

UNIVERSITY OF WYOMING SCHOOL OF ENERGY RESOURCES ACADEMIC AND FINANCIAL PLAN

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This version of the report incorporates a change in the name of the University of Wyoming Energy Resources Council, made on October 31, 2005 to avoid duplicating the corporate name of a previously registered organization.

ABSTRACT

In response to a legislative request, the University of Wyoming proposes to establish a School of Energy Resources. The school's mission will bolster Wyoming's economic development and the preparation of students in three major ways:

- Academics, through the addition of 12 new faculty positions, permanently dedicated to energy-related teaching and research in appropriate disciplines; curriculum and certificate programs relevant to Wyoming's energy economy; and stronger links to the state's schools and to the energy industry.
- Research, through a stably funded Institute for Energy Research that will include the existing Enhanced Oil Recovery Institute as well as additional externally-funded research centers focusing on such other energy resources as coalbed natural gas, coal conversion, and renewable energy. In the long term, these centers may change over time, depending on emerging trends in energy research and the availability of external funding. All research centers in the Institute for Energy Research will focus on energy resources of importance to Wyoming.
- Service, through a new Energy Outreach Center, whose mission will be to disseminate scientific, engineering, and economic information to support Wyoming's near-term and long-term energy-related activities.

To maximize the school's impact on the university's teaching mission — and hence its capacity to prepare students for energy-related careers relevant to Wyoming — the director will report to the Vice President for Academic Affairs. This reporting line, together with the state resources assigned permanently to the school, will enable the director to influence curriculum and scholarly activities in all seven of UW's colleges as well as in other key academic units. We also propose the establishment of a University of Wyoming Energy Resources Council, appointed by the Board of Trustees, that will provide guidance to the Trustees, President, and Vice President for Academic Affairs on the school's academic directions, research accomplishments, and outreach effectiveness. A staged funding plan will allow for the development of the school, including the hiring of a director, new faculty members, and other staff members, over the span of fiscal years 2007, 2008, and 2009.

1. INTRODUCTION

In response to a request by the Wyoming Legislature, the University of Wyoming proposes to establish a School of Energy Resources. The school's mission will have three dimensions:

- I. Academics. Strengthen baccalaureate and graduate teaching, to produce UW graduates who are equipped to work in fields integral to Wyoming's energy economy.
- II. Research. Advance the state of the art in energy-related science, technology, and economics through world-class research that attracts premier scholars and teachers to Wyoming.
- III. Statewide outreach and service. Support scientific, engineering, and economic outreach for near-term and long-range energy planning, through the open dissemination of information needed for energy-related activities in Wyoming.

Core questions. The organizing principles underlying the school will be a set of broadly framed core questions related to Wyoming's energy portfolio:

- How can Wyoming sustain and optimize the long-term production of fossil energy resources, through better geologic understanding, more powerful engineering design, more refined process modeling, more sophisticated economics, better business and regulatory practices, and enhanced reclamation?
- What curriculum will be required to prepare UW students for careers in Wyoming's current and future energy economy?
- To what extent can Wyoming produce energy from renewable and sustainable resources, including wind, solar energy, and possibly other resources?
- What are Wyoming's roles in the emerging and potential markets for carbon dioxide sequestration, hydrogen production, and transportation fuels derived from coal?
- What are the potential land-use and environmental benefits of optimizing production, for example through more efficient utilization of already developed fields and more effective management and utilization of byproducts, such as flue gas, fly ash, and coalbed natural gas water?
- What planning measures — technological, economic, environmental, and policy-related — will smooth Wyoming's transition to a long-range energy economy that may involve greater use of non-fossil energy resources?

Technological focus. The technological focus of the school will be in areas that (a) are directly related to Wyoming's energy portfolio and (b) have a foundation in UW's existing faculty expertise. In the near term, this portfolio includes oil, natural gas (including coalbed natural gas), coal, and renewable sources such as solar and wind energy. The school will also help UW maintain supporting expertise in such related fields as energy economics, reclamation ecology, carbon sequestration, coal conversion, energy conservation, legal and permitting issues, and electric power generation and transmission.

In the longer term, Wyoming's active energy portfolio may expand to encompass greater production of uranium, hydrogen, and possibly other resources. Recognizing that the specific research initiatives will need to evolve over time, we propose a structure that avoids over-specification, retaining the capacity to anticipate and accommodate intermediate-term and long-term changes in Wyoming's energy economy as well as to address the state's current needs.

Structural elements. The structural elements of the school will include the following, each of which is described in further detail in section 4:

I. Academics

- Faculty. The school will have permanent funding for 12 distinguished professorships, to help attract faculty members who have achieved international recognition for their teaching and research in fields related to energy. The intent of these positions will be to attract high-profile, senior scholars from outside the university who can (a) help in the ongoing recruitment of talented junior faculty members and (b) advance UW's teaching and curriculum in directions that both support the state's economic health and strengthen UW graduates' preparation for careers in energy-related fields. To ensure that these professorships remain focused on energy, the positions will belong permanently to the school, with the director of the school retaining control over their allocation among specific academic disciplines. Of special interest for the foreseeable future will be professors who have expertise to teach in areas related to oil and gas, coal, coalbed natural gas, renewable energy resources, and the economics of Wyoming's energy resources.

- Curriculum. Curricular initiatives will include:
 - Measures, such as augmented degree options and possibly a professional masters' degree program in energy science, to promote greater interdisciplinarity in energy-related graduate programs.
 - Re-institution of a baccalaureate degree in Petroleum Engineering¹. This initiative will be a matter for the university's Trustees to consider during the 2005-2006 academic year, independent of the legislature's action on the proposal for a School of Energy Resources.
 - Exploration of other curricular measures — such as certificate programs in natural resource accounting and mineral property law and an area of emphasis in these subjects for MBA students — that can enhance the employability of UW graduates in energy-related fields. Such measures will also include the development of internship opportunities that will provide practical industrial experience for baccalaureate and masters'-level students.

- Links to industry. These links will include:
 - Distinguished visiting professorships, aimed at attracting year-long teaching and research appointments for scientists, engineers, and other professionals who have attained wide recognition for their applied energy-related work in the industrial sector and in other applied settings.
 - A program of industrial subscribers, through which corporations can help fund faculty-directed student research, provide venues for summer internships, and open doorways into energy-related careers.

- Links to Wyoming's educational system. These links will include:
 - Distinguished teaching internships for Wyoming high-school and community-college faculty members, providing opportunities for fully funded sabbatical leaves to teach classes at UW and to enhance their own backgrounds in energy-related fields. Summer programs for high school teachers, offered either on the Laramie campus or through WEN, the statewide videoconferencing network.
 - A summer program for Wyoming high school students interested in exploring potential careers in earth sciences, engineering, and other fields related to energy production and research.
 - A series of annual articulation meetings with Wyoming community colleges offering energy-related curricula.

II. Research

- Research staff. Permanent research staff and an operating budget for UW's existing Institute for Energy Research (IER), which will continue to house the Enhanced Oil Recovery Institute and will incubate other research institutes related to Wyoming's energy economy as scientific advances and external funding permit.

- Incentives for broad faculty contributions. Three-year appointments that include half-time support and dedicated graduate assistants for faculty members in existing academic departments. These appointments, will furnish the school's director with the capacity to offer sustained incentives for UW's departments to fill vacant faculty positions in areas that can support the IER — especially oil and gas, coal, coalbed

¹ UW already offers the M.S. and Ph.D. in Petroleum Engineering, as well as a petroleum option in its baccalaureate program in Chemical Engineering.

natural gas, and renewable energy resources. The appointments will be renewable at the discretion of the director.

- Grant matching. A \$1 million pool of matching funds. Faculty members participating in IER will continue to seek competitive external funding to support their energy-related research. The proposed grant-matching fund will enable faculty members to compete for federal research grants from agencies, such as the U.S. Department of Energy, that require significant institutional or state matching commitments.
- Links to industry. An interdisciplinary technical advisory board to help steer the scientific work conducted under the aegis of IER. This board will include experts from internationally recognized industrial laboratories and national laboratories, representation from Wyoming's energy industries and state government, and academic representatives from other universities with distinguished programs in energy research.

III. Statewide outreach and service

- Outreach. A permanently staffed Energy Outreach Center dedicated to technical reports to support (a) sound energy project design, (b) scientifically-based analysis of energy resources, and (c) effective long-term energy planning. The purpose is to respond to the needs of Wyoming industry groups and state agencies for state-of-the-art information about energy resources and the technologies and economic factors needed to produce, transport, and use them.
- Links to industry. A team of non-faculty consulting specialists assigned to provide technical consulting, workshops, and regular symposia for independent energy producers, government agencies, and communities.
- Statewide coordination. Cooperation and data sharing with other agencies directly associated with energy-related activities, including the Wyoming State Geological Survey, the Western Research Institute, the Rocky Mountain Oilfield Testing Center, the Wyoming Oil and Gas Conservation Commission, the Wyoming Infrastructure Authority, the Wyoming Pipeline Authority, and other appropriate agencies.

IV. Administration

The school's director will report to the Vice President for Academic Affairs. Thus, in addition to managing a significant array of permanent resources, the director will have the administrative stature needed to address energy-related issues that cross existing departmental and college boundaries, as well as the academic reporting line required to influence curriculum, research, and faculty hiring. In addition, we propose the formation of a nine-member University of Wyoming Energy Resources Council, appointed by the Board of Trustees, whose mission will be to provide guidance from an industrial perspective to the Trustees, the President of the University, and the Vice President for Academic Affairs. Section 4 below reviews the details and rationale for this structure.

Deliverables. The mission of the school will be to answer the core questions posed above, which are long-term in scope, and to identify and address new energy-related issues as they emerge. To lay a solid foundation for this mission, the school will deliver several tangible benefits over the next five years:

- I. Academics: Stronger integration of energy issues in UW's academic mission, to support better interdisciplinary teaching in energy-related undergraduate and graduate programs.

These programs will produce graduates who are better equipped to contribute to Wyoming's energy economy. Specific initiatives include:

- a) Twelve new distinguished faculty positions permanently dedicated to energy-related subjects and having regular teaching assignments in academic departments (initiated in Fiscal Year 2007 and fully in place by Fiscal Year 2009);
- b) Stronger ties with the energy industry via visiting professorships (initiated in Fiscal Year 2008 and fully implemented by Fiscal Year 2009);
- c) Richer links to high-school and community-college curricula, through teaching internships, summer programs for high school teachers, and summer programs for high school students (initiated in Fiscal Year 2007 and fully implemented by Fiscal Year 2009);
- d) A revitalized baccalaureate program in Petroleum Engineering (initiated in Fiscal Year 2006; producing graduates by the end of the 2008-2009 academic year); and
- e) Exploration of curricular enhancements — such as a professional masters' program and certificate programs in energy resource accounting and legal issues associated with natural resource extraction — that can enhance our graduates' access to energy-related careers in Wyoming (initiated in Fiscal Year 2007 and ongoing after that).
- f) Establishment of an annual articulation conference involving Wyoming community colleges planning or delivering energy-related curricula, including Casper College, Western Wyoming College, and others as appropriate.

II. Research: The university will broaden the scope of the existing Institute for Energy Research. IER now houses the Enhanced Oil Recovery Institute. By the end of Fiscal Year 2007, IER will produce an incubation plan, outlining an array of new, externally funded research centers dedicated to other elements of Wyoming's energy portfolio. Examples of research centers envisioned for the near term include:

- a) The Enhanced Oil Recovery Institute, already in existence;
- b) A Coalbed Natural Gas Center;
- c) A Center for Coal Conversion Technologies;
- d) A Center for Renewable Energy Resources.

Groundwork for two such centers — a center for coalbed natural gas research and a center for research into coal conversion technologies — is currently under way at the university, in response to the federal Energy Act of 2005. Research centers focusing on long-term energy markets, carbon sequestration, and other topics may also prove viable. IER's incubation plan will examine the viability of centers of this type, based on estimates of the availability of external research funding from federal agencies, industry groups, and state agencies.

III. Statewide outreach and service: By the end of Fiscal Year 2007, the university will establish a new Energy Outreach Center, dedicated to:

- a) Dissemination of technical information on best practices in energy production;
- b) Statewide workshops and symposia on energy-related science, technology, economics, and legal and permitting issues, to support the needs of the energy industry as well as short- and long-term energy planning;
- c) Data sharing, as appropriate, with the Wyoming State Geological Survey, the Western Research Institute, the Rocky Mountain Oilfield Testing Center, the Wyoming Oil and Gas Conservation Commission, the Wyoming Infrastructure Authority, and the Wyoming Pipeline Authority.

The discussion below briefly describes Wyoming's setting in the energy economy, reviews the university's existing foundation in energy-related education and research, and describes in further detail the new school's structure and funding.

2. WYOMING'S ENERGY PORTFOLIO

Wyoming has a remarkable portfolio of energy resources. Oil, natural gas from various sources, and coal have been traditional mainstays of the state's natural resource base, and the state enjoys ample supplies of uranium, wind, and solar energy. While Wyoming's future economic health will depend in part on its ability to foster economic diversification beyond energy and minerals, production of energy resources is certain to be one of the state's economic anchors, not only for the near term but also for the more distant future.

The near term. For at least the next decade, four natural resources are likely to dominate:

- Oil. Wyoming has significant oil resources. As in many of the nation's oil provinces, most of the state's oil reservoirs are in declining production, despite the fact that the vast majority of the oil originally in place is still underground. Much of this oil is recoverable only through the application of enhanced and improved oil recovery. This suite of technologies requires geologic, engineering, and computational expertise more demanding and less firmly established than those used in exploration and primary recovery. Anadarko's carbon dioxide floods in the Salt Creek field and in the Monell Unit are indicators of the industry's current interest in enhanced oil recovery.
- Gas. The discovery and production of large natural gas reserves have increased over the past two decades. Much of this increase is attributable to two trends: (1) improved scientific methods for finding large, geologically anomalous gas deposits and (2) the emergence of technologies for producing natural gas from coal beds. The production of coalbed natural gas, in particular, has led to a distinctive set of engineering, environmental, legal, and socioeconomic issues. Among the most visible of these issues are those associated with split-estate property and the disposal of produced water. However, there are subtler issues of comparable importance, such as the unanswered engineering and scientific issues surrounding optimal production techniques.
- Coal. Wyoming continues to be the nation's largest producer of low-sulfur coal; indeed, the state's coal deposits rank with the largest in the world. Among the economically significant issues associated with this resource are: (1) Wyoming's distance from the nation's largest coal markets and the attendant interest in converting coal to other fuels, (2) the technologies and costs associated with effective mine-land reclamation, (3) the difficulty of mining Wyoming's enormous reserves of deep coal, and (4) emerging economics of carbon dioxide emissions and the resulting interest in advanced coal combustion and flue-gas separation technologies.
- Renewable energy sources. Wyoming is home to an increasing number of wind farms. While harvesting wind energy for electric power generation has many attractive aspects, significant barriers remain. One is the issue of land use and site selection, which has important environmental and social dimensions. Another is the array of technological problems associated with power conditioning and wind-turbine design. Tackling these problems will require advances in structural design, materials science, power-grid control, and electric power engineering. Wyoming also has hydroelectric generating capacity associated with the state's major water reservoirs. This capacity already plays a significant role in the regional power grid.

The longer term. Anticipating the energy economy of the more distant future is a less straightforward project. Arguments abound about how long traditional fossil fuels will remain

viable and, therefore, how long they can sustain Wyoming and the nation. And there are many disparate opinions about which energy sources, production technologies, processing methods, and transmission and transportation modes deserve the most focused attention. Among the most vigorous debates are those surrounding solar power, nuclear fission, nuclear fusion, hydrogen, and such unconventional carbon-based resources as oil shale and synthetic fuels.

Although it is impossible to identify all of the critical energy-related issues that will emerge in Wyoming over the next few decades, the following observations seem reasonable:

- Enhanced and improved oil recovery techniques. The worldwide oil economy is undergoing fundamental change. Owing in part to rising demand in Asia, global oil consumption is growing faster than global production capacity. As these curves cross — possibly within the next decade or two — the attractiveness of oil *as a fuel* may diminish in favor of alternative energy sources. Even so, oil will remain an indispensable industrial feedstock for plastics, pharmaceuticals, and other products. Unless other raw materials are found, the manufacturing sector is likely to accommodate the high prices needed to support enhanced and improved oil recovery, regardless of the extent to which other resources replace oil as an energy source.
- Reclamation. Because Wyoming's coal resources are enormous, mine-land reclamation will continue to be an economically, environmentally, and socially significant activity. Similar considerations apply to the reclamation of lands and waters disturbed by energy development of all types. Reclamation ecology is already an important area of applied research, yielding practical advances that transfer quickly from the laboratory to the field.
- Coal conversion. Wyoming's distance from major coal markets and the depth of some of the state's large coal deposits will continue to spur interest in processes that convert coal to more desirable energy sources, such as hydrocarbon liquids or hydrogen. These processes may be of special significance in Wyoming's deep coal seams, where underground coal gasification offers a technically and environmentally promising way to extract energy, and at power plants, where integrated gasification combined-cycle processes can help control carbon dioxide emissions.
- Carbon sequestration. Burning fossil fuels releases carbon dioxide, the most important of the greenhouse gases. Owing both to the production of carbon dioxide from gas wells and to the venting of flue gas from large, coal-fired power plants, Wyoming is one of the world's largest per-capita emitters of greenhouse gas. By the same token, Wyoming has extraordinary capacity to sequester carbon dioxide underground. An unusually fortuitous opportunity for carbon sequestration exists in some of Wyoming's old oil reservoirs, where carbon dioxide injection can enhance the production of oil. Emerging interest in cap-and-trade systems for controlling carbon dioxide emissions may stimulate national and international markets for carbon sequestration, further increasing the economic viability of carbon dioxide flooding in several of Wyoming's important oilfields. Comprehensive economic and financial analysis of these markets and trends is essential for long-term energy planning in Wyoming.
- Long-range electric transmission. Wyoming possesses raw materials with which to generate electricity, but at present the transmission infrastructure limits our capacity to export this form of energy to other regions. Advances in power-grid capacity and stability, coupled with cleaner technologies for generating power, can help overcome this limitation.
- Local energy systems. Large-scale power generation and long-distance transmission will continue to dominate the electric power market for decades to come. But community-scale distributed power systems — such as those based on wind generators, active and passive solar systems, low-head hydroelectricity, and improved energy conservation —

have the potential to meet many local needs. Although the lifestyle and infrastructural changes required will slow the widespread adoption of these systems, it is increasingly possible for these systems to mesh with large power grids and to reduce costs to consumers. In addition, local systems are less vulnerable to region-crippling failures resulting from accidents, human error, or sabotage.

- State and regional impacts. Global changes in the energy economy and their effects on the energy economy in Wyoming will have lasting impact on the region's development. These changes also have implications for the state's budgetary practices. Analysis of the economic and fiscal impacts of energy development is an integral part of planning for sustainable growth in the state.
- Nuclear power. Worldwide pressure to reduce carbon dioxide emissions is reviving interest in nuclear power generation. However, in contrast to the 1960s and 1970s, the public economics of nuclear power now includes the costs and risks of power-plant decommissioning and nuclear waste disposal. These costs may suppress the demand for uranium for many years to come, at least within the U.S. Still, despite the misgivings that dominate today's discussions, it is conceivable that advances in nuclear waste management and reactor design will rekindle interest in Wyoming's vast uranium deposits in the foreseeable future.
- Oil shale. The Rocky Mountain region — especially Wyoming, Colorado, and Utah — is home to enormous deposits of oil shale. As world prices for oil increase, the economics of in situ oil-shale conversion become more attractive. While these technologies have yet to prove profitable, the current world market for oil suggests that interest in oil-shale technologies may increase in the next few years.

Wherever these trends may lead, the long-term importance of energy resources for the Rocky Mountain region and the nation at large is clear. For Wyoming, with its rich natural endowment, energy-related education and research will be sound investments under any scenario.

3. THE UNIVERSITY'S EXISTING ASSETS AND PLANS

The University of Wyoming has significant assets in energy-related education, research, and service, including existing faculty expertise and curricula. The university also has a proven record of effective planning and allocation of faculty resources to strengthen its areas of distinction. These assets furnish solid ground upon which to build national prominence in energy-related education and research in Wyoming.

Existing assets. Among UW's longest-standing areas of faculty expertise is in earth and energy sciences. The Department of Geology and Geophysics is arguably the premier example. In addition to a strong faculty, nationally recognized degree programs, and outstanding classroom and laboratory facilities, the department is home to the Brinkerhoff Library of Earth Science and the Geology Museum, and it is adjacent to offices of the Wyoming State Geological Survey.

Other departments have maintained nuclei of energy-related expertise over several decades:

- The Department of Chemical and Petroleum Engineering houses expertise in petroleum reservoir engineering, coal conversion, catalysis, and gas separation. It also home to the current appointee to the Wold Energy Chair, Dr. Norman Morrow, one of only three faculty members in Wyoming's history to be elected to a national academy.
- The Department of Economics and Finance is recognized internationally for its contributions to regulatory and resource economics. It is home to several endowed faculty positions focused on natural resources, including the Stroock Professorship and

Bugas Professorship, and it has recently secured an endowment for the True Chair in Energy Economics.

- The Department of Mathematics has a 20-year history of contributions to computational modeling of underground flows — a field that is critical to advances in the understanding and design of enhanced oil recovery projects and other processes for utilizing underground energy resources.
- The Department of Renewable Resources is home to the Wyoming Reclamation Ecology Center and several scientists having nationally recognized expertise in the impacts of coalbed natural gas production, carbon sequestration, and the utilization of coal conversion byproducts.
- The Department of Agricultural and Applied Economics houses faculty expertise in the community impacts of economic development as well as in the economics of carbon sequestration and coalbed natural gas water production.
- The Department of Chemistry is home to faculty members conducting research into fuel-cell technology.
- Many other departments contribute in areas relevant to the energy industry. For example, the Departments of Chemistry, Mechanical Engineering and Physics and Astronomy have launched a research program in materials science. The Department of Electrical and Computer Engineering has faculty expertise in electric power transmission and network control. The Department of Civil and Architectural Engineering has expertise related to water resources and energy-efficient building design. Several of UW's engineering, life-science, and social science departments house research into the atmospheric, biological, and social implications of energy production.

In addition to mainstream academic departments, the university has several institutes and centers dedicated to disciplines having close links to energy resources:

- The Enhanced Oil Recovery Institute (EORI) and Institute for Energy Research (IER) have served for two decades as institution-wide platforms for interdisciplinary research, involving faculty members from several academic departments as well as research scientists of its own. After a decade of diminished industrial funding for enhanced oil recovery, these two institutes have recently launched a legislature-funded suite of research activities aimed at fundamental research and technology transfer related to improved waterflooding, CO₂ injection, and separation of power-plant flue gases.
- The Ruckleshaus Institute and Haub School of Environment and Natural Resources recently established an Energy Working Group, focused on natural-resource management aspects of enhanced oil recovery, coalbed natural gas, mine-land reclamation, carbon sequestration, and Wyoming's long-term energy planning. The Ruckleshaus Institute maintains a highly regarded and heavily used web-based Coalbed Methane Clearinghouse, and the Haub School recently launched a new course series in environmental sustainability, including important aspects of energy efficiency and renewable energy. At the request of Governor Freudenthal, the Ruckleshaus Institute has developed an extensive review of management options for the vast quantities of water brought to the surface during coalbed natural gas production.
- Western Research Institute (WRI), UW's technology development partner, serves private clients, industry, and government agencies on a contract basis. In addition to its research in transportation materials and environmental engineering, WRI houses expertise in alternative fuels, coal, oil and gas production, and heavy oil refining. WRI's Advanced Technology Center houses facilities to examine advanced coal combustion, coal-to-liquids conversion, fuel-cell and biofuel technologies, and environmental remediation technologies.

- The Wyoming Geographic Information Science Center, established as an outgrowth of UW's 1999 *Academic Plan*, is a national-caliber facility for the computational analysis of spatial data and remote sensing — tools that are critical to the design, siting, and monitoring of energy-related projects ranging from enhanced oil recovery to coalbed natural gas production to the reclamation of abandoned mine lands and the siting of wind farms. Geographic information science plays an increasingly important role in the reservoir characterization phases of energy project design.

In several of these units, programmatic strength and numbers of contributing faculty have fluctuated. UW is one of the nation's smallest public research universities. Consequently its energy-related expertise in any single department is sometimes one or two faculty members deep and vulnerable to unexpected resignations. At an institution of UW's size, effective depth typically requires interdisciplinary clusters of faculty, staff, and students working together for sustained periods of time. One purpose of the proposed school will be to serve as a nucleation site for clusters of this type, to sustain the curricular strength needed to train UW graduates for energy-related careers.

Another purpose of the proposed school will be to stabilize and broaden the scope of UW's externally funded energy research centers. For example, the existing Enhanced Oil Recovery Institute can focus on only one of many key energy research issues of importance to Wyoming, albeit an important one. Once a stably funded core is in place, the Institute for Energy Research will have the capacity to incubate and oversee an array of such centers, focusing on research in other critical energy-related technologies, depending on the availability of external research funding. In the foreseeable future, examples may include but are not limited to coalbed natural gas production, coal conversion technologies including underground coal gasification, and renewable energy research including wind energy production.

Institution-level planning. Academic depth also requires consistent, focused leadership. The university's *Academic Plan II*, approved by the Trustees in May 2004, calls for a new era in energy-related education and research, along with a commitment to dedicate resources to build and integrate the relevant disciplines. The plan calls for increased faculty strength in earth and energy sciences over the next five years, to be accomplished in part by the reallocation of faculty positions to these fields (Action Item 32).

Backing up these plans are several important management tools. Key among these tools is a system of central position management, which allows for the reallocation of faculty positions vacated by resignations and retirements. This system — relatively rare in public universities — allows the institution to redirect staffing resources toward areas of distinction identified in the *Academic Plan* and provides incentives for departments to align their faculty position requests with institution-level planning imperatives.

As necessary as the reallocation of existing faculty positions may be, it is not sufficient. It is unrealistic to expect that internal resource shifts away from other areas of the curriculum will be sufficient to build the faculty strength needed to ensure lasting national distinction in energy-related scholarship. The competition from larger institutions is simply too intense. To achieve national prominence, one must turn to more ambitious models, such as the Jackson School of Geosciences at the University of Texas at Austin and the Sarkeys Energy Center at the University of Oklahoma. Both of these organizations enjoy substantial and stable funding; they provide effective forums for cooperation among faculty from a wide variety of disciplines; and they help their host institutions to attract outstanding permanent faculty members from other institutions around the world. There are no such schools in the Rocky Mountain West.

In addition, it is unlikely that internal reallocation alone will allow UW to develop effective energy outreach within the time frame needed. Effective dissemination of information about energy technologies requires not only technological and academic expertise but also infrastructure: an editor, publishing facilities, consulting engineers and scientists, and production staff. Sustaining

such an enterprise also requires the capacity to release faculty experts temporarily from their core teaching duties, compensating their home departments to avoid adversely affecting the university's fundamental instructional mission. The budget proposed below includes resources to allow for these temporary changes in assignment.

Long-range flexibility. It is ill advised to prescribe for the long term how to allocate the school's permanent assets — such as faculty positions — among different areas of energy research. One reason is that the teaching and research needs associated with various energy resources overlap. The physics associated with coalbed natural gas production has important elements in common with those associated with enhanced oil recovery, for example. Another reason for not trying to apportion the school's funding strictly along resource categories or academic department lines is that the scientific principles used to recover energy resources change over time. For example, two decades ago the effects of geologic variability were a significant barrier to the realistic modeling of oilfield projects. But today, as a result of intensive research at major universities around the world, there are multiscale computational tools for this stage of project design, and the focus of computational modeling research has changed. Finally, as the past thirty years have demonstrated, the demand for energy resources changes over time, and as a result the research interests and workforce needs in energy-related fields fluctuate. Giving the school's director the permanent ability to shift faculty resources among disciplines to match these interests and needs — while still maintaining the focus on energy — is critical to the school's long-term success.

Impact on UW's mission. The most important impact that a School of Energy Resources can have on UW's mission is to enhance the university's stature in nationally recognized education and research in areas vital to Wyoming. By bolstering UW's ability to recruit high-caliber faculty members and by focusing on education in disciplines critical to the state's future, the school will enhance several of UW's existing strengths. It will promote greater interdisciplinarity in teaching and research, reinforcing the institution's contributions to Wyoming's economic development both through more effective preparation of graduates for energy-related careers and through the advancement of the state of the art in these fields.

4. PROPOSED STRUCTURE FOR THE SCHOOL

The School of Energy Resources will be an integral part of the university's academic mission, as shown in the first organization chart below. In particular, the school will be an academic unit managed by a director, who reports to the Vice President for Academic Affairs. To ensure lasting connections between the academic mission and the state's energy economy, we propose the establishment of a nine-member University of Wyoming Energy Resources Council that can provide guidance, from the perspective of Wyoming industries and state agencies, to the Board of Trustees, the President of the University, and the Vice President for Academic Affairs, as described in more detail below.

The director's role will be analogous to that of a dean of one of UW's seven existing colleges. Unlike a college, however, the school will not have a separate faculty or curriculum. Instead, the faculty and curriculum associated with the school will have homes in existing colleges, to ensure the stable and influential embedding of energy-related scholarship in a broad swath of the university's teaching and research missions.

However, the school's resources will not be entitlements. Instead, the director will be able to redirect them, as necessary, to departments and colleges that can make the most substantial commitments to the school's mission. The school will therefore have the administrative stature, fiscal resources, and infrastructure to influence the faculty hiring and curricular decisions made by college deans.

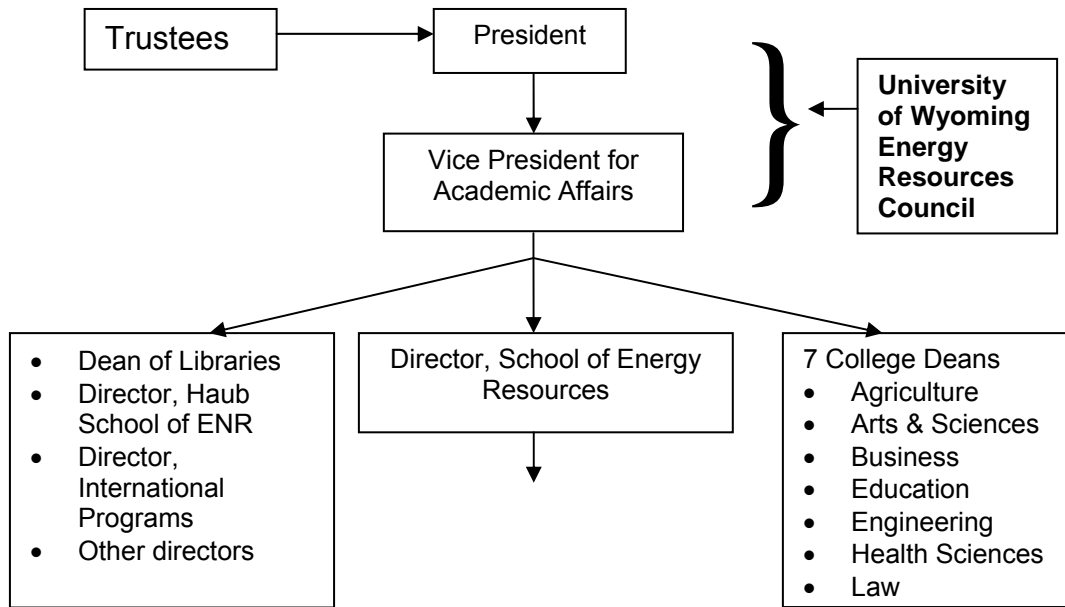
Rationale. The rationale for this structure is threefold: administrative stature, broad impacts on the university's educational mission, and market-like incentives for college deans to contribute.

The school's position in the university will give it significant administrative stature. The director will report to the university's chief academic officer, as shown in the diagram below. The director will also control a significant set of the most highly prized resources available in academic institutions: faculty positions. This structure will position the school to work influentially with the deans of UW's seven academic colleges and directors of other programs, will allow the director to draw on the talents of faculty members and students from many different disciplines, and will help insulate the school from college-specific budget decisions — decisions sometimes driven as much by transitory enrollment pressures as much as any long-range vision.

Other, more traditional structures — such as a separate college of energy resources or a separate institute dedicated to applied energy research and reporting outside the scope of the Office of Academic Affairs — hold much less potential for broad-reaching and lasting impacts on the university's core mission. For example, a separate college of energy resources would be limited by the natural dynamics of college deans' competing with other colleges for resources. Compounding this limitation would be the lack of concrete incentives for other colleges to contribute curriculum, faculty positions, and other resources to energy-related teaching and research. Such a structure would result in a college that had little leverage over the missions of other colleges. On the other hand, a separate institute dedicated to applied energy research, analogous to the University of North Dakota's Energy and Environmental Research Center, may have significant immediate impacts on energy research and development. But institutes of this type have no direct connection to the university's teaching mission, and their employees face constant pressures to generate external funding. For these reasons, a separate research institute, operated independently of the university's faculty, would have little capacity to influence graduates' preparation to work in the state's energy economy.

Having a School of Energy Resources whose director controls resources for which college deans want to compete creates market-like forces that can augment the state's investment in the school. Specifically, it provides leverage: deans from many colleges will seek to build strength in energy-related teaching *and* research, precisely because they stand to gain access to resources from the School of Energy Resources.

See chart
below for
structural
details



Organization. The school will house three units as described below and shown by the accompanying diagram.

I. An Academic Coordinator. The Academic Coordinator will have five primary responsibilities:

- To coordinate courses across department and college lines, to ensure greater opportunities for interdisciplinarity in upper-division and graduate curricula related to energy resources. This responsibility will require the ability to fund undergraduate research fellowships and interdisciplinary graduate assistantships, to provide incentives for departments to develop and deliver of cross-departmental and cross-college coursework.
- To explore new curricular measures, including (a) certificate programs in areas such as natural resource accounting and legal issues in natural resource extraction, (b) a professional masters' program in energy science, and (c) augmented degree options in traditional disciplines. Examples of such options include certificate programs in natural resource accounting and mineral property law and an area of emphasis in these subjects for MBA students.
- To recruit talented Wyoming high-school and community-college faculty members to participate in funded sabbatical leaves at UW. During these leaves, these distinguished teaching interns will teach classes at UW in appropriate disciplines, such as science and mathematics, and take courses in fields that enrich their careers. These internships will not only facilitate continuing professional development of Wyoming's educators; they will also provide an effective long-term vehicle for articulation in critical high-school-to-college transition courses.
- To run summer programs. One such program will be a summer school in energy science for high school students. This program will provide opportunities for

outstanding Wyoming high school students to spend several weeks on the UW campus, working with professors and undergraduate mentors on energy-related projects. The purpose will be to enrich these students' preparation for college and to help recruit talented young people into energy-related undergraduate majors. Another program will be a set of summer internships for undergraduates studying energy-related fields, to allow baccalaureate candidates to develop industrial field experience and to help facilitate opportunities for future employment. A third program will be a series of summer courses for high school teachers on topics related to energy science, technology, and economics. These courses, formulated as part of UW's existing Summer School, can be delivered either on the Laramie campus or via WEN, the statewide videoconferencing network, depending on demand.

- To initiate a series of regular articulation conferences with Wyoming community colleges to coordinate the development and delivery of curricula related to Wyoming's energy industry.
- II. The Institute for Energy Research (IER). UW's existing IER will have a broader scope of activity, serving as UW's primary incubator for outstanding interdisciplinary research and graduate education in energy-related fields of relevance to Wyoming. The director of the school will manage this institute, which will be the umbrella for externally funded research centers dedicated to specific areas of energy-related research. Examples of external funding might include competitive grants from the National Science Foundation and U.S. Department of Energy, legislative initiatives, and industrial sponsorships or contracts.

Currently, IER houses the Enhanced Oil Recovery Institute, funded by the state legislature and, in part, through federal and industrial research grants. Additional centers to be studied in the near term include a center devoted to coalbed natural gas research, a center for research in coal conversion technologies, and a center dedicated to renewable energy resources. The viability of these centers — and others that may be established in the future — hinges not only on the ability of the director to provide start-up resources but also on the availability of sustained external funding to support equipment purchases, faculty summer research, postdoctoral fellowships, research scientists, and graduate research assistantships. By the end of Fiscal Year 2007, the IER director will analyze the prospects for establishing new centers of this type and will present a plan for incubating centers in viable areas.

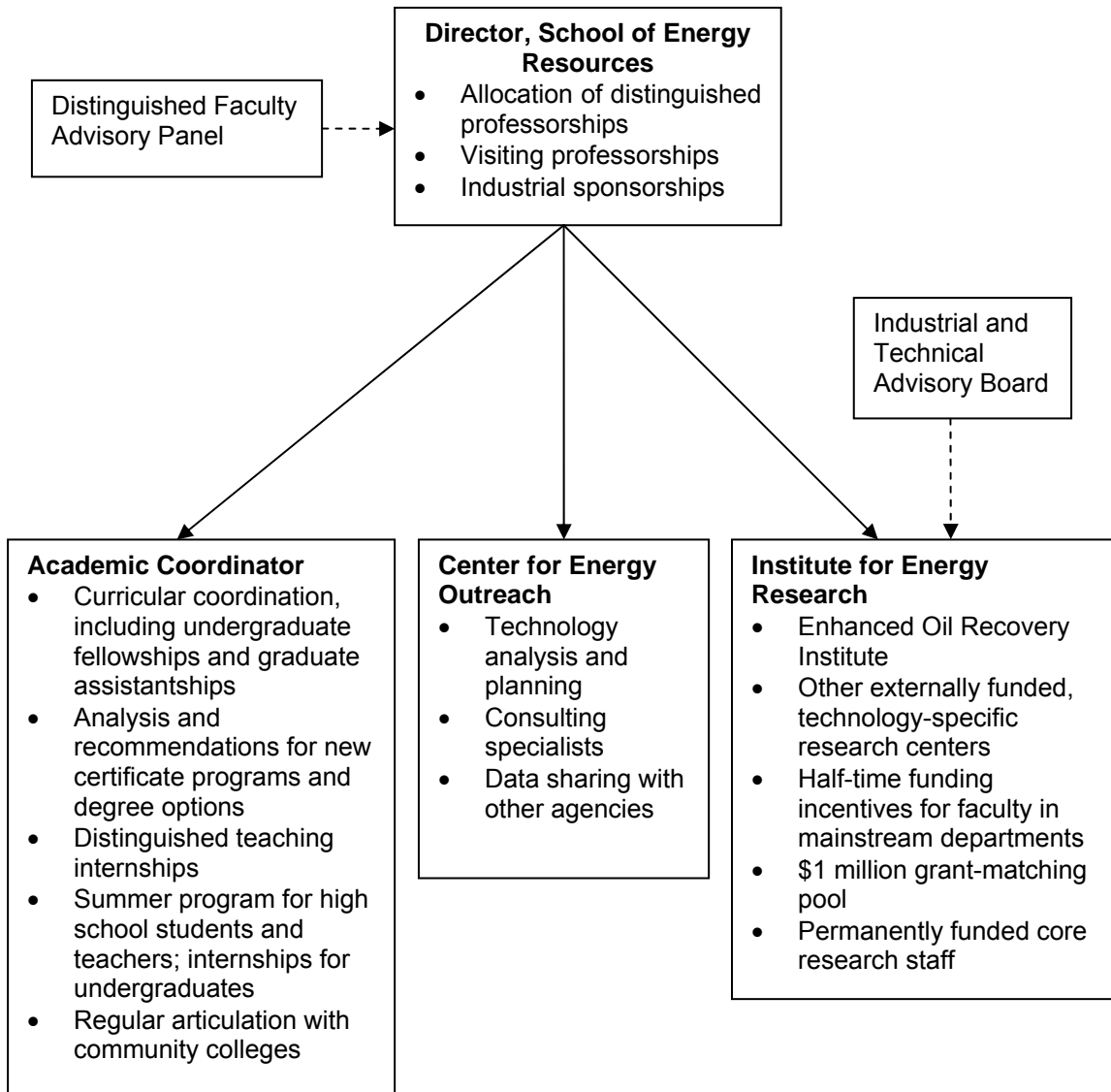
Planning is already underway at UW for two such research initiatives. One is a coalbed natural gas research center, currently being considered in the Energy and Water appropriations bill presently before Congress. The other relates to language in the federal Energy Act of 2005 calling for the Secretary of Energy to "establish Coal Research Centers in institutions of higher learning." UW currently is planning a proposal to the Department of Energy to establish a sub-bituminous coal process research center.

Also, UW, together with the Idaho National Laboratory, assisted the Wyoming Natural Gas Pipeline Authority and the Wyoming Infrastructure Authority in preparing a report entitled "Adding Value to Wyoming's Coal Resource – the Next Generation". This report, submitted to the Wyoming Legislature's Joint Minerals, Business and Economic Development Committee, provides extensive discussion of emerging technologies for processing Wyoming's sub-bituminous coals. And it outlines the need for Wyoming to be aggressive in pursuing a demonstration project utilizing sub-bituminous coal combusted at elevation — a project specifically called for in the Energy Act of 2005. In this project, UW would play a critical research-and-development role, in cooperation with the state and federal governments, Idaho National Laboratory, and industry.

We intend for these efforts to help jump-start UW's incubation of new research centers critical to Wyoming's near-term energy economy.

To help guide and assess IER's scientific research, the director of the school will establish an Industrial and Technical Advisory Board. This board will include experts from internationally recognized industrial laboratories and national laboratories, representation from the Wyoming state government, and academic representatives from other universities with distinguished programs in energy research.

- III. The Center for Energy Outreach. This new center will have a two-part mission. The first part will be to provide technical reports and long-term energy planning. The center will house a permanent staff dedicated to the editing and production of reports and the organization of workshops and symposia to support these activities. It will also have a budget that can temporarily release regular faculty members from part of their normal research and teaching responsibilities, to provide the applied expertise required. The second part of the center's mission will be to provide technical consulting, short courses, and annual forums for independent energy producers, state agencies, and community leaders. The center will employ four consulting specialists with full-time responsibility for this type of outreach. The center will also develop systems for data sharing, as appropriate, with the Wyoming Geological Survey, the Western Research Institute, the Rocky Mountain Oilfield Testing Center, the Wyoming Oil and Gas Conservation Commission, the Wyoming Infrastructure Authority, the Wyoming Pipeline Authority, and similar organizations.



Role of the director. The director will have management responsibility for all three units, shown in the diagram above. Among the director's specific roles are the following

- To oversee the recruitment of distinguished faculty positions and their assignment to academic disciplines, to ensure that the people hired will have department homes and scholarly expertise that best serve the need to strengthen UW's contributions to energy-related teaching and research. The director will retain permanent control of all fiscal resources associated with these positions, to ensure that the positions' focus remains on energy. The distinguished faculty members hired under this program will serve as an advisory panel to the director, as described below.
- To recruit distinguished researchers from industrial and national laboratories for one-year visiting appointments to the UW faculty, to help enrich the connections between academic, industrial, and government-sponsored research.

- To solicit industrial subscribers, whose sponsorships can provide corporate financial support for students to participate in research projects related to energy production.

The university will hire the director through a search to be conducted in fiscal year 2007. The search will be international in scope. The qualifications will include (1) an earned doctorate or commensurate record of industrial or applied contributions to an energy-related discipline, (2) experience in managing a complex research organization, (3) a distinguished record of professional leadership in at least one energy-related field of relevance to Wyoming, and (4) demonstrated awareness of the relationships between teaching, research, and service in the university setting and the potential for these functions to benefit Wyoming's energy economy.

University of Wyoming Energy Resources Council. To ensure long-term links between the school and the energy industry, the university proposes to establish a nine-member University of Wyoming Energy Resources Council. The council members will be appointed by the Board of Trustees, upon recommendation of the President of the University, for three-year terms, with the initial appointments staggered so that three new members are appointed annually. The council's membership will consist of representatives from energy industries operating in Wyoming and the Rocky Mountain region as well as representatives from the executive and legislative branches of the state government. The council's function will be to provide guidance to the Trustees, President, and Vice President for Academic Affairs regarding the school's academic directions, research accomplishments, and outreach effectiveness.

Distinguished Faculty Advisory Panel. To ensure stable connections between the school's mission and the academic departments who receive resources from the school, the 12 faculty members occupying the distinguished faculty positions will serve as a formal advisory panel reporting to the director. The primary function of this expert panel will be to identify promising directions for curricular innovation, opportunities for ground-breaking research, and important themes for statewide service and outreach.

5. STATE FUNDING REQUIRED

Key elements of the school requiring state funding will include the following. Specific budget estimates appear below.

I. Academics:

- An Academic Coordinator, along with a budget for undergraduate fellowships and interdisciplinary graduate assistantships to support cross-department and cross-college curricular development and coordination. This budget will also support annual articulation conferences with Wyoming community colleges on energy-related curricula.
- Twelve new distinguished faculty positions in energy science, analogous to existing Wold Chair in Energy Research and True Chair in Energy Economics. These fully funded positions will enable the university to lure prominent senior experts in energy-related teaching and research from other institutions. In turn, these senior-level faculty members will increase the institution's overall effectiveness at recruiting outstanding younger faculty members in these areas. The faculty members hired will have academic homes and regular teaching assignments in such cognate departments as Geology and Geophysics, Chemical and Petroleum Engineering, Mathematics, Economics and Finance, Renewable Resources, and other departments that have previously demonstrated a commitment to hiring in energy-related fields. However, the positions will remain under the permanent control of the school's director, who may elect to reallocate positions among departments to ensure a sustained focus on energy and to adapt to emerging trends in Wyoming's energy economy. The intent of the

positions is to strengthen UW's international stature and presence in scholarship directly related to oil and gas, coal, coalbed natural gas, and renewable energy resources.

- Fully funded visiting professorships, aimed at attracting year-long teaching and research appointments for scientists and engineers who have attained national or international recognition for their energy-related work in the industrial sector, in national laboratories, or at other universities.
- Fully funded one-year distinguished teaching internships at UW for Wyoming high-school teachers and community-college faculty members. These competitive internships, offered at full salary and benefits (or full reimbursement to the teachers' school district) with a cost-of-living stipend, will help cultivate effective citizenship in a world facing difficult, energy-driven challenges. Teachers participating in these internships will take coursework in curriculum-enriching topics as geographic information science, resource economics, and energy technology. At the same time, they will teach university courses in their disciplines, including basic sciences, mathematics, and social sciences. Through this mechanism, the school will foster both the curricular enrichment and the subject-matter articulation needed to effect a more seamless transition from high school to college throughout the state.
- Funding for a summer program for high school students. This program will attract 16 outstanding high school students to the UW campus, to work with faculty members and undergraduate mentors on energy-related projects. The program will include funding for the students' travel, room, and board. The school's director will explore effective funding arrangements for the summer field internships for undergraduates with interested industry representatives. The university will run summer courses for high school teachers as part of its normal Summer School funding mechanisms.

II. Research:

- Permanent funding for core research staff and an operating budget for UW's Institute for Energy Research. This institute will continue to house the Enhanced Oil Recovery Institute and will accommodate other research centers in energy-related problems, as scientific advances and external funding permit. Initially, these additional centers may include a center for coalbed natural gas studies, a center focusing on coal conversion, and a center for renewable energy resources. A permanent budget will help provide start-up funding for new research centers, which will be expected to develop sustained external funding after their initial incubation periods. IER will provide state-funded base staffing, with each new center being responsible for seeking competitive external research funding to support research projects conducted by faculty members, postdoctoral fellows, and graduate students from cognate academic departments.
- A fund to offer half-time appointments to selected faculty members who have proven expertise directly relevant to oil and gas, coal, coalbed natural gas, and renewable energy resources. These appointments, offered competitively for renewable three-year terms, will carry summer-salary enhancements, funding for half of each salary, and dedicated graduate assistants for the duration of each appointment. By freeing a portion of selected faculty members' normal General Fund salary for other uses in their home departments, these appointments will create strong, lasting incentives for departments to align their hiring with the school's focus areas.
- Grant matching. Since the U.S. Department of Energy typically requires institutional matching funds for research grants, we are requesting a \$1 million/year pool of grant-matching funds. This pool will enhance the competitiveness of UW faculty members in seeking externally funded grants to support research equipment, undergraduate- and graduate-student training, and laboratory technicians.

III. Statewide outreach and service:

- Editorial and production staff for the Center for Energy Outreach, together with a budget to support released time for faculty members and other employees who can temporarily devote time to the dissemination of applied knowledge through reports and workshops.
- A permanent staff of consulting specialists. These positions will be filled by non-faculty scientists and engineers who have the expertise needed to provide technical consulting and short courses for independent energy producers, government agencies, and community leaders.

IV. Funding for the Director of the School of Energy Resources, including the director's salary, office staff, and a support budget.

Table 1 summarizes the specific budget estimates for these elements.

Table 1. Proposed ultimate state funding for the School of Energy Resources

Category	Brief description	Annual budget
Academic Coordinator's office	Academic Coordinator, staff, 18 undergraduate fellowships & 18 graduate assistantships	\$765,900
Distinguished faculty chairs in energy resources	12 distinguished chairs, with fringe & discretionary funds	\$3,312,000
Visiting professorships	2 visitors from industry or national labs, with moving and travel allowances	\$600,000
Distinguished teaching internships	3 teaching interns from Wyoming schools or community colleges, with moving and travel allowances	\$303,000
Summer program for high school students	2 faculty members, 2 undergraduate mentors, and travel, room, and board for 16 student participants per year	\$63,600
Institute for Energy Research	Postdocs, technicians, equipment, grant matching funds, and office support	\$518,550
Half-time faculty appointments	9 half-time appointments, with summer stipends and fringe	\$1,230,296
Startup assistance	Funds to help college deans to hire in targeted areas	\$500,000
Grant matching pool	Funds to provide institutional matching required for research grants from some federal agencies	\$1,000,000
Center for Energy Outreach	Director, editor, staff, released time, with fringe and support	\$561,000
Consulting specialists	4 full-time scientists and engineers to provide technical consulting and short courses	\$432,000
Director's office	Director, staff, fringe, support. (Director also administers IER)	\$513,100
State-funded annual budget		\$9,799,446

6. FINANCIAL PLAN, SCHEDULING, and FACILITIES

The development of the school will require three years. During this development period, it is possible to stage the funding of the school, to allow time for the national and international searches required to fill many of the positions. Table 2 summarizes a plan for ramping up state funding over fiscal years 2007-2009, with full funding in place in fiscal year 2009. Table 3 provides details of this staged funding plan as well as cumulative funding totals.

Table 2. Overview of staged funding proposal for the School of Energy Resources

Fiscal Year	New Funding Required	Cumulative Funding
FY 2007	\$4,403,649	\$4,403,649
FY 2008	\$3,264,699	\$7,668,348
FY 2009	\$2,131,098	\$9,799,446

Table 3. Detailed staged funding proposal for the School of Energy Resources

Element	FY 2007 Budget	FY 2008 Budget	FY 2009 Budget
Academic Coordinator's office (student support starting in FY 2008)	\$132,300	\$765,900	\$765,900
Distinguished faculty positions (4 new positions per year)	\$1,104,000	\$2,208,000	\$3,312,000
Visiting professorships (1 starting in FY 2008, 1 starting in FY 2009)	\$0	\$300,000	\$600,000
Distinguished teaching internships (1 new internship each year)	\$101,000	\$202,000	\$303,000
Summer program for high school students	\$63,600	\$63,600	\$63,600
Institute for Energy Research (full staffing support starting in FY 2007)	\$518,550	\$518,550	\$518,550
Half-time faculty appointments (phased in at 3 per year)	\$410,099	\$820,198	\$1,230,296
Startup assistance fund	\$500,000	\$500,000	\$500,000
Grant matching pool (phased in during FY 2008 and FY 2009)	\$500,000	\$1,000,000	\$1,000,000
Center for Energy Outreach (full staffing starting in FY 2007)	\$561,000	\$561,000	\$561,000
Consulting specialists (2 in FY 2008, 2 more in FY 2009)	\$0	\$216,000	\$432,000
Director's office (full funding starting in FY 2007)	\$513,100	\$513,100	\$513,100
Totals	\$4,403,649	\$7,668,348	\$9,799,446

Facilities. We foresee the need for one-time funding for remodeling and construction of facilities:

- to provide office space for the school's director, the academic coordinator, and staff;
- to house laboratory and office space for faculty members affiliated with the Institute for Energy Research; and
- to develop conference facilities and a physical home for the director and staff of the Center for Energy Outreach.

In view of the need for more specific facilities planning to estimate the expenditures involved, we propose to develop a detailed plan for the configuration, costs, and siting of these facilities in time for the 2007 Legislature.

An investment of this type, made at a time when Wyoming enjoys an extraordinary budget surplus owing to its wealth of energy resources, can help guide the state through the most pressing energy issues of the coming decades. In addition, by helping to make the University of Wyoming one of the world's premier centers of expertise in energy-related science, technology, and economics, such an investment can help build a sound long-term energy future for the state, the Rocky Mountain region, and the nation.

APPENDIX A: LEGISLATION RELATED TO THE SCHOOL OF ENERGY RESOURCES

ORIGINAL SENATE **ENGROSSED**

FILE NO. 0001

ENROLLED ACT NO. 90, SENATE

FIFTY-EIGHTH LEGISLATURE OF THE STATE OF WYOMING

2005 GENERAL SESSION

[UNIVERSITY ENERGY INSTITUTE]

Section 337.

(a) By October 1, 2005, the University of Wyoming shall develop an academic and financial plan for the development and operation of a proposed energy institute. The plan shall be submitted to the governor and a legislative committee designated to receive it by the legislature's management council. The plan shall include:

- (i) The mission of the energy institute and its goals, objective and structure including:
 - (A) Its relationship and relevance to energy and natural resource issues facing Wyoming;
 - (B) The contributions the institute is likely to make to university research and scholarship and to assisting the state and its people in sustaining and developing the state's economy;
 - (C) The impact the institute would have on the university's mission.
- (ii) A summary of the personnel by rank and academic discipline needed to achieve the institute's goals and objectives;
- (iii) An analysis of the level of funding necessary to sustain a meaningful, long term presence in research and scholarship related to energy and natural resources;
- (iv) Identification of other financial resources, especially research grants and contracts, that may reasonably be sought for continuing support of the institute;
- (v) A time schedule for raising matching funds and for implementation of the institute and the plan;
- (vi) The means by which the leadership of the institute will be recruited, including the industrial and academic qualifications of that leadership;
- (vii) A statement of the laboratory and other facility needs for the institute and their estimated cost;
- (viii) In its development, extensive consultation with leaders of Wyoming's renewable and nonrenewable energy industry. The university shall consult with the legislative committee on how and with whom this consultation will occur.

(b) Business leaders participating in the development of the plan under this section at the request of the university shall be entitled to receive travel and per diem expenses in the manner and amount provided for state employees under W.S. 9-3-102 and 9-3-103. Five thousand dollars (\$5,000.00) is appropriated from the budget reserve account to the university which shall only be used to pay the per diem and travel expenses authorized under this subsection.

APPENDIX B: SHORT RESPONSES TO SENATE FILE 0001, SECTION 337

The legislation called for responses to the following items.

(i) The mission of the energy institute and its goals, objective and structure including:

- (A) Its relationship and relevance to energy and natural resource issues facing Wyoming;
- (B) The contributions the institute is likely to make to university research and scholarship and to assisting the state and its people in sustaining and developing the state's economy;
- (C) The impact the institute would have on the university's mission.

Response: The school's mission will have three dimensions:

Academics. Strengthen baccalaureate and graduate teaching, to produce UW graduates who are equipped to work in fields integral to Wyoming's energy economy.

Research. Advance the state of the art in energy-related science, technology, and economics through world-class research that attracts premier scholars and teachers to Wyoming.

Statewide outreach and service. Support technology outreach, public decision-making, and long-range energy planning, through both the open dissemination of information needed for expert project design and sound, objective policy analyses.

The text of the proposal describes the school's structure in more detail, together with its relevance to Wyoming's energy portfolio, its relationship to the state's economy.

The most important impact that a School of Energy Resources would have on UW's mission will be to enhance the university's stature in nationally recognized education and research in areas vital to Wyoming. By bolstering UW's ability to recruit high-caliber faculty members and by focusing on disciplines critical to the state's future, the school will enhance several of UW's existing strengths. It will promote greater interdisciplinarity in teaching and research, reinforcing the institution's contributions to Wyoming's economic development both through more effective preparation of graduates for energy-related careers and through the advancement of the state of the art in these fields.

(ii) A summary of the personnel by rank and academic discipline needed to achieve the institute's goals and objectives;

Response: The proposal calls for 12 new, senior faculty positions, to be filled through national or international searches. These positions will be interdisciplinary in nature, with departmental assignments to be determined through a bidding process in which academic departments commit to additional future faculty hiring in energy-related areas. Among the departments most likely to submit successful bids are Geology and Geophysics, Chemical and Petroleum Engineering, Economics and Finance, Mathematics, Renewable Resources, and Electrical and Computer Engineering. This list is not exhaustive; the aim will be to build interdisciplinary strength analogous to that found in industrial research organizations and national laboratories.

(iii) An analysis of the level of funding necessary to sustain a meaningful, long term presence in research and scholarship related to energy and natural resources;

Response: The level of direct state funding required is \$9.8 million/year. The funding can be staged over three fiscal years: \$4.4 million in FY 2007, \$7.7 million in FY 2008, and \$9.8 million in FY 2009. Complementing this funding will be (a) the university's internal reallocation of five faculty positions to earth and energy sciences during the period of the 2004-2009 Academic Plan, (b) additional reallocation of internal funding to restart the baccalaureate degree in Petroleum Engineering, (c) ongoing state and external support for the Enhanced Oil Recovery Institute, (d) other external funding, through continuing industrial support for faculty research as well as through such federal agencies as the US Department of Energy and the National Science Foundation.

(iv) Identification of other financial resources, especially research grants and contracts, that may reasonably be sought for continuing support of the institute;

Response: The university will continue to seek external research funding from industry and in the form of competitive research grants. The School of Energy Resources will enhance the university's ability to attract funding of this type (a) by adding the capacity to incubate new research centers under the umbrella of the existing Institute for Energy Research, (b) by adding a mechanism for corporate financial support for students to participate in research projects related to energy production, and (c) by creating a grant-matching fund to help support grant proposals to the US Department of Energy and the National Science Foundation.

(v) A time schedule for raising matching funds and for implementation of the institute and the plan;

Response: The university will begin raising matching funds — in the form of industrial sponsorships, competitive grants, and private gifts — as soon as authorizing legislation is passed. The implementation of the school will span three fiscal years, ending in FY 2009, as detailed in the staged funding proposal in Table 2 of the text.

(vi) The means by which the leadership of the institute will be recruited, including the industrial and academic qualifications of that leadership;

Response: The university will hire the director through a search to be conducted in fiscal year 2007. The search will be international in scope. The qualifications will include (1) an earned doctorate or commensurate record of contributions to an energy-related discipline, (2) experience in managing a complex research or academic organization, (3) knowledge of at least one energy-related field of relevance to Wyoming, and (4) demonstrated awareness of the relationships between teaching, research, and service in the university setting.

(vii) A statement of the laboratory and other facility needs for the institute and their estimated cost;

Response: We foresee the need for one-time funding for remodeling and construction of facilities:

- *to provide office space for the school's director, the academic coordinator, and staff;*
- *to house laboratory and office space for faculty members affiliated with the Institute for Energy Research; and*
- *to develop conference facilities and a physical home for the director and staff of the Center for Energy Outreach.*

In view of the need for more specific facilities planning to estimate the expenditures involved, we propose to develop a detailed plan for the configuration, costs, and siting of these facilities in time for the 2007 Legislature.

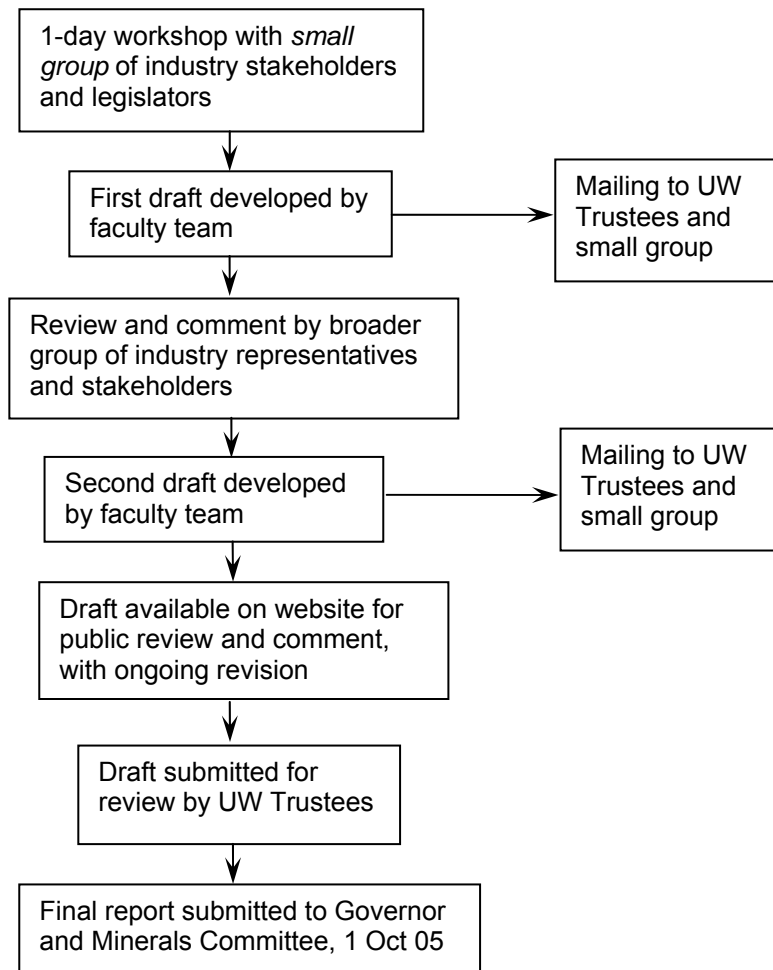
(viii) In its development, extensive consultation with leaders of Wyoming's renewable and nonrenewable energy industry. The university shall consult with the legislative committee on how and with whom this consultation will occur.

Response: Appendix C summarizes the process used for this consultation.

APPENDIX C: PROCESS FOR DEVELOPMENT OF THE REPORT

In collaboration with the co-chairs of the Joint Minerals, Business, and Economic Development Committee, the University of Wyoming developed this report through a process that involved several stages and input from several sets of stakeholders:

- An interdisciplinary report drafting team composed of UW faculty members,
- The Joint Minerals, Business, and Economic Development Committee,
- A small group of non-university stakeholders, selected by the Joint Committee,
- A broader group of industry representatives and stakeholders,
- UW college deans and affected department heads,
- The UW Board of Trustees.



Acknowledgments

The following UW faculty members and administrators developed early drafts of this report:

Dr. Myron B. Allen, Vice President for Academic Affairs
Dr. Morris Argyle, Assistant Professor of Chemical and Petroleum Engineering
Dr. Mark Balas, Professor and Head of Electrical and Computer Engineering
Dr. Nicole Ballenger, Associate Vice President for Academic Affairs
Dr. Ed Barbier, Professor of Economics
Dr. William Gern, Vice President for Research
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Dr. Katta J. Reddy, Professor of Renewable Resources
Dr. James Steidtmann, Director of the Institute for Energy Research
Dr. Brian Tower, Professor and Head of Chemical and Petroleum Engineering

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Senator Kit Jennings
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Mr. Michael Moody, PPM Energy
Mr. Steve Reynolds, Encana
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Dr. Ron Surdam, Wyoming Geological Survey
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