeabilities for Enhanced Oil Recover Schemes	\$80,000	\$200,000	\$280,000
Johnson, Patrick	North Central Sun Grant Center	Recoverable Enzyme Nanoparticle Systems for Cellulose Hydrolysis	\$51,600	\$284,600	\$336,200
Tang, Jinke	Sharp Laboratories of America	Investigation of nanospheres for general lighting application	\$50,000	\$120,000	\$170,000
Argyle, Morris	Western Research Institute	Integration of a Structural Water Gas Shift Catalyst with a Vanadium Alloy Hydrogen Transport Device	\$100,000	\$100,000	\$200,000
Bell, David	Idaho National Laboratory	Model Development: Fischer-Tropsch Synthesis & Product Refining	\$50,000	\$50,000	\$100,000
Mavriplis, Dimitri	Department of Energy	Sensitivity Analysis for Uncertainty Quantification & Improved Accuracy in Nuclear Reactor Core Simulations	\$70,000	\$287,426	\$357,426
Argyle, Morris	Idaho National Laboratory	Nonthermal Plasma Reactors for the Decomposition of Hydrogen Sulfide	\$12,492	\$12,492	\$24,984
FY07 Subtotal			\$479,092	\$1,169,518	\$1,648,610
# Proposals			9		

Appendix G

SCHOOL OF ENERGY RESOURCES FINANCIAL REPORT JULY 1 - AUGUST 31, 2008

EXPENDITURES BY DIVISION

Fiscal Year 2009
FYTD Expenditures

ACADEMICS

Coordinator's Office -	
<i>Salary & Benefits</i>	\$36,178
<i>Office Support Expenses</i>	\$1,476
Undergraduate Research Fellowship Stipends	\$3,550
Distinguished Faculty	\$50,366
Visiting Professorships	\$0
Teaching Internships	\$0
Energy Summer Institute	\$883
Other Support (Course Dev, Faculty Searches, Faculty Start-up)	<u>\$105,971</u>
SUBTOTAL ACADEMICS	\$198,424

RESEARCH

Institute for Energy Research Technical & Support Staff	\$0
Half-Time Faculty Appointment and Summer Research Salary	\$0
Graduate Assistant Stipends	\$22,395
Research Center Seed Money (aka Start-up Assistance Fund)	\$0
Matching Grants Fund (Awarded and Obligated)	\$0
Transfer to Sponsored Programs (Matching Grants Reserve Fund)	<u>\$0</u>
SUBTOTAL RESEARCH	\$22,395

OUTREACH AND SERVICE

Energy Outreach Center	\$0
Consulting Specialists	\$0
Other Outreach (Office Support, Workshops)	<u>\$17,769</u>
SUBTOTAL OUTREACH AND SERVICE	\$17,769

ADMINISTRATION

Director's Office -	
<i>Salary & Benefits</i>	\$61,525
<i>Office Support Expenses</i>	<u>\$18,276</u>
SUBTOTAL ADMINISTRATION	\$79,801

TOTAL FISCAL YEAR TO DATE EXPENDITURES FOR 2009 **\$318,388**