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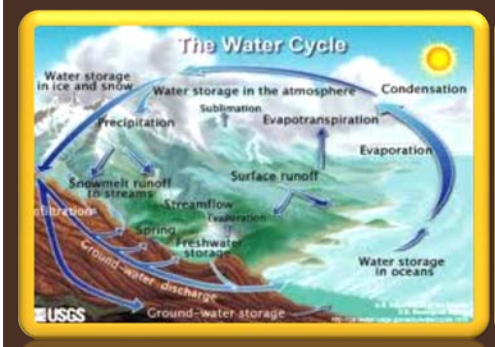

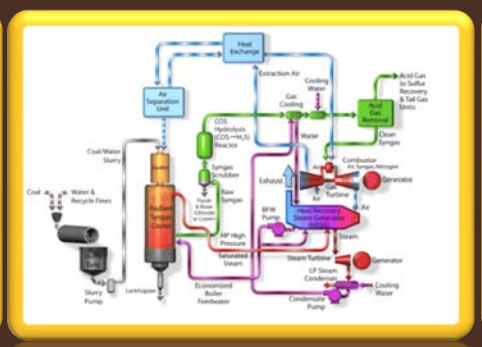

A Plan for Wyoming Science and Technology

DAVE FREUDENTHAL
GOVERNOR

THE STATE OF WYOMING

STATE CAPITOL
CHEYENNE, WY 82002

Office of the Governor

September 29, 2010

Wyoming Science and Technology Planning Group:

I am writing in response to your efforts to create a Wyoming Plan for Science and Technology. I would make two major observations. First, I want to acknowledge and applaud you for the breadth of your outreach process in constructing the planning document. Your approach to involving a wide cross-section of Wyoming institutions is very much appreciated and I think will serve us all well going forward.

Secondly, I concur with your selection of key areas of focus, namely energy, water and computation capability. These three topics as you correctly point out are strategically at the core of Wyoming's future. Understanding these three areas of study and particularly their inter-relationships will significantly add to the thoughtful development of our State.

I look forward to watching your progress.

Best regards,

Dave Freudenthal
Governor

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A PLAN FOR WYOMING SCIENCE AND TECHNOLOGY

2010

1. OVERVIEW

The State of Wyoming is engaging in long-term strategic planning to guide science, technology and workforce development in the state. The process has been initiated through the office of Governor Dave Freudenthal, under the direction of Mr. Rob Hurless, Energy and Telecommunications Advisor to the Governor in cooperation with the Office of Research and Economic Development at the University of Wyoming. Participants include representatives from the state, business, education, research and public sectors. The outcome of the strategic planning process is development of a dynamic and relevant Wyoming Science and Technology Plan that will guide the state government research and development, and business efforts over the coming decades. It will be used by the Wyoming Business Council, the University of Wyoming, Wyoming EPSCoR and other entities as they undertake science and technology development in Wyoming. In order for a strategic plan to be successful it must be flexible and adaptable over time to capitalize on unforeseen future opportunities and allow for shifts in focus as appropriate to implement identified strategies. In other words, the plan must undergo continuous or regular revision. In that sense, every plan is a draft of the next.

The first step of the process is to develop a clearly articulated vision for the State's Science and Technology (S&T) future that produces a strong, diversified economy and educated workforce. The second step is to generate a plan to implement the vision. This plan will 1) define the current state economic indicators within the context of national and global economies; 2) plan for the continued advances in energy and the extractive industry technologies, which have been a hallmark of Wyoming innovation over the last decades; 3) increase connectivity to position the state as a major center for science, technology, natural resource management and communication in the region; 4) provide mechanisms for broadening and diversifying the science and technology base in the state; and 5) prepare for educated workforce to meet these goals.

2. INTRODUCTION

BACKGROUND. Wyoming is the least populated state, and with about 533,000 residents spread across nearly 100,000 square miles it is also the second least densely populated state (following Alaska). Wyoming is geographically diverse and includes high mountains, broad valleys, Great Plains, and arid basins. Positioned on the Continental Divide, Wyoming serves as the headwaters for four major U.S. river basins including the Missouri-Mississippi River Basin, which drains approximately 72% of the landmass in Wyoming. Two major tributaries of the Missouri, including the Platte and Yellowstone rivers have headwaters in Wyoming. Three other major river basins served by Wyoming include the Green-Colorado, Snake-Columbia, and Great Salt Lake. Water, some would argue with justification, may be the single most critical resource in Wyoming. Year-to-year changes and long-term trends of water availability are highly uncertain. Because of its position at these headwaters, changes in snowfall, precipitation patterns, water availability and climate affect the regions nearby and downstream into the U.S. more broadly.

ECONOMY. Wyoming's economy is dominated by extractive mineral industries to an extent that surpasses other states. Wyoming produces more energy than any other state (except Texas) –over 10 quadrillion Btus per year. And importantly, it exports more energy to the nation than any other state or country. Wyoming stands as the largest supplier of energy to the United States, followed by Canada, West Virginia, Mexico, Saudi Arabia, Venezuela, Nigeria, Alaska, Iraq and Angola in that order (Surdam, 2008).

Wyoming has led the nation in coal production for about two decades, is second or third in annual natural gas production depending on the year, and is eighth in petroleum production. In addition Wyoming leads the nation in the production of processed uranium (yellowcake), and currently stands 11th in wind energy production with the potential to develop its large class 5 and 6 airsheds. Wyoming produces 90% of the U.S. supply of trona, a mineral salt used to produce soda ash used in the majority of U.S. glass and detergent manufacture.

In addition to providing the basis for the extractive industries, the abundant natural resources in the state also serve a tourist industry. For example, Grand Teton and Yellowstone National Parks and several national monuments, including Devil's Tower, are all located in Wyoming. Hunting, fishing and other outdoor activities generate considerable revenue to communities throughout the state.

Another long-standing economic basis for the state is agriculture. Grazing agriculture predominates and is found throughout the state, whereas row-crop agriculture is primarily localized on the eastern plain and in some mountain basins.

R.C. Surdam 2008, Wyoming Energy Development in Context of the Global Energy Economy, Wyoming Geological Survey; Challenges in Geologic Resources Development Series.

Telecommunications is becoming a major factor in Wyoming's economy. A significant amount of the nation's long-haul telecommunications fiber transits through Wyoming's southern quarter along the mainline of the Union Pacific railroad and Interstate 80. Major telecommunications centers as well as the National Center for Atmospheric Research (NCAR) – Wyoming Supercomputing Center are located in Cheyenne. Fiber connectivity along with the availability of electrical power and favorable climate for data center operation is making southeastern Wyoming an important IT hub.

WYOMING INNOVATION. Wyomingites start small businesses at a high rate. Innovation and technology development have been a hallmark of Wyoming's progress over the last decades. One example is the development and implementation of directional drilling technology, which directs the tip of a deep drill to better exploit deposits of gas and oil. This technology revolutionized the gas and oil industry and today the vast majority of wells are directional. Associated with directional drilling are new technologies dealing with hydraulic fracturing. There is an extraordinary amount of modeling associated with hydraulic fracturing because only the oil/gas bearing strata is fractured without damaging the over and underlying strata which provides the seals for the reservoir. In addition the fluids used in fracturing are highly proprietary and may be custom made for specific types of reservoir rock. Both hydraulic fracturing and directional drilling used early in Wyoming, unlocked much of the shale gas availability in the rest of the nation.

Another example of innovation is the focus on environmental solutions, particularly related to water management. To address issues of snowpack formation processes and drivers, the Wyoming Water Development Commission has contracted with NCAR and other entities to examine the feasibility of mountain snowpack enhancement by means of glaciogenic cloud seeding in the cold season. This $11 million contract involves measurement of atmospheric conditions and modeling (using NCAR supercomputers) to understand how best to manage precipitation.

A third example is the current effort from the University of Wyoming in cooperation with other entities in the region to generate predictive models for the future energy and water, use and development, of the state. Through collaboration with NCAR, researchers and educators throughout the region, plans are in place to use high performance computing to support innovation.

Yet another example of innovation and integration of complex data sets is evidenced by the sage grouse management plan. This interdisciplinary effort draws on analysis of landscape management issues, water availability patterns, long and short-term population dynamics and habitat monitoring.

Because of the importance of water, energy development and efficient extraction, and computation, to Wyoming, these three centers of focus – water, energy, and computation – were selected for emphasis in this Science and Technology plan. Two of the three areas listed above, energy and water, are historically important to Wyoming and the third, described here as computation, has gained importance recently and will continue to grow. Over the years, Wyoming has made considerable investment in each of these areas. In addition the University of Wyoming has focused on these areas over the past several years and this focus continues in University Plan III which serves as an important science and technology plan in its own right (although it goes beyond science and technology growth at the University), where each of the three areas are slated for growth. Closer examination of recent state investment explains why focus on energy, water and computation is appropriate.

Water. Many in Wyoming are concerned about water availability, prolonged drought and associated impacts. This concern is well founded. Statewide Wyoming averages 12.9 inches of precipitation annually (mostly in the form of late season snow) making it the third most arid state behind Nevada and Utah. In addition to providing large amounts of water to down-stream states Wyoming effectively uses the water it is legally allocated to irrigate approximately 1,160,000 million acres making

it 16th in the nation in irrigated land. Because of its reliance on scarce water resources, Wyoming has a history of funding water-related research and development projects. In addition, the State of Wyoming has recently funded other major water research initiatives. These include examining stream flow variability due to weather modification, land use change and climate variability in the North Platte River basin, and a Wind River Mountains glacier study. Funding for these three studies amounted to approximately $750,000. Finally, over the past 5 years the State Legislature has provided $3.06 million to the University of Wyoming Office Of Water Programs to administer a water research program specifically supporting research needs of state agencies. This funding reflects only the research needs regarding water. The State of Wyoming spends many additional millions of dollars annually to support water development, water storage projects and many municipal water projects. Simply stated, water is critically important to Wyoming and its inclusion as an area deserving focus in this plan is well justified.

Energy. The State of Wyoming has provided significant funding supporting science and technology development in energy disciplines. The University of Wyoming, working with GE Energy is developing the High Plains Gasification – Advanced Technology Center (HPG-ATC). This $100 million initiative will build a pilot scale coal gasification test facility, centered on GE Energy's gasification technology. The State of Wyoming has invested $50 million into the HPG-ATC. The facility is designed to support investigations into the process of coal gasification and subsequent use of the synthesis gas through catalytic processes that can convert it to other useful materials. Understanding gasification of Wyoming's Powder River Basin coal is important to Wyoming and the nation. More than 33% of the nation's electrical power is generated using Powder River Basin coal as the fuel source. But gasification also can lead to the formation of fleet fuels, other important chemical feedstocks and even methane and hydrogen through processes using unique catalysts and arrangement of these catalysts. Research is intensifying into catalytic processes to convert synthesis gas (the product of gasification) to these other products. The Western Research Institute, a non-profit research company in Wyoming has a major reputation in gasification technologies, and in catalysis leading to other products from the synthesis gas.

In 2007 the University of Wyoming created the School for Energy Resources (it was a centerpiece of University Plan II and III) and the State of Wyoming is providing more than $10 million annually to support this new school. It is multifaceted. A major component of the new school is nine (9) research centers and institutes spanning energy disciplines from fossil fuel utilization to renewable energy sources. Several of the centers involve significant amounts of scientific computation that will be referred to later. The new school also has major programs in K-12 outreach, public education and service and they have a curriculum leading to a BS degree in energy sciences. The school is providing significant assistance to Wyoming's energy industry through research.

Wyoming is very involved in carbon dioxide capture and storage. The State of Wyoming has provided $45 million to be matched, for establishing a carbon dioxide storage test site. Understanding the long-term fate and movement of carbon dioxide in the subsurface in deep saline aquifers is a major undertaking for Wyoming. Significant amounts of research and development is needed to understand how carbon dioxide behaves at depth and will require significant knowledge of porosity and permeability and structural integrity of reservoir and overlying seals, reactive transport, and modeling long term movement in the storage reservoir rock.

With these few examples, it is clear that Wyoming has made very serious investments in the science and technology dealing with all aspects of energy. Clearly, energy is a significant focus area for the state S&T plan.

Computation. The National Center for Atmospheric Research-Wyoming Supercomputing Center, (NWSC) is currently under construction west of Cheyenne, Wyoming. The State of Wyoming, the University of Wyoming, Cheyenne LEADS, the Wyoming Business Council and Cheyenne Light, Fuel and Power, along with the University Corporation for Atmospheric Research (UCAR) and the NCAR through the National Science Foundation have all made significant investments in this computing center. The center will house a very large supercomputer and mass storage for data to support the Earth system

sciences community of researchers. Cheyenne LEADS, the economic development entity for Cheyenne, has identified data and computation centers as a major element of their strategic plan for business development. Cheyenne has available power, a very large available optic fiber resource, and a cool, dry climate that minimizes both heating and cooling costs, making it an ideal location for large data centers. The University of Wyoming has been building computational sciences, especially computational geosciences, through actions taken in three succeeding University planning exercises, 25 new computational science faculty members (in a variety of Earth system science disciplines) have been added over the past 12 years. The NCAR/UW alliance will receive a 20% allocation of the NSF base funded computing resource housed within the NWSC, which will strongly and positively impact computational Earth system science throughout the university. In addition, Cheyenne will be looking for AA, BS, MS, Ph.D. degree holders to support the growing data/computation business community that already is aggregating due to the impact of a major Sprint Center, EchoStar (a major U.S. satellite TV company) and the NWSC. UW will continue to add computational science-oriented faculty, especially in the Earth system sciences, to take full advantage of what the NWSC presents to the institution. The impact of NWSC will be large, but difficult to measure immediately. Clearly the inclusion of computational science as one of the focus areas of the science and technology plan is a necessity.

EDUCATION AND RESEARCH. Wyoming is the only state with a single baccalaureate and graduate degree granting university – the University of Wyoming. UW is a Carnegie Foundation Research and Doctoral Extensive University. A separate system of seven accredited community colleges is governed by local boards elected from the district each college serves with articulation gained through a state community college commission. A single tribal college, not yet accredited, is located on the only Indian reservation in the state, the Wind River Reservation. Articulation among the educational entities is essential to reach a population that is broadly dispersed across the state.

WYOMING'S INDEX OF INNOVATION. A recently completed innovation index compares Wyoming's position relative to other states in the region (those with a contiguous border) and also to nine other states that like Wyoming, export more energy than they consume. It serves as an information companion to this S&T plan and is intended to examine Wyoming's capacity to innovate, including an evaluation of whether conditions specific to energy exporting states affect or direct their ability to innovate.

An Index of Wyoming Innovation is divided into three sections. The first examines the major business sectors within Wyoming, the second examines factors related to R&D and competitiveness, and the third examines workforce parameters. Below are items identified from the innovation index influencing this S&T plan:

- a strong state economy and a state that is debt-free
- a strong, financially well-supported K-12 educational system that places an emphasis on understanding and applying science and technology
- more baccalaureate-degree holding workers than the state's current industry can employ
- a research university that strongly supports innovation and technology transfer leading to business development
- one of the largest state investments in R&D
- a very small amount of industrial R&D – Wyoming ranks last in the nation in industrial R&D even when expressed against the gross state product.
    - associated lesser amount of patenting and IP protection
- low amount of venture capital investment

3. Details of the Planning Process

Mr. Rob Hurless, Energy and Telecommunications Advisor to Governor Dave Freudenthal, is chairperson for this planning process and is strongly supported by the University of Wyoming. The Innovation Index was first developed to benchmark Wyoming's position among two distinct sets of states and the U.S in general. Using 41 different indicators and other data this index examined parameters associated with innovation-based economies. This index was very helpful in developing strategies and outcomes and outputs of this S&T plan.

Visioning meetings were held with a variety of entities representing Wyoming government, education and industry, 23 in all, as part of the planning process. The Innovation Index and a draft plan was distributed to these entities as background material, but more importantly during these visioning meetings items were gleaned to be used in shaping the strategies, outcomes and outputs of this S&T plan.

Entities participating in these meetings were:

Agencies	
Wyoming Community College Commission	Campbell County Economic Development Corporation
Wyoming Business Council	Wyoming EPSCoR
Cheyenne LEADS	University of Wyoming
Western Research Institute	Wyoming Game and Fish Department
National Center for Atmospheric Research	Laramie Economic Development Corporation
Wyoming Technology Business Center	Wyoming Association of Conservation Districts
Manufacturing-Works!	United States Geological Survey
Wyoming Entrepreneur	Wyoming State Engineer's Office
Wyoming Small Business Development Centers	Wyoming Water Development Commission
Research Products Center	Wyoming Department of Environmental Quality
Wyoming SBIR/STTR Initiative	Wyoming State Climatologist
Wyoming Governor's Office	

4. Science and Technology Plan

This Wyoming Science and Technology Plan is intended to outline the directions, capability and vision for the educational, research, and economic development efforts of the state that will frame future decisions about directions for Wyoming and for public higher education.

This plan provides the foundation for focusing research and education efforts statewide. It is an element in the development of Wyoming's participation in federally-supported research stimulation programs such as the Experimental Program to Stimulate Competitive Research (EPSCoR).

The strategies summarized in this plan will better leverage the state's research and development resources, promote innovation, create jobs, and diversify the state's economic basis in an increasingly global economy.

This plan is intended to provide a framework for state government, economic development organizations, and business and academic leaders to make informed decisions that produce a more vibrant and dynamic state economy.

An innovation index (An Index of Wyoming Innovation 2010) was prepared and used to assess Wyoming's strengths and weakness relative to the state's capacity to innovate. This Index aided development of this S&T plan.

The plan consists of five Strategies:

1. Identification of research and development focus areas that take advantage of Wyoming's strengths;
2. Infrastructure needed to develop those key R&D areas;
3. Partnerships between industry, government and academia required;
4. Workforce required to develop Wyoming's economy in the focus areas; and
5. Public education programs needed to ensure that the state's residents support the plan for developing a robust future state economy.

Strategy One: Focus Wyoming's research and development in areas in which Wyoming has strength and in which additional strategic investment will provide the critical advantage.

A. Advocate for and support focused state research and development investments in Wyoming's targeted areas:

1. Energy development, use and transmission
    i. Output – Hold public meetings dealing with the topic of carbon dioxide sequestration and its relation to use of coal, climate and power generation through IGCC.
2. Water use and management
    i. Output – Develop research programs aimed at improving predictive capability for precipitation and water availability in specific river systems such as the Platte.
    ii. Output – Provide predictive capability of late season flow in those river systems receiving glacial meltwater.
    iii. Output – Predictive models of runoff patterns and volumes in various river systems using variable climatological assumptions.
3. Information technology and computational capacity
    i. Output – Develop sophisticated models of biosphere-atmosphere interaction that help to improve predictive capability for water availability.
    ii. Output – Use ongoing research programs, such as weather modification research, to improve modeling and predictive capabilities.
    iii. Output – Develop sophisticated models describing carbon dioxide behavior with substrate at the pore, and field scale.

B. Promote synergies between these focus areas (e.g. the fundamental and cross-cutting science and technology challenges and needs for three Wyoming targeted areas).
1. Catalysis and advanced biological, chemical and thermal cycles, including hybrid cycles
2. Material science and engineering for advanced energy and water systems
3. Environmental sciences and emission control sciences and technologies
4. Computational modeling and simulation (M&S)
    i. Output – Using the Moxa Arch project final reports produce a special volume on the sequestration of carbon dioxide in a Wyoming deep saline aquifer.
    ii. Output – The University of Wyoming Office of Research and Economic Development will provide to interested entities listings of potential science and technology funding opportunities in these three areas through databases.
    iii. Output – Hold a regional/national meeting on modeling carbon dioxide behavior in the subsurface.
    iv. Output – Students are educated and graduate with leading-edge, state-of-the-art knowledge for target areas to support industry growth.
    v. Output – Increase in new innovative technology inventions and patents.
    vi. Output – Commercially viable technological solutions for Wyoming and our Nation.

STRATEGY TWO: SUPPORT AND EXPAND THE STATE'S RESEARCH AND DEVELOPMENT INFRASTRUCTURE AT THE UNIVERSITY OF WYOMING.

A. Provide continued support for R&D infrastructure programs such as Wyoming EPSCoR, the NCAR-Wyoming Supercomputing Center, The High Plains Gasification – Advanced Technology Center, the School of Energy Resources and the Ruckelshaus Institute for Environment and Natural Resources.
    i. Output – Hire new faculty in areas critical to the three major focus areas of this Science and Technology plan.
    ii. Output – Support community colleges throughout Wyoming as they develop programs in water, energy and computational technologies.
    iii. Output – The University of Wyoming will hire a special Assistant to the Vice President for Research & Economic Development, the Provost, and the Vice President for Information Technology to coordinate organization of

computational science faculty and research professionals on the campus and to coordinate this activity with NCAR.

iv. Output – Purchase a mid-sized computer (several teraflops in processor speed) to serve as the core of the UW computing facility.

B. Support these programs by providing
   a. Outstanding physical facilities
   b. Modern equipment
   c. Supportive infrastructure
   d. Critical mass of highly qualified research scientists, engineers, graduate students, and technicians
      i. Output – Hire new technical staff in the area of computational science to support computing-based research on the campus.
      ii. Output – The University will hire a special assistant to coordinate equipment acquisition in the computational sciences and the development of a computer condo featuring a core computer of sufficient size to effectively determine correct model parameters as programs are shifted to the NWSC supercomputer system.

C. Share these strengths and assets with existing Wyoming community colleges, schools, and businesses to garner their participation and thus extend use of this R&D infrastructure throughout the state
   i. Output – With NCAR hold meetings with community colleges interested in developing programs of study that will articulate with the University of Wyoming in areas of computational science.
   ii. Output – With NCAR, Cheyenne LEADS, and other Wyoming NWSC partners develop a public visitor center at the NWSC facility.
   iii. Work with the State Energy Office within the Wyoming Business Council as they provide trusted information on energy efficiency, conservation and to entities within Wyoming both public and private.
   iv. Output – the Wyoming State Energy Office will develop education and outreach programs on energy conservation and efficiencies.
   v. Output – Support the State Energy Office to ascertain the public's knowledge for energy efficiency and conservation and use that information to develop useful programming to be used state-wide.

D. Develop R&D focus to draw new business and investment to the state of Wyoming
   i. Output – with the University of Wyoming and the Wyoming Business Council, hold public educational forums discussing water related research such as Continuing Legal Education programs on water issues.
   ii. Output – with the School for Energy Resources hold public meetings on the fate and transport of carbon dioxide in the subsurface.

STRATEGY THREE: BUILD STRATEGIC ALLIANCES AND RESEARCH COLLABORATIONS AMONG BUSINESS, ENTREPRENEURS, GOVERNMENT, NON-PROFIT ENTITIES AND ACADEMIA.

Through partnerships with business, support to education, new investments in technologies and practices for the development of new ideas and inventions, help produce informed citizens and employees.

A. Develop public and private funding, including venture capital, for early stage, research-intensive business development and commercialization of research.
   i. Output – Working with the Research Products Center, provide the Wyoming Business Council access to research results to develop transfer of new technology to the private sector.

B. Build a critical mass of entrepreneurial management and science to technology transfer assistance. Promote strategic alliances between these organizations.
    a. Wyoming Business Council
    b. Western Research Institute
    c. Regional state economic development groups
    d. Small Business Development Centers (SBDC)
    e. Manufacturing-Works (M-W)
    f. Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR)
    g. Wyoming Technology Business Center (WTBC)
    h. Research Products Center (RPC)
    i. Wyoming Tourism
    j. State resource management agencies
        i. Output – Provide information at the annual Inventor's Workshop about the activity of each entity listed above and how they work with each other to support technology related businesses in Wyoming.
        ii. Output – Provide the Wyoming Business Council a list of technology that is open for development by the private sector.
C. Increase training opportunities for university faculty, Wyoming businesses, and citizens in entrepreneurship and research commercialization in order to increase the ability of students to contribute to Wyoming's innovation efforts.
D. Provide ongoing SBIR training programs and proposal writing and grants management workshops to increase Wyoming's success in obtaining federal grants.
E. Provide an annual conference on new scientific advances to share new knowledge with technology development entities and business.
F. Partner with the Wyoming Business Council in providing information to local economic developers regarding all aspect of development and use through the School for Energy Resources Outreach program.
G. Partner with the Wyoming Business Council in development of materials for trade shows and other presentation regarding Wyoming energy resources.
        i. Output – Accelerated transfer of scientific discoveries into technology developments.
        ii. Output – Shortened technology maturation timelines.
        iii. Output – More rapid growth of Wyoming's technology business sector.

STRATEGY FOUR: DEVELOP AND RETAIN AN EDUCATED, TECHNICALLY-SKILLED AND TECHNOLOGY BUSINESS SAVVY WORKFORCE.

Advanced and targeted education and skills training are key to science and technology development. Opportunities for graduate students to attend the University of Wyoming and to work with a mentor on research projects will produce students dedicated to solving problems important to Wyoming and the nation.

A. Prepare highly skilled, knowledgeable bachelors and masters-level graduates (including teachers) with strong mathematics and science capabilities;
B. Continue to develop and sustain interdisciplinary PhD programs in Ecology, Computational Science, Water Resources;
C. Develop a "Diploma in Innovation" for PhD students to encourage knowledge and technology transfer and greater societal applications for the PhD student's research;
D. Develop a business degree in management of new technology businesses and ventures; and
E. Expand visiting professorships for industry experts through the existing SER program and other avenues.

i. Output – Develop a specific set of courses that can be taken at Wyoming Community Colleges which will transfer to the University that support degree programs or degree enhancements in computational science.
ii. Output – Hold training sessions at the Wind River Tribal College or Arapahoe Ranch outlining how computational science is used in the areas of natural resource preservation and use.
iii. Output – Articulate Education Outreach and Training programs between NCAR and the University of Wyoming using the special assistant as the point of contact.
iv. Output – Critical mass of trained technical and business professionals to support new S&T business growth.
v. Output – Increase in skilled workforce to support Wyoming S&T business growth.

STRATEGY FIVE: PROMOTE THIS SCIENCE AND TECHNOLOGY PLAN TO INCREASE PUBLIC AWARENESS AND SUPPORT FOR AN INNOVATION-DRIVEN ECONOMY.

Solutions to the state's most serious challenges will be based upon science, research and data. These needs and opportunities must be communicated to the public, from school-age students, to legislators, policy-makers and government officials, and to all interested residents. Wyoming residents should be informed and understand the significance of energy and water issues as they relate to their quality of life and economic opportunity. A well-informed public can support difficult decisions and the need for development of new laws and policies that policymakers and administrators may have to make.

A. Provide accurate and reliable information, data and analysis of Wyoming's innovation-based economy in order to promote public understanding and support.
    a. Continue to produce and update the Wyoming Innovation Index.
        i. Output – An updated Innovation Index in two years.
    b. Various energy policy white papers.
        i. Output – White papers developed on topics of importance to Wyoming such as coal gasification, carbon dioxide sequestration, shale gas development, etc.
        ii. Output – Various water policy white papers.
        iii. Output – Description of the Wyoming precipitation enhancement study, the Wyoming glacier study, the history of climate change in Wyoming, etc.
    c. Other documents (CREG reports, Division of Economic Analysis Reports, etc.).
        i. Develop an effective web site that is regularly updated.
B. Inform legislators through frequent concise reports; and
C. Establish high school science and technology institutes at UW to encourage more young Wyoming residents to pursue scientific or technical careers or at least have an appreciation of the importance of science and technology for their own benefit as well as the state's.
        i. Output – Expand the EPSCoR Summer Research Apprentice Program.
        ii. Output – Develop special EOT programs with NCAR on computation and modeling.
        iii. Output – Help SER expand their Energy Academies for Wyoming K-12 students.
        iv. Output – Work with the UW Department of Mathematics to expand REU opportunities in the computational sciences.

PLAN IMPLEMENTATION

1. Identify the lead person or entity that will be responsible to advancing this Plan and overseeing future edits.
2. Identify specific steps for how strategies will be implemented including the specific people or entities that will be engaged.
3. Identify the resources (human and financial) needed to implement this plan.
4. Identify a timeline for future actions.
5. Identify how progress will be measured or quantified.

Energy…
Water…
Computation…

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