

The Big Idea – Partnerships between industries and research universities can transform economies. In fact, they may be essential. Industries are increasingly eager to engage with universities to provide access to leading-edge R&D and open research communities that they cannot engage with on their own. Investments in research capacity at the University of Wyoming, coupled with state incentives for industry to locate here, can yield new university/industry partnerships that will drive economic diversification. Opportunities for strengthening through university research/industry partnerships with Wyoming's present industries are rich. Opportunities central to diversifying Wyoming's future economy are also flush. Many reside in areas that present national vulnerabilities. Forging partnerships in these areas will require investments in research capacity, incentives for business, and relationship building with potential sponsors. A vehicle for executing university/industry/government partnerships is outlined, Centers for Emergent Technologies and Innovation, or CETIs.

Background – It is well established that, without increases in natural resources, influxes of inexpensive labor, or improvements in infrastructure, the only way to diversify and strengthen economies is through innovation driven by fundamental research. Increasingly, industry is partnering with research universities to provide access to the best ideas to enable innovation. Such partnerships have proven to be economically transformative.

Based on UW's present research capacity, areas where Wyoming is or could readily contribute through new or strengthened partnerships with industry include enhanced oil recovery, cybersecurity, data analytics for natural resource management, and rural health care. But there likely more opportunities that could come to the fore through a dedicated approach to developing research partnerships. Now is the time to capitalize on investments recently made in Wyoming's research and education infrastructure to promote both innovation and partnering. The state has shown a commitment to research-based education through the Tier-1 Engineering and Science Initiatives as well as the Enzi STEM Education Building. Building on these can create the foundation for a new Wyoming future. The combination of a strong research infrastructure and a new system of university/college and state practices promoting university/industry partnerships can enable Wyoming to lead in supporting research-based businesses, enabling them to serve growing national interests as they serve the state.

At least three required elements are missing or need strengthening for Wyoming to capture the power of research for economic benefit. ENDOW can help fill these gaps. One, while UW research is highly regarded nationally and globally in many areas, it's capacity to dive deeply into some areas of opportunity may not be sufficient to respond to enable calls to action. Clusters of research excellence with depth in strategically important areas may need to be created. Two, sustainable areas of research and business opportunity need to be identified. Related to both of

these, ENDOW can support assembling thought leaders from business, academia, and state and federal agencies to identify sustainable partnering opportunities, supported by the university performing a gaps and opportunities analysis to identify where strategic strengthening should be pursued. Three, ENDOW can recommend the creation of state incentives for industry to locate in Wyoming and partner with UW and its networked research institutions.

Research opportunities to strengthen Wyoming's present industries – All of the leading industries presently contributing to Wyoming's economic base can benefit from innovation spawned by research. Examples include agriculture, mineral and petroleum extraction and use of these products, land reclamation, and tourism.

The potential for these industries benefitting from explicit research partnerships with UW and its partner colleges is strong. For example, much more can be made of advances in our ability to understand and manipulate biological processes to have great impact in high altitude agriculture. While the University of Wyoming is already asserting national and world leadership in advanced techniques of petroleum extraction, research-informed land reclamation techniques following extraction has potentially large markets well beyond Wyoming's borders. In tourism, research can strengthen the hospitality industry, and marketing research can strengthen Wyoming's brand. These are just a few examples of where partnering between the university and industry can strengthen Wyoming's present industrial base. More generally, Wyoming provides a platform for research in areas that have national or global potential that is presently under-exploited. Such potential growth areas include rural health care delivery and distance education.

Research opportunities for a diversified Wyoming future- There is an eagerness at the federal level to encourage partnerships between industry with universities where broadening of the research base is seen as in the nation's interest. Such interest in closing gaps national vulnerabilities in semiconductor research prompted the State University of New York (SUNY) system in upstate New York to invest state dollars to enable a SUNY/IBM partnership to be established that subsequently broadened to other companies. This has yielded billions of dollars of industry investment in a region which previously had seen a collapse of its industrial base. UW likely has the research capacity now to respond to a few such opportunities, and with investment, to do so with substantial force.

Recognized areas of national vulnerability where university-industry research partnerships are recognized as essential but that presently exist well below national demand include the following. This list is far from exhaustive:

- Cybersecurity, including protecting petroleum extraction technologies
- Biotechnology: Understanding, applying, and controlling the application of rapidly

changing biotechnologies, based on the ability to manipulate genetic material

- Materials science for advanced energy applications
- Artificial intelligence

National needs related to security and health will be a growing market regardless of national political leadership. By appealing to issues of national interest, vibrant and diverse research enterprises can emerge in areas at the foundations of these interests. These will position Wyoming to respond to important emerging national opportunities not presently anticipated, and will enable it to lead in creating new ones. University-industry partnerships in research areas where there is a national pull can find consistent levels of federal support. Such university/business/government partnering will be the source of ideas stimulating the market place and creating a Wyoming workforce that can serve the nation.

To identify the most promising opportunities, businesses with an interest in benefitting from foundational research in national interest areas will need to be engaged. State incentives to attract industry could include tax relief, reduced utility costs, and funding to incentivize, maintain, and grow industry partnerships with the UW university/college network. These partnerships would include joint appointments and programs for internships to develop labor pipelines with Wyoming's students. Flexible university appointments and IP arrangements would encourage back-and-forth motion of faculty and employers between campuses and businesses.

Proposed approach – ENDOW can recommend identifying and promoting opportunities to create an engine to drive a research-driven Wyoming economy. In particular, ENDOW can:

1. Support UW bringing together leaders from industry, state and federal sponsors, and academia to identify areas of long-term, sustainable research need for existing and potentially new Wyoming industries. Many of these needs are discussed in agency reports and strategic plans. Others can be identified through discussions.
2. Recommend UW develop statements of interest in research partnering opportunities for consideration by potential sponsors in Wyoming and in Washington.
3. Informed by a gaps and opportunities analysis, recommend support for UW deepening its research capacity in key strategic areas.
4. Recommend CETIs be pursued in areas of near- and long-term opportunity, with business research partnership with UW and its research network ultimately incentivized by state investment and policy.
5. Urge new state practices and policies be developed to incentivize businesses to partner in research, locate and remain in Wyoming.