



HIGHER EDUCATION RESEARCH STRATEGIC PLAN

(2017-2022)

Submitted by: Higher Education Research Council

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EXECUTIVE SUMMARY

Research is being increasingly acknowledged by industry, government and education as a key factor in the future economic vitality of Idaho. The universities and colleges of Idaho's system of higher education understand the need for greater collaboration in order to be competitive in today's global environment. Recognizing the need to focus on and emphasize existing strengths and opportunities in Idaho's research community, the vice presidents for research and economic development developed the following statewide strategic plan for research to ensure the greatest potential for achieving a vital and sustainable research base for Idaho. The strategic plan identifies the key research areas (basic, translational and clinical) that will become the focal points for research and economic development through partnering among academia, industry and government in science, technology, and creative activity.



Research is fundamental to the mission of a university due to its role in knowledge discovery and in providing new ideas for technology commercialization via patents, copyright, licenses and startup companies. University faculty who engage in research and creative activity are at the leading edge of their respective fields. Research also enhances the national reputation of the faculty and the universities. These faculty and their vibrant research programs attract

the best graduate and undergraduate students by providing unique cutting-edge learning experiences in their research laboratories, studios, field sites and classrooms. On the most basic level, and also bolstered through collaborative, interdisciplinary and interprofessional research, such activities strengthen a university's primary product — innovative, well-educated students ready to enter a competitive workforce.



Research is the foundation of a university's economic development role. The influx of research dollars from external grants and contracts creates new jobs at the university, along with the attendant purchases of supplies, services, materials and equipment. The results of the research are new knowledge,

new ideas, and new processes, which lead to patents, startup companies, more efficient businesses as well as a highly trained workforce prepared to tackle 21st century challenges.

Idaho's research universities have strengths and opportunities for economic development in 1) Energy Systems, 2) Natural Resource Utilization and Conservation, 3) Biomedical and Healthcare Sciences, 4) Novel Materials and 5) Systems Engineering and Cybersecurity.

By focusing collaborative efforts in these areas, the research universities will expand research success by:

- Helping Idaho institutions focus on their research strengths;
- Strengthening collaboration among Idaho institutions;
- Creating research and development opportunities that build relationships between universities and the private sector;
- Contributing to the economic development of the State of Idaho;
- Enhancing learning and professional development through research and scholarly activity – also by promoting interdisciplinary and inter-professional research; and
- Building and improving the research infrastructure of Idaho universities to meet current and future research needs.

This statewide Strategic Research Plan for Idaho Higher Education is a tool for identifying and attaining quantifiable goals for research and economic growth and success in Idaho. The plan will be reviewed and updated annually as needed amid the fast-changing pace of research discovery.





VISION

Idaho's public universities will be a catalyst and engine to spur creation of new knowledge, technologies, products and industries that lead to advances and opportunities for economic growth and enhance the quality of life in Idaho and the nation.

MISSION

The research mission for Idaho's universities is to develop a sustainable resource base by:

- Identifying, recruiting and retaining top faculty with expertise in key research areas;
- Building research infrastructure including facilities, instrumentation, connectivity and database systems to support an expanding statewide and national research platform;
- Attracting top-tier students to Idaho universities at the undergraduate and graduate levels and providing outstanding education and research opportunities that will prepare them to excel in future careers;
- Raising awareness among state, national and international constituencies about the research excellence and capabilities of Idaho's universities by developing and implementing targeted outreach, programs and policies; and
- Collaborating with external public, private, state and national entities to further the shared research agenda for the state, thereby promoting economic and workforce development and addressing the needs and challenges of the state, region and nation.



GOALS AND OBJECTIVES

Goal 1: Increase research at, and collaboration among, Idaho universities and colleges to advance research strengths and opportunities pertaining to critical issues in Idaho, while also providing a vision for national and global impact.

Objective 1.A: Ensure growth and sustainability of public university research efforts.

Performance Measure 1.A.1: Statewide amount of total annual research and development expenditures as reported in the National Science Foundation (NSF) Higher Education Research and Development Survey.

Benchmark: 10% increase per year.

Objective 1.B: Ensure the growth and sustainability of the existing collaborative research at the Center for Advanced Energy Studies (CAES).

Performance Measure 1.B.1: Statewide amount of U.S. Department of Energy (DOE) research and development expenditures as reported in the National Science Foundation (NSF) Higher Education Research and Development Survey.

Benchmark: 10% increase per year.

Objective 1.C: Expand joint research ventures among the state universities.

Performance Measure 1.C.1: Number of new fully sponsored project proposals submitted by an Idaho University that involve a subaward with another Idaho institution of higher education (in either direction).

Benchmark: 50% increase per year.

Performance Measure 1.C.2: Number of new fully sponsored project awards to an Idaho University that involve a subaward with another Idaho institution of higher education (in either direction). Benchmark: 30% increase per year.

Performance Measure 1.C.3: Establish/fund at least one HERC-directed research project per year which collaborates with one other Idaho university that directly addresses issues of particular importance to the State of Idaho.

Benchmark: 1 per year

Goal 2: Create research and development opportunities that strengthen the relationship between state universities and the private sector.

Objective 2.A: Increase the number of sponsored projects involving the private sector.

Performance Measure 2.A.1: Number of new sponsored projects involving the private sector.

Benchmark: 50% increase per year.

Goal 3: Contribute to the economic development of the State of Idaho.

Objective 3.A: Increase the amount of university-generated intellectual property introduced into the marketplace.

Performance Measure 3.A.1: Number of technology transfer agreements (as defined by AUTM [Association of University Technology Managers]).
Benchmark: 15% increase per year.

Performance Measure 3.A.2: Number of invention disclosures (including biomic varieties).
Benchmark: 1 for every \$2M of research expenditures.

Performance Measure: 3.A.3: Amount of licensing revenues.
Benchmark: 10% increase per year.

Performance Measure: 3.A.4: Number of startup companies.
Benchmark: 10% increase per year.

Goal 4: Enhance learning and professional development through research and scholarly activity.

Objective 4.A: Increase the number of university and college students and staff involved in sponsored project activities.

Performance Measure 4.A.1: Number of undergraduate and graduate students paid from sponsored projects.
Benchmark: 20% increase per year.

Performance Measure 4.A.2: Percentage of baccalaureate students who had a research experience.
Benchmark: 20% increase per year.

Performance Measure 4.A.3: Number of faculty and staff paid from sponsored projects.
Benchmark: 20% increase per year.

RESEARCH OPPORTUNITIES

Idaho's research universities have developed statewide strengths in strategic research areas that have great potential to drive future economic growth and success. The criteria used to select these areas include: number of faculty and qualifications; peer-reviewed publications and impact; infrastructure (facilities, equipment, information technology, staff); external grant and contract funding; academic programs; student involvement; potential benefit to the State of Idaho; and technology transfer activity, including patents, licenses, and startup companies. By focusing collective research efforts and resources in these areas, the universities will be on the most efficient and effective route to research success and state-wide economic development. These high impact areas include 1) Energy Systems, 2) Natural Resource Utilization and Conservation, 3) Biomedical and Healthcare Sciences, 4) Novel Materials, and 5) Systems Engineering and Cybersecurity.

Energy Systems: Energy is a critical driver of any economy. The projected increases in the population of the world and increases in the standard of living will produce severe strains on the ability to meet the demands of the next few decades. In addition, finite reserves of fossil fuels and pollution from their combustion requires that alternative sources of energy production be developed. The combination of natural resources in Idaho and presence of the Idaho National Laboratory makes energy a natural area of emphasis. Indeed, the three universities with research capabilities already have extensive research projects in this area. The Center for Advanced Energy Studies (CAES) is an example of the significant investment the three Idaho universities, the University of Wyoming, and the Idaho National Laboratory have made to develop expertise in nuclear science and engineering, materials science and engineering, energy systems design and analysis, fossil carbon conversion, geological systems and applications, energy policy and cybersecurity, and environmental and resource sustainability. Further growth in these areas not only takes advantage of the strong base but strongly supports a positive economic impact through new markets for new product development

Natural Resource Utilization and Conservation: In the broad field of natural resource utilization and conservation, Idaho's universities have expertise in water resources, wildfire management and restoration, agriculture, forestry, recreation, and geophysics and geochemical detection, geographical information systems, and monitoring of groundwater pollutants. For example, university geologists, ecologists, and policy experts are collaborating on broad-ranging research projects that examine and predict the impact of climate change on Idaho's water resources. As water is essential to agriculture, recreation, the ecosystem, and human health, the universities have research strength in an area of tremendous societal and economic impact. Agriculture remains an important part of the economy of Idaho. Development of new biomic varieties with improved resistance to disease and climate change remain an area of importance as does the development of new feeds for domestic fish production. The often competing demands for preservation and exploitation put on the environment require understanding of the various ecosystems in the state and region as well as societal, human health, and

economic impacts of policy decisions. Recent national research imperatives, as particularly captured in National Science Foundation's Innovation at the Nexus of Food, Energy, and Water Systems (INFEWS) foundation-wide program and the Department of Energy's report *Water-Energy Nexus: Challenges and Opportunities* increasingly require multi-sectoral, multi-disciplinary approaches to problems in natural resource utilization and conservation. The depth and breadth of relevant research expertise in the biophysical, rural health and social science fields within Idaho's universities underscores an opportunity that a national emphasis on food, energy, and water security provides. Provided that enhanced coordination and collaboration between Idaho's universities can be successfully executed, we are particularly well-placed to exhibit national and international leadership at the nexus of food, energy, water system research. The future economic success of the state will rely on a deep understanding of these processes.

Biomedical and Healthcare Sciences: Idaho's universities have well-established research programs in selected areas of biological and biomedical sciences. University microbiologists and informatics experts, for example, study real-time change in pathogenic microorganisms that enable them to become resistant to drugs and chemical toxins thus resulting in worsening human disease and mortality rates. These effects are not restricted to humans, domestic and wild animals as well as food plants and trees are experiencing the same phenomena. Also, weeds are becoming resistant to herbicides. These phenomena are having a significant negative impact on Idaho's agriculture and forests. Further stress is being put on these important commercial sectors through climate variability. Research in these areas is critical for preserving important economic sectors of Idaho's economy while addressing future global needs.

The public health infrastructure in rural Idaho is not well understood but is potentially the most fragile aspect of the state's health care system. The rural environment, especially typical in Idaho where agriculture, manufacturing, and fishing are important or dominant parts of the economy, presents extraordinary threats to health. Agriculture brings the use of pesticides and herbicides as well as heavy and potentially dangerous machinery. Manufacturing – depending on the type – is a consistently hazardous industry, and employees involved in fishing and forestry are at much higher risks of trauma. Healthcare and in particular a focus on rural health, provides significant opportunities for economic development in Idaho. Partnerships with private entities in the healthcare industry, funding through the National Institutes of Health and other federal agencies utilize the natural laboratory of Idaho's rural population. Idaho's universities' contributions towards this emerging area of scholarship will add to the global competitiveness of the United States and the State.

Novel Materials: The global materials industry is worth an estimated \$550 billion, conservatively. Materials revolutionize our lives by offering advanced performance and new possibilities for design and usage. For example, the market for biocompatible materials has grown from a few to \$60B in the past decade. Market size is growing for materials in emerging areas such as photonic materials, electronic and dielectric materials, functional coatings, and green materials. Materials research in Idaho is conducted by a wide range of scientists in diverse fields. Across the state, faculty members in Biology, Chemistry, Geosciences, Physics, Electrical Engineering, Mechanical Engineering ,

Nuclear Engineering and Materials Science and Engineering conduct research on improving and developing new materials. Current materials researchers in Idaho cover a broad spectrum of specializations, including semiconductor device reliability, microelectronic packaging, shape memory alloys, DNA machinery, environmental degradation, materials for extreme environments, biomaterials and bio-machinery, materials characterization, and materials modeling. Nanoscale materials and devices, functional materials and their uses and materials for energy applications are a focus of research throughout the state. These areas of research are highly synergistic with local industries and the Idaho National Laboratory (INL). Access to materials characterization equipment and processing laboratories has resulted in collaborations with small businesses and start-up companies.

Systems Engineering and Cybersecurity: Device control, information management, and cybersecurity are an essential part of 21st century life and, therefore, are an important part of educational requirements. For instance, large amounts of sensitive data are collected, processed, and stored electronically but must be accessed and moved in order to have any impact. In fact, many systems are computer controlled through networks. These include such things as the electric transmission grid and transportation in major cities. The universities are beginning to develop research expertise in software development and data management lifecycle design and operations and secure and dependable system design and operations. This area provides a significant area of opportunity for positive economic impact in Idaho, partnerships with the Idaho National Laboratory, and in improving the global competitiveness of the United States. There are already a significant number of firms in Idaho whose interests are in software development for device control, information management and processing. In addition, many of the major research projects being undertaken in the region by various state and federal agencies as well as the universities require the handling of significant amounts of data in a secure and dependable fashion. Currently, research funding in the universities from private and governmental sources is limited by the number of qualified personnel. In addition, within Idaho there is a high demand for graduates at all levels in computer science, hence workforce development in these areas should be a matter of urgency.

EXTERNAL FACTORS: IDAHO RESEARCH ADVANTAGES AND CHALLENGES

There are unique advantages and challenges to research in Idaho. This document seeks to provide guidance on building upon the advantages present in Idaho and address the challenges through the goals in this strategic plan.

Research Advantages

The Idaho National Laboratory (INL) and the Center for Advanced Energy Studies: Idaho is fortunate to be home to the Idaho National Laboratory, one of only 17 U.S. Department of Energy national laboratories in the U.S. The INL's unique history and expertise in nuclear energy, environmental sciences and engineering, alternative forms

of energy, and biological and geological sciences and related fields provides an excellent opportunity for research collaboration with Idaho's university faculty in the sciences, engineering, business and other fields.

The Center for Advanced Energy Studies (CAES), established at the request of the U.S. Department of Energy, is a public-private partnership that includes Idaho's research universities (Boise State University, Idaho State University, and the University of Idaho), the University of Wyoming, and the Battelle Energy Alliance (BEA), which manages the INL. The CAES partners work together to create unique educational and research opportunities that blend the talents and capabilities of Idaho's universities and the INL. A 55,000 square-foot research facility in Idaho Falls supports the CAES energy mission with laboratory space and equipment for students, faculty, and INL staff in collaborative research projects. The State of Idaho invests \$3M per year in direct support of the three Idaho research universities.

Natural Resources: Idaho's beautiful natural resources are well known to fishermen, hunters, skiers, and other outdoor enthusiasts. Through its rivers, forests, wildlife, geological formations, and rangelands, Idaho itself is a unique natural laboratory for geological, ecological, and forestry studies. Idaho is home to some of the largest tracts of remote wilderness in the lower 48 states. In addition, the proximity of Yellowstone National Park and the Great Salt Lake provide additional one of a kind opportunities for ecology and geology research.

Small Population: Idaho's relatively small population of 1.6 million people enables every group in the state to be included in research surveys, providing more accurate information than a sampling of only some groups.

Intrastate Networks: The existing networks within the state, including agricultural extension services and rural health networks, provide a foundation for collecting research data from across the state, and rapidly implementing new policies and practices as a result of research discoveries.

Research Challenges

The goals set forth in this strategic plan are specifically designed to address challenges in Idaho. These challenges are identified below and include a description of the challenge and the goal from this strategic plan that addresses that specific challenge.

Lack of Coordination Among Universities In Advancing Research and Economic Development (technology transfer): By and large the research universities have not coordinated and shared their technology transfer and economic development activities among themselves. This not only decreases each university's competitiveness at the national and state level but also increases the costs for achieving a particular goal. There is some redundancy in programs, services and infrastructure between the universities. This duplication both limits the success that any one university can achieve and increases the cost.

Historical Competition Between Universities: One of the greatest problems with growing the research and economic development enterprise within the Idaho university arena has been the competitiveness between research universities. This problem existed at all levels within the universities themselves, extended through university administration to the state level, and was even prevalent in the press. While competition between the universities is to be expected when all are competing for a finite pot of money within the state and is even healthy at some level, the level of competition was counterproductive. The real competition that Idaho universities face is other universities in the United States when it comes to research dollars and attracting faculty and students. Economic development is also not a competition between the state universities but rather a competition with other states.

Goal 1 is designed to remedy these two challenges by “increas(ing) research at, and collaboration among Idaho universities and colleges to advance research strengths and opportunities pertaining to critical issues in Idaho, while also providing a vision for national and global impact.”

Competition from Other Universities: In research, university faculty competes nationally for grant funds from federal agencies such as the National Science Foundation, Department of Energy, and the Department of Health and Human Services. Many other states’ universities are well ahead of Idaho’s universities in terms of state funding per student, patent royalty income, endowments, etc., and are able to move ahead at a faster pace, leaving Idaho universities further behind as time goes on.

Goals 1 and 2 are designed to make Idaho’s research universities more competitive nationally and globally through collaboration with each other and by “(strengthening) the relationship between state universities and the private sector.”

University Culture: Each of Idaho’s research universities aspires to greater levels of achievement in research and creative activity, yet many faculty at each of the universities are not fully engaged on a national level in their respective fields. This is changing for the better under new leadership and with new research-active faculty hires at each institution, but these cultural differences remain, resulting in discomfort with change aimed at making the universities more nationally competitive.

While Goal 1 urges the researchers at Idaho’s universities to keep a national and global vision for their research, Goal 4 aims to enhance the research capabilities of faculty by “(enhancing) learning and professional development.”

Private Sector Support: Idaho has very little high-technology industry within its borders. This reduces the potential for developing an applied research initiative within the universities that, in many states, provides one important arm of economic development and technology transfer. This also means that it is much harder to develop those private/public partnerships that provide the universities with additional capital to construct research and technology transfer facilities.

The private sector plays a critical role in research. Goal 2 states that we will “create research and development opportunities that strengthen the relationship between state universities and the private sector.”

Fragmented Economic Development Initiatives: There are seemingly too many economic development initiatives in Idaho and they are not well coordinated. It is imperative that state, university, and community initiatives work together toward common and agreed to goals. As it is, little progress is being made towards developing an economic strategy for the state that includes the research universities and little money has been secured to drive the economic development process. In fact, it is not uncommon to find that different entities in Idaho are competing against each other.

Positive economic impact is the result of well-organized and collaborative research. It requires strategic planning and execution. Goal 3 indicates that Idaho’s research universities focus on “(contributing) to the positive economic impact of the State of Idaho.”

Conclusion

This statewide Strategic Research Plan for Idaho Higher Education provides a framework to mitigate these external challenges and help Idaho institutions continue to focus on their research strengths. Overcoming the challenges discussed in this document will require enhanced cooperation between the functional groups at each Idaho university, fueled by a desire to work together towards the common goal of improving Idaho’s economy for future generations.