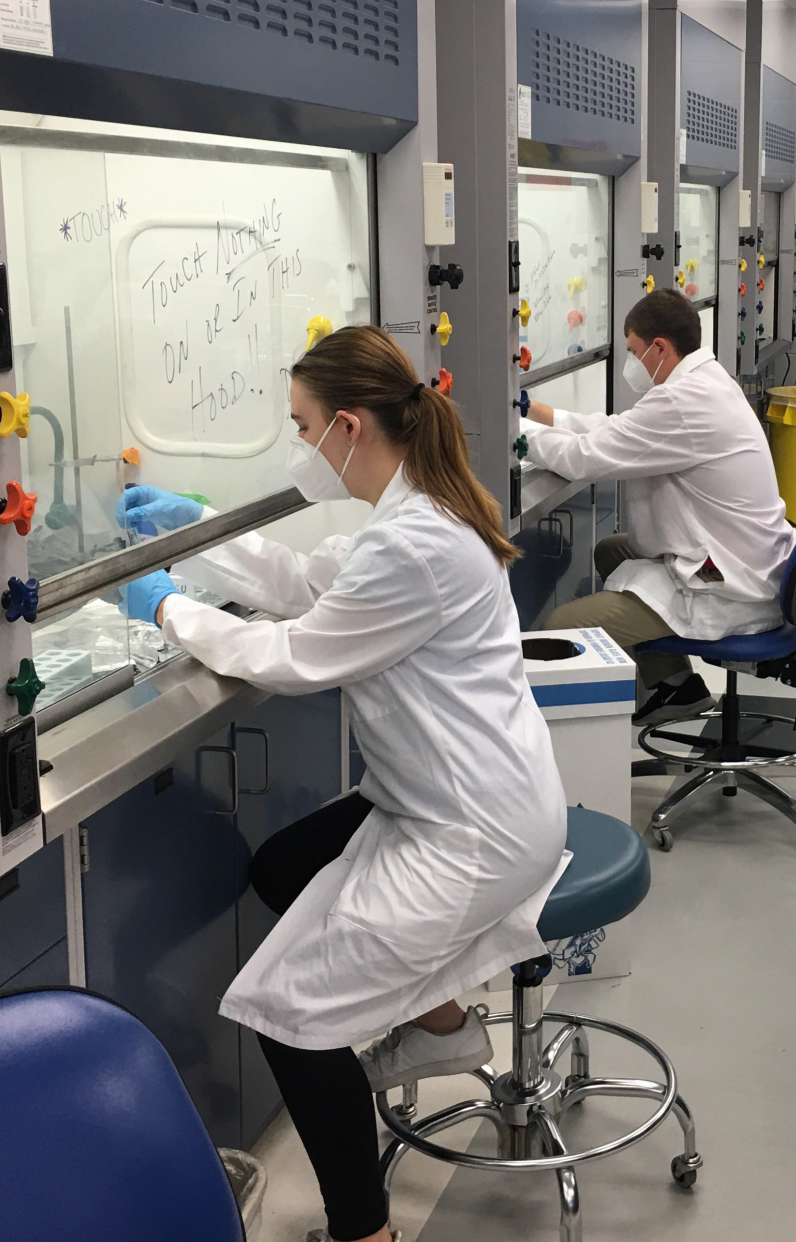




The South Dakota Science and Innovation Strategic Plan

South Dakota EPSCoR
REACH Committee
April 2022



above

Dakota State University students Christina Maloney and Sammy Drummond are conducting research in Madison at Dr. Michael Gaylor's lab.

on the cover

UPPER LEFT

At the South Dakota Chamber of Commerce's Governor's Giant Vision Competition, Brigit Blote and Payton Ryz of the University of South Dakota describe their entry, Fomeno, a platform to connect thrift shoppers with online stores for specific items.

LOWER LEFT

At the summer 3D Printing for the Future workshop, Cyle Miller (Sturgis Brown HS CTE teacher) helps Kanyen (Lakota Tech HS student and program participant) with her CAD Design.

RIGHT

Dr. Govind Chilkoor, a research scientist at South Dakota Mines, uses the autoclave to sterilize growth media and glassware used for the microbial corrosion experiments.



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reach committee

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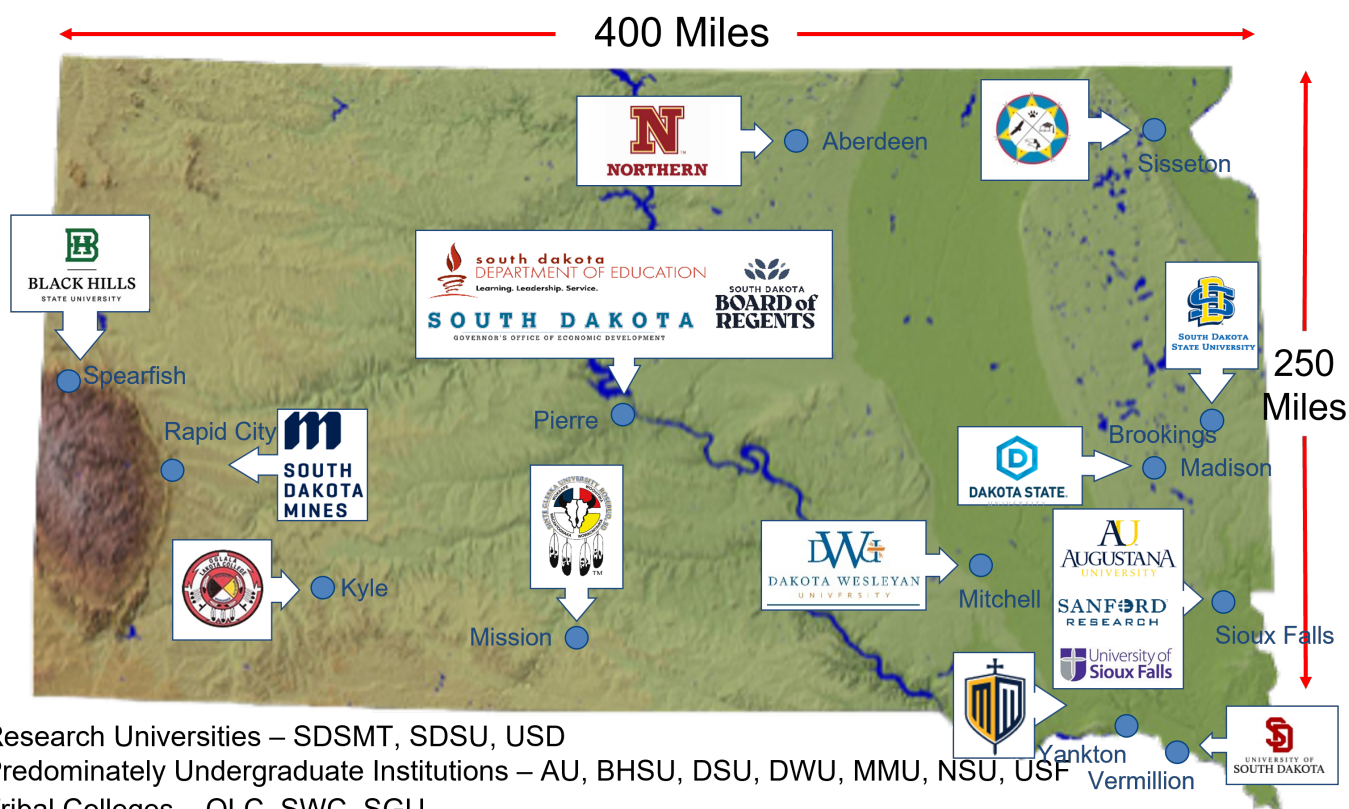
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EPSCoR Participating Institutions



A MESSAGE FROM REACH COMMITTEE CHAIR AND SD EPSCOR DIRECTOR

The South Dakota REACH Committee updated the Science and Innovation Strategic Plan for the State of South Dakota in late 2021 and early 2022. This plan guides the selection of the NSF EPSCoR Track-1 proposals, as well as other state initiatives including Research Center and Board of Regents research program funding. The South Dakota Science and Innovation Strategic Plan published in April 2022 was the result of this effort.

The goal of The South Dakota Science and Innovation Strategic Plan is to build science and technology capacity in South Dakota by promoting research, fostering knowledge-based companies, generation of higher wage jobs, and building the capacity to sustain the prosperity they create. The REACH Committee developed the South Dakota Science and Innovation Strategic Plan to address this challenge. The strategic plan is, at its core, a collaborative venture between the state's public and private sectors to build the capacity to produce and grow the new ideas, the talent, and the companies that will power South Dakota's future innovation-rich, higher value economy.

Seven initiatives are included that will build the solid base of science, technology, engineering, and math (STEM) knowledge and infrastructure needed to support and grow target industry sectors over the next several decades.

Sincerely,



Eddie Sullivan
REACH Committee Chair



Mel Ustad
SD EPSCoR Director

EXECUTIVE SUMMARY

The National Science Foundation (NSF) created the Experimental Program to Stimulate Competitive Research (EPSCoR) in 1979 because Congress recognized the uneven distribution of federal research and development funds. The program later became the Established Program to Stimulate Competitive Research (EPSCoR). The EPSCoR program was designed to help facilitate grants to states that historically do not receive substantial amounts of federal Research and Development (R&D) funding. South Dakota responded to this opportunity by forming the REACH (Research Excellence: A Critical Hallmark) Committee to oversee EPSCoR activities in 1986. Since 1989, South Dakota has successfully competed for NSF EPSCoR funding.

REACH, a South Dakota non-profit corporation, oversees the state's EPSCoR programs and management of the NSF EPSCoR projects. The REACH Committee includes private sector, university, tribal college, and state government members. South Dakota EPSCoR programs involve a collaboration of state and private universities, Tribal Colleges, technical colleges, state government, and industry developing research infrastructure; an educated and skilled workforce in science, technology, engineering, and mathematics (STEM); and an innovative business ecosystem.

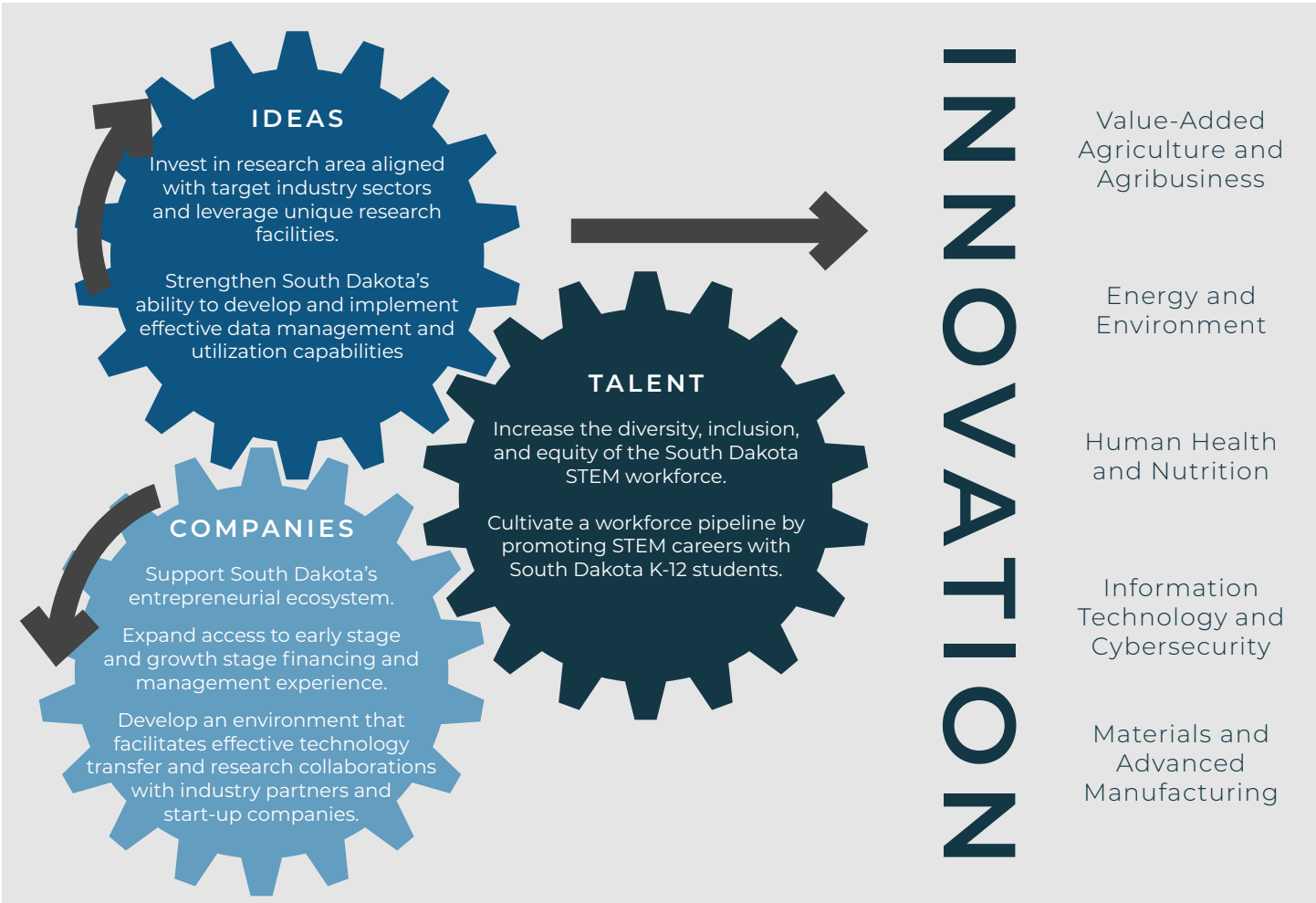
South Dakota EPSCoR helps build South Dakota's research infrastructure and increases its capacity to successfully compete for federal funding. EPSCoR programs have provided more than \$300 million to South Dakota supporting research, STEM education, and economic development through competitive capacity building grants from the NSF, National Institutes of Health (NIH), Department of Energy (DOE), the National Aeronautics and Space Agency (NASA), and the U.S. Department of Agriculture (USDA).

The South Dakota Science and Innovation Strategic Plan maps goals and initiatives to guide collaborative opportunities amongst partners. The process of developing the plan was inclusive of all stakeholders: industry, post-secondary education, K-12 education, economic development organizations, and state government. The strategic plan acknowledges the critical role data will play in the future. Effective utilization of digital data will be critical to the operation of businesses, governmental entities, and other organizations. Effective management, protection, analysis, and use of that data is critical in all the target industry sectors, governmental entities, other organizations, and by individual citizens of South Dakota.

The target industries identified in the Science and Innovation Strategic Plan are aligned with South Dakota’s STEM-oriented sectors that drive a high-value economic future and unique research infrastructure in South Dakota. The target industries include value-added agriculture and agribusiness; energy and environment; human health and nutrition; information technology and cybersecurity; and materials and advanced manufacturing. Unique research infrastructure in South Dakota include Sanford Underground Research Facility (SURF), POET Bioproducts Institute, MadLabs, Raven Precision Agriculture Center, and EROS Data Center, which are described in greater detail under the Target Industry section.

The plan employs an innovation equation to address three elements that capture the essence of the innovation process.

- *Ideas* = the ability and capacity to generate new ideas and transform them into value in the marketplace.
- *Talent* = producing, nurturing, and attracting talent to generate new and valuable ideas and growing companies.
- *Companies* = the innovation implementation vehicle where the new ideas, the new value, and the talent come together.



The strategic plan goals that will inform investment decisions include:

IDEAS

1. Continue to make strategic investments in Governor's Research Centers, NSF EPSCoR Track-1 projects and other programs. Invest in research areas aligned with target industry sectors and leveraging unique research infrastructure.
2. Strengthen South Dakota's ability to develop and implement effective data management and utilization capabilities.

TALENT

3. Increase the diversity, inclusion, and equity of the South Dakota STEM workforce.
4. Cultivate a workforce pipeline by promoting STEM careers with South Dakota K-12 students.

COMPANIES

5. Support South Dakota's entrepreneurial ecosystem.
6. Expand access to early stage and growth stage financing and management experience.
7. Develop an environment that facilitates effective technology transfer and research collaborations with industry partners and start-up companies.



mission, vision, and principles

MISSION STATEMENT

The mission of the South Dakota Science and Innovation Strategic Plan is to enable innovative research and develop the skilled workforce that will drive future economic prosperity by building the science and technology capacity in South Dakota.

VISION STATEMENT

The South Dakota Science and Innovation Strategic Plan's vision is to grow South Dakota's economy through research and development, thereby enabling businesses to prosper, producing better paying jobs, and enhancing all South Dakotans' quality of life.

GUIDING PRINCIPLES

The plan's approach is founded in four guiding principles:

1

The state's educational institutions will play a crucial role in the success of the strategy because the scientific knowledge, technological know-how, and research capacity will drive the innovation process, and graduates will provide the skilled workforce enabling the economy to grow.

2

Each project will be required to plan for data management, including collection, security, analysis, and utilizing data to make informed decisions.

3

The plan will be evaluated and adjusted every two years to consider for external factors.

4

Partnerships between research universities, primarily undergraduate universities, Tribal Colleges, technical colleges and industry will prepare and increase South Dakota's STEM workforce.

target industries

The target industries were selected based on four criteria:

1. The sectors show critical mass or demonstrable momentum as a statewide strategic choice from an economic development policy standpoint, including consistency with the adopted targets of the state and its regions.
2. The sectors demonstrate potential impact across the state, including urban, rural, and Native areas.
3. The target sectors demonstrate strong economic measures in South Dakota.
4. The sectors include mature industries within the state, those that have established themselves within the last few decades, and those that are emerging but demonstrate long-term potential.

South Dakota has made strategic investments in Governor's Research Centers, NSF EPSCoR RII Track-1 projects, and other programs to build multidisciplinary research capacity to compete for external funding. Governor's Research Centers establish recognized leaders in a focused research area and commercialize promising research results in collaboration with private sector partners. These strategic investments have focused on research areas aligned with target industry sectors and leveraging the unique research infrastructure in South Dakota. An example of these strategic investments includes the \$60 million invested in Governor's Research Centers across the state since 2005. These investments have resulted in those 21 Governor's Research Centers being awarded \$354 million in state, federal, and private investments. In addition, the state, federal, and private sector have made major investments into research and development facilities.

The following pages list the five target industries and associated Governor's Research Centers and private and public sector assets.





VALUE-ADDED AGRICULTURE AND AGRIBUSINESS

Governor's Research Centers

South Dakota Center for Biologics Research and Commercialization is a Governor's Research Center based at South Dakota State University (SDSU). The state of South Dakota invested \$3.8 million in the Center from FY18-FY22. The Center focuses on translational research in nutraceuticals, probiotics, vaccines and animal diagnostics.

Research Infrastructure

South Dakota Animal Disease Research Diagnostic Laboratory (SDSU), a \$58 million project, is a collaborative effort involving South Dakota commodity and farm organizations, the state veterinarian and veterinarian associations, and the state legislature. The updated facility allows faculty and staff to expand research efforts. The facility opened in August 2019.

POET Bioproducts Institute is a collaboration involving SDSU, South Dakota Mines, and POET focused on transforming low-value agricultural and forestry materials into high-value bioproducts, such as specialty feeds and degradable bioplastics. The \$27 million, 45,000-square-foot facility at SDSU Research Park is scheduled to be completed in 2023.

Private Sector

Medgene Labs, an SDSU spinoff company, is a leader in the new field of prescription vaccines. These are vaccines prescribed by a veterinarian to proactively target emerging diseases. The lab offers a variety of USDA licensed products and services to help producers and veterinarians improve herd health and lower production costs. They placed in the 2014 Giant Vision competition and received three SBIR Phase I and one Phase II awards amounting to \$1.2 million. The lab has raised private capital to develop their research and production facility in Brookings.

Prairie AquaTech, an SDSU spinoff company, produces powerful plant-based nutritional ingredients for agriculture and aquaculture feed products. The company uses a patented fermentation technology that creates high protein ingredients. This product enables producers to lower their feed costs while improving operating metrics, such as survivability and growth. They placed second in the 2013 Giant Vision competition and received five SBIR Phase I and two Phase II awards amounting to \$1.5 million. The company constructed a \$60 million processing facility in Volga and a research and development facility in Brookings.



ENERGY AND ENVIRONMENT

Governor's Research Centers

Center for Electrochemical Energy Storage is a Governor's Research Center at South Dakota Mines with collaboration from SDSU. The state of South Dakota invested \$3.9 million in the Governor's Research Center from FY22-FY26. The Center, with support of a \$4.5 million NSF Industry University Collaborative Research Center (IUCRC) award, involves a multidisciplinary team of university, national laboratories, and private sector partners working to develop and commercialize innovative energy storage technologies.

Composite and Nanocomposite Advanced Manufacturing Center-Biomaterials is a Governor's Research Center at South Dakota Mines, in collaboration with SDSU, is supported from FY19-FY23 for \$1.8 million. The Center focuses on the use of renewable feedstocks to produce and commercialize high-performance biopolymers and biocomposites.

Research Infrastructure

POET Bioproducts Institute's facility is a 45,000-square-foot, \$27 million facility at the SDSU Research Park. The Institute houses researchers from SDSU and South Dakota Mines working with POET and other private sector partners to develop cutting-edge innovations in low-carbon biofuels and bioproducts.

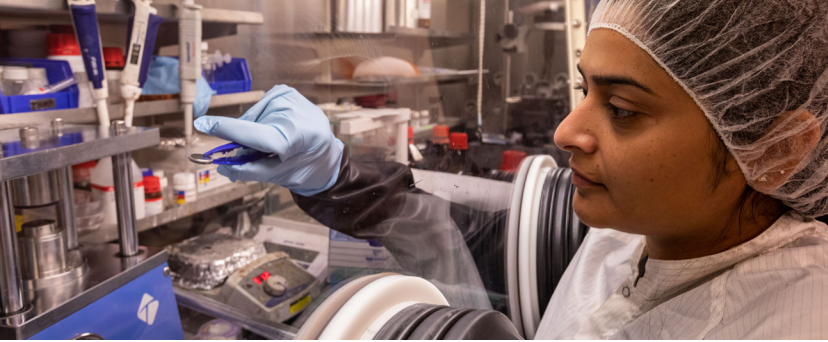
Missouri River Institute, at the University of South Dakota (USD), seeks to increase interest and knowledge about the Missouri River and its basin. The Institute focuses on the upper Missouri River basin working with Montana, North Dakota, and Wyoming on a range of natural and cultural resource studies.

Private Sector

AEsir Technologies constructed a 600,000-square-foot factory in Rapid City to manufacture nickel zinc batteries that use potassium hydroxide as the electrolyte.

POET, the world's largest producer of biofuels, is based in Sioux Falls. POET produces renewable biofuels, distillers grains, and renewable bioproducts. They have an integrated business model that combines technology development with expertise in construction, operations, risk management, and marketing.

RESPEC, founded in 1969, and based in Rapid City, is a global leader in geoscience, engineering, data and integrated technology solutions for major industry sectors. The company is working in 50 countries and 40 states.



HUMAN HEALTH AND NUTRITION

Health Systems

Avera, Monument, and Sanford Health continued to lead growth of the healthcare sector and medical research in South Dakota. These private sector organizations have made major investments in research and partnered with several university-based Governor's Research Centers.

Avera Research Institute has been involved in a range of medical research efforts since 1998. These include the Avera Institute for Human Genetics, an international Twin Register, Avera Cancer Institute, and applied research through Alumend, a lab developing innovative treatment for peripheral vascular disease in Phase 1 clinical trials in 2021.

Sanford Research is home to four research centers and three focus areas of research. The focus areas include regenerative medicine, the Sanford Project for Type 1 Diabetes, and treatment of rare diseases. The research centers supported by NIH CoBRE awards include the Center for Pediatric Research, Center for Cancer Biology Research, Center for Health Outcomes and Population Research, and Center for Pediatric Research.

Monument Health, based in Rapid City, provides health services in western South Dakota. The health system participates in numerous clinical research studies.

Governor's Research Centers

Center for Drug, Disease and Delivery is a collaboration between SDSU, South Dakota Mines, and Avera Research. The state of South Dakota will invest \$3.9 million in the Center from FY22-FY26. The Center focuses on modifying existing drugs to optimize their biological and delivery properties, identifying new molecular targets for existing drugs, and developing new formulations and delivery systems for existing drugs.

Center for Genetics and Behavioral Health is a collaboration between USD and Avera Research. The state of South Dakota invested \$3.5 million into the collaboration during FY18-FY22. The Center studies the genetic and environmental influences that interact with other biological, psychological and behavioral factors to impact post-traumatic stress disorder (PTSD).

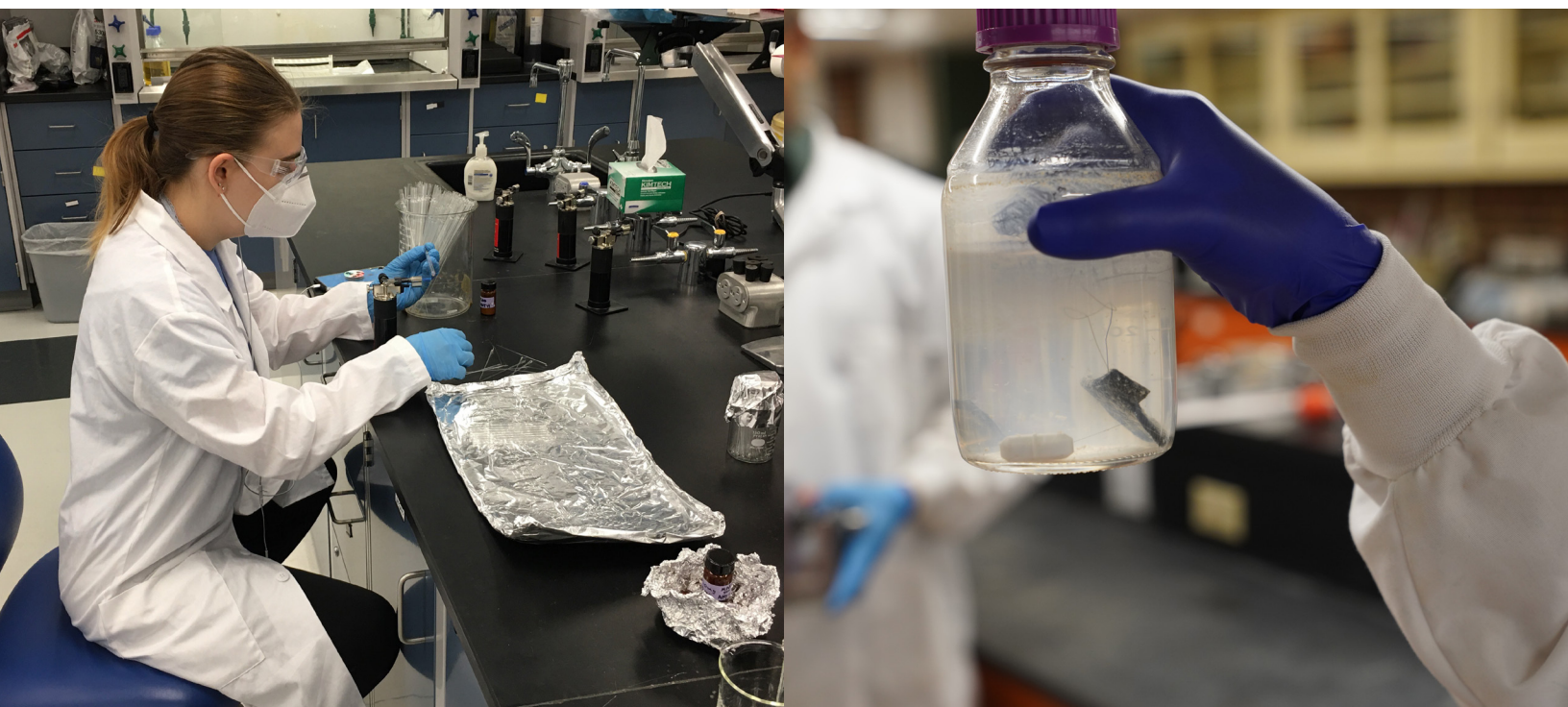
BioSystems Networks & Transitional Research (BioSNTR) is a collaboration between SDSU, South Dakota Mines, USD, and Sanford Research. The state of South Dakota invested \$11.8 million in FY14-FY19 in the collaboration. The Center focuses on development of world-class microscopy, seeing into cells and tissues and cutting-edge sequencing capabilities as well as high performance computing resources. These tools and resources are used to support human, animal and plant research.

Earlier Governor's Research Center investment in human health include:

- Biological Control and Analysis by Applied Photonics (FY09 - FY14)
- Translational Cancer Research (FY09 - FY14)
- Cardiovascular Research Institute (FY04 - FY09)

Private Sector

SAB Biotherapeutics is a component of Operation Warp Speed in response to the COVID-19 pandemic, developing and producing polyclonal antibodies to treat and prevent COVID-19. The company has received more than \$200 million in federal funds to support commercial manufacturing and clinical development of SAB-185 for the treatment of COVID-19. SAB is currently advancing multiple clinical programs and has collaborations with the US government and global pharmaceutical companies. The company continues to expand not only its research activities but also its antibody production and processing capabilities.





INFORMATION TECHNOLOGY AND CYBERSECURITY

Governor's Research Centers

Center for Understanding and Disrupting the Illicit Economy is a collaboration between South Dakota Mines, Dakota State University (DSU), SDSU, and USD. The state of South Dakota invested \$3.9 million from FY22-FY26 in this Governor's Research Center. The Center will integrate cyber, physical, and social systems to understand and disrupt illicit criminal networks.

Research Infrastructure

Cybersecurity and cyber operations education through DSU's National Cryptologic School partnership with the National Security Agency is rapidly expanding. DSU has partnerships with the National Security Agency, the Department of Homeland Security and the National Science Foundation, offering training to employees and students from its \$18 million, 40,000-square-foot Madison Cyber Lab (MadLabs®) building.

The DigForCE (Digital Forensics for Cyber Enforcement) Lab at DSU is funded through grants and contracts with the SD Attorney General's Office, National Science Foundation, National Security Administration, Homeland Security, and other private entities. The Lab conducts digital forensic investigations for law enforcement, and creates novel approaches to identify, extract and analyze digital items. One of the Lab's specialties is host-based dark web artifact investigations.

Raven Precision Agriculture Center is a partnership between SDSU and Raven industries supporting development and implementation of precision agriculture technologies. The \$46 million, 129,000-square-foot research and teaching facility opened in 2021.

Earth Resources Observation and Science (EROS) is a federal science center operated by the U.S. Geological Survey located near Sioux Falls. Since 1972, EROS has worked to map, monitor, and analyze land change across the United States and around the world. The land change data products are used by researchers, resource managers, and policy makers.

Sanford Underground Research Facility (SURF) supports world-leading research in particle and nuclear physics, geology, biology and engineering. There are currently 27 research projects housed at SURF. The main level for science is 4,850 feet below ground. SURF continues to grow with several new experiments installed and employment growing to more than 200 people. A recent study of the economic impact of the facility projected its net economic impact to South Dakota between 2020 and 2029 will reach \$1.6 billion and 1,052 additional jobs created.

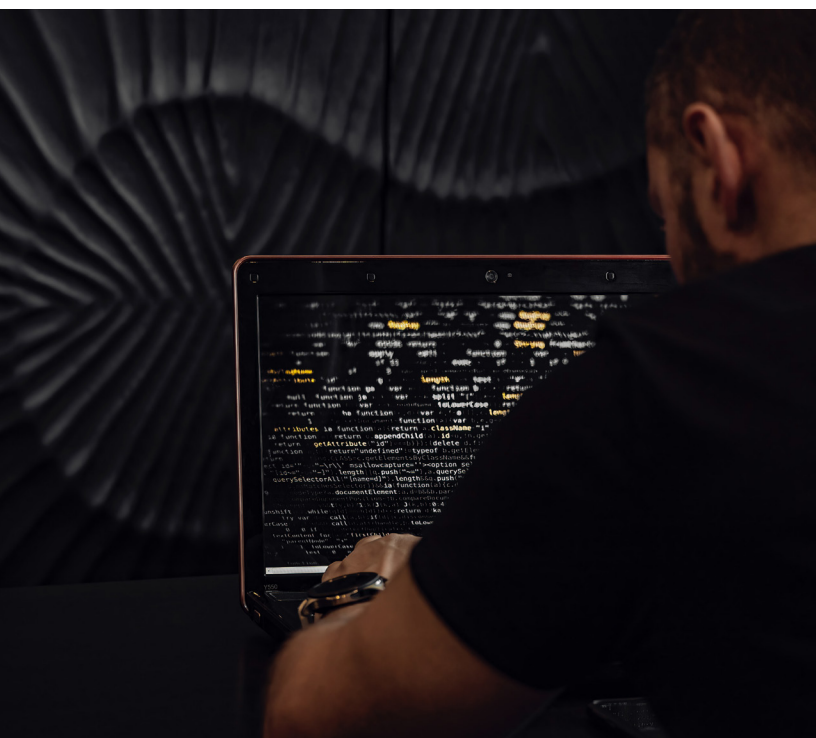
Private Sector

Sanford Imagenetics is a \$125 million investment by Sanford. It is based in a 100,000-square-foot facility and is focused on advancing personalized medicine research and implementation.

Farmer's Business Network is a 2014 Silicon Valley startup, and its facility is located in Sioux Falls. It provides information, unbiased analytics and competition for the more than 30,000 farmer members' business.

SBS Cybersecurity is a DSU spinoff company based in Madison. It is a premier cybersecurity consulting and audit firm providing services throughout the United States and abroad.

Experity, formerly known as DocuTap, is a Sioux Falls startup that grew into a leading provider of electronic medical records for urgent care facilities.





MATERIALS AND ADVANCED MANUFACTURING

Governor's Research Centers

Repair, Refurbish and Return to Service was a Governor's Research Center at South Dakota Mines, supported FY09-FY14 at \$2.0 million, that focused on friction stir welding and other additive manufacturing technologies.

Advanced Manufacturing Process Technology Transition and Training Center was a Governor's Research Center at South Dakota Mines, supported FY13-FY18 with \$2.4 million, that focused on development and certification of cold spray technologies for repairing and manufacturing new products.

Composite and Nanocomposite Advanced Manufacturing Center is a Governor's Research Center at South Dakota Mines, supported FY13-FY18 with \$2 million, that focused on scaling up engineered structures. The Center, with support of an NSF Industry University Collaborative Research Center (IUCRC) award, involved a multidisciplinary team of university, national laboratories, and private sector partners working to develop and commercialize innovative composite materials.

Center for Fluorinated Functional Materials is a Governor's Research Center at USD supported FY18-FY22 at \$2.7 million, that is focused on commercializing fluorinated functional materials in a range of applications. In 2021, the Center received an NSF planning grant for an Engineering Research Center.

Private Sector

VRC Metal Systems, a South Dakota Mines spinoff company, has become a cold spray leader. The company develops and manufactures cold spray systems that allow agile, high-quality metal repairs. They won the 2015 Giant Vision competition and received 13 SBIR Phase I and 7 Phase II awards, totaling \$10.7 million. The company has grown to more than 120 employees and was named the 2020 South Dakota SBA Veteran Owned Small Business of the Year. VRC used a \$5 million SBA loan and GOED REDI fund loan for their facility and equipment in Box Elder.

Novum Nano, a VRC Metal Systems company, specializes in carbon fiber nanotube innovation and commercializing products for the aerospace and defense sector as well as electronics and petroleum industries.

Secure Markings, a South Dakota Mines & USD spinoff company won the 2017 Giant Vision competition and secured NSF STTR Phase I and II funding. It was also selected by the Department of Defense (DoD) to be one of 10 companies to participate in the Tech Star program in Boston in 2018. The company has received additional DoD funding and works with numerous state and federal law enforcement organizations.

RPM & Associates, a leader in laser deposition technology, is contracted to manufacture and repair equipment for the power generation, mining, and concrete production industries.



goals

The South Dakota Science and Innovation Strategic Plan is organized around the three elements of the prosperity equation that drive the innovation process and foster economic growth. Each goal is supported by initiatives that will be executed by education, public, and private partners.

IDEAS

1. **Continue to make strategic investments in Governor's Research Centers, NSF EPSCoR Track-1 projects and other programs. Invest in research areas aligned with target industry sectors and leverage unique research facilities.**

The primary driver of this initiative is the selection and support of Governor's Research Centers through a competitive selection process. Based on this plan, the Research and Commercialization Council awards funding for five years to support Governor's Research Centers. The program provided funding for five years, ranging between \$2 million and \$10 million, to develop nationally competitive research centers in collaboration with private sector partners. The NSF EPSCoR Track-1 program provides \$24 million over a 5-year period to develop the state's research infrastructure, expand the STEM graduate pipeline, and support technology based economic development.

INITIATIVES

- Continue to make strategic investments in Governor's Research Centers, NSF EPSCoR Track-1 projects, and other programs to build multidisciplinary research capacity to compete for external funding.
- Partner with target industry collaborators to identify applied research opportunities and implement innovations.



Value-Added
Agriculture and
Agribusiness



Energy and
Environment



Human Health
and Nutrition



Information
Technology and
Cybersecurity



Materials and
Advanced
Manufacturing

RESOURCES AND ASSETS

- Governor's Research Centers have represented strategic state investments since FY2005. More than \$60 million has been invested in 21 research centers. The Centers have leveraged \$6 for each state \$1 invested. The Centers have training 1, 385 students and generated 205 invention disclosures. The research centers have spun off 24 companies.

IDEAS

2. Strengthen South Dakota's ability to develop and implement effective data management and utilization capabilities.

All EPSCoR, Board of Regents, and Research and Commercialization Council requests for proposals should require a plan for effective data collection, security, analysis, and utilization. This should emphasize sharing of data with other researchers and users to maximize the impact of the research activity.

INITIATIVES

- Include data management and use as a priority for all research competitions
- Continue to invest in cybersecurity and data management infrastructure, education and training programs.

RESOURCES AND ASSETS

Applied Research Lab (ARL), at Dakota State University will be expanding with a \$90 million initiative to grow the cyber-research industry in South Dakota. The initiative announced in January 2022 involves:

- Continue to fill 125-150 full-time cybersecurity jobs in Madison.
- Increase DSU's capacity to double the number of graduates of the Beacom College from 200 to 400 annually by recruiting and retaining faculty, students and staff.
- Expand the cyber talent pipeline and career pathways through the Governor's Cyber Academy to offer dual credit programs to high school students statewide.
- Expand the ARL in Sioux Falls with a specialized facility to be opened in 2025 and support 400 to 500 jobs.
- Conduct intensive summer cybersecurity boot camps for students from other universities in South Dakota majoring in cyber-related disciplines such as computer science, computer engineering, software engineering, etc. starting in the summer of 2023.

South Dakota has several programs and services supporting all people in their pursuit of education. Many of these programs focus on STEM education and workforce development. Several scholarship programs support students pursuing STEM degrees and to meet critical workforce needs. These scholarships include:

- **Build Dakota Scholarship:** Awarded to students entering high-need workforce programs at South Dakota's technical colleges to fill the state's technical careers with skilled professionals. Recipients of the full-ride scholarships commit to living and working in South Dakota in their field of study for three years following graduation.
- **Critical Teaching Needs Scholarship:** Provides financial assistance to South Dakota high school graduates who attend an eligible higher education institution in South Dakota and promise to work in critical teaching need occupations in South Dakota for five years after graduation.
- **Dakota Corps Scholarship:** Provide full tuition to South Dakota high school students who promise to enter a critical need occupation in South Dakota following completion of the program of study.
- **South Dakota Needs Based Grant:** Since 2014 the needs-based grant program has supported students attending post-secondary institutions in South Dakota. In 2020, 231 students received support.

TALENT

3. Increase the diversity, inclusion, and equity of South Dakota STEM Workforce.

INITIATIVES

- Foster a culture of collaboration between research universities, primarily undergraduate universities, Tribal Colleges, technical colleges, and industry to leverage facilities, faculty knowledge, and student development to support STEM education and address Tribal community needs.
- Partner with Tribes and Tribal Colleges to expose students to jobs and careers in their local community that utilize STEM. This may include job shadowing, classroom presentations, internships and other awareness activities.
- Partner with Tribal colleges to encourage more Native American students to pursue teaching careers at the K-12 and higher education level. Native American teachers serve as role models and mentors for students.
- Partner with Tribes and Tribal Colleges to integrate Tribal culture and their community into STEM curriculum. Including examples and exercises involving Tribal culture and their community environment will make STEM more relevant to Native American students.

RESOURCES AND ASSETS

South Dakota is home to nine Tribes and Native Americans represent nine percent of the population. Three Tribal Colleges are based in South Dakota: and Sitting Bull College, based in North Dakota, supports residents on the Standing Rock Reservation in South Dakota.

- **The Indian University of North America**, at Crazy Horse Memorial, began in 2010 with the 7TH GEN Summer Program, and has since added the Wizipan Fall Program which commenced in Fall 2020. Students learn how to navigate college while completing a semester of college in a worldly setting unlike any other.

South Dakota universities and private sector partners have programs and initiatives to support Native American students and other diverse populations. Some of the support programs include:

- **South Dakota School of Mines and Technology Tiospaye Scholar Program**
The purpose of the Tiospaye Scholar Program is to increase the number of American Indian students graduating with degrees in engineering, science, and mathematics through support in five areas: Financial, Academic, Professional, Cultural, and Social.
- **South Dakota State University, Wokini Initiative**
The Wokini Initiative is SDSU's collaborative and holistic framework to support American Indian student success and Indigenous Nation-building. Ongoing collaboration between key campus and Tribal stakeholders is central to the Wokini framework. The Initiative builds upon SDSU's current Tribal partnerships and American Indian Student Center services to 1) enhance cultural programming and support for American Indian students, 2) offer Wokini scholarships for citizens of the nine Tribal nations in South Dakota, and 3) enhance research and outreach partnerships with Tribes, Tribal Colleges and other Tribal organizations.
- **University of South Dakota Native American Cultural Center**
The Native American Cultural Center (NACC) provides a culturally relevant environment for Native American students and others interested in Native American cultures. The NACC houses Native Student Services (NSS), which provides student support services and culturally relevant programming throughout the year, including cultural gatherings, leadership development and academic support.

TALENT

4. Cultivate a workforce pipeline by promoting STEM skills and careers in the South Dakota K-12 education.

INITIATIVES

- Continue to make strategic investments at all educational levels supporting STEM education and encouraging students to obtain skills required to be productive in the knowledge economy.
- Develop and reinforce K-12 teacher comfort and ability to teach STEM skills at all levels. This may include providing support to college student teachers, as well as professional development opportunities for teachers to strengthen their ability to teach STEM and related skills.
- Encourage students and individuals to pursue careers in education at all levels. This includes alternative routes for individuals with degrees to gain teacher certification and opportunities for residents in rural areas to gain the skills and certifications needed to teach STEM skills.
- Collaborate between secondary education and higher education to provide a clear path to STEM degrees and skills needed in the workplace.
- Introduce the need for STEM skills in jobs at the elementary school level. Leverage existing outreach resources and engage industry partners to expose students throughout their academic careers to the critical skills needed in the workplace. Include careers and opportunities in their local community as well as other part of South Dakota, the United States and globally.
- Make the transition through educational levels seamless. Universities should partner with Tribal Colleges and technical colleges to increase matriculation to the STEM workforce.

RESOURCES AND ASSETS

- **Sanford Science Education Center (SSEC)** is a partnership between SURF, BHSU, and the Sanford Lab Homestake Visitor Center. The SSEC is committed to developing and facilitating rich, innovative learning experiences and preparing the next generation of scientists, engineers, mathematicians and educators. The SSEC lends support to SURF's Education and Outreach programs, BHSU's Underground Campus and the Sanford Lab Homestake Visitor Center. This includes teacher workshops, research experiences for undergraduates and high school students, internships, and public outreach activities.
- **Sanford Promise** engages K-12 through graduate students with science and research. Sanford Promise provides classes, workshops, internships, and scholarships to students. This includes teacher resources and community outreach lectures and programs.
- **Jewett Regional Science Education Center** at Northern State University (NSU), a \$25 million facility opened in 2021, enhances research and science education for the entire region through community outreach. As part of these efforts, NSU offers teacher workshops and STEM programs and kits to 3rd - 5th graders in the region.
- **Dakota Seeds** is an innovative internship program that connects students with employers to provide internship experiences and establish a pipeline for future permanent employment. Qualifying businesses can receive matching funds up to \$2,000 per internships in STEM fields.
- South Dakota is fortunate to have **science centers** for children to discover science and engineering through experiential hands-on activities. The facilities include the Washington Pavilion in Sioux Falls, the Brookings Children's Museum in Brookings, the South Dakota Discovery Center in Pierre, and the Journey Museum in Rapid City.

COMPANIES

5. Support South Dakota's entrepreneurial ecosystem.

INITIATIVES

- Continue to work to strengthen the entrepreneurial culture by maintaining the business plan competitions and entrepreneurship support programs.
- Work to expand the business networking and mentoring programs throughout South Dakota.
- Match higher education research and development to industry and community needs and opportunities. Through this experience, students will have an enhanced learning experience, exposure to opportunities in their community, and may result in new innovations or solutions.

RESOURCES AND ASSETS

- **South Dakota** has developed a strong entrepreneurial support system. At the high school level there are business idea competitions such as the Big Idea Competition and I2I. These students, as well as college, undergraduate and graduate students, participate in campus business plan competitions and the Student Giant Vision business plan competition. South Dakota students have gone on to win national and international business plan competitions and start success businesses. Entrepreneurs and early-stage businesses have a range of support programs, business incubators and programs as well as the Giant Vision business plan competition to assist them.
- **The Governor's Office of Economic Development Proof of Concept Program** along with the federal **Small Business Innovation Research Program (SBIR/STTR)** provides support for innovative entrepreneurs and small businesses. These programs have helped to launch numerous successful South Dakota businesses.

COMPANIES

6. Expand access to early stage and growth stage financing and management experience.

INITIATIVES

- Continue to sustain and expand early-stage capital funding to enable entrepreneurs to secure capital.
- Expand access to later-stage capital for South Dakota-based and prospective South Dakota-based companies through networking with regional and national equity capital investors.
- Support strong economic development organizations across the state that address the creation of STEM jobs and the infrastructure to support employees.

RESOURCES AND ASSETS

South Dakota has developed angel investments networks and early-stage capital sources to support early-stage companies. These capital sources have enabled South Dakota companies such as SAB Biotherapeutics and DocuTap to raise significant outside capital enabling their rapid growth.

- **South Dakota Innovation Partners:** South Dakota Innovation Partners, a \$6M early-stage venture capital firm focused on commercializing research, invested in six university-based companies. Three of the companies, secured \$2M in funding from the investors. Two companies, Prairie Aquatech and Medgene Labs, have successfully commercialized the research innovations.
- **South Dakota Equity Partners:** South Dakota Equity Partners is a \$22M venture fund focused on early and growth stage businesses in South Dakota. The fund has invested in South Dakota research-based companies and is currently raising a second larger fund. Investments include SAB Biotherapeutics, Inanovate, and Query.AI.
- **Enterprise Institute Angel Investment Network:** The Enterprise Institute aided in the establishment and management of local and regional angel investment funds. This includes angel investment funds in Aberdeen, Brookings, Rapid City, Sioux Falls, Watertown and Yankton.

COMPANIES

7. Develop an environment that facilitates effective technology transfer and research collaborations with industry partners and start-up companies.

South Dakota universities collaborate with industry on a range of research and development activities. NSF Industry University Collaborative Research Centers based in South Dakota are examples of these efforts.

INITIATIVES

- Provide entrepreneurship training such as invention disclosure, patent filing, customer discovery, and business plan development to faculty and students. Continue programs such as the TRAC at USD, Entrepreneur-in-Residence at South Dakota Mines, and other programs to educate, support, and network with university personnel. Encourage researchers to apply and participate in the NSF I-Corps program to develop their entrepreneurial skills and evaluate the commercial potential of their innovation.
- Adjust university incentives including tenure policies, to encourage faculty to disclose inventions and to conduct applied and collaborative research with industry. Faculty successes in inventing and commercializing innovations should be considered in promotion and tenure decisions.
- Partner with industry to conduct research, development and testing potential solutions to real-world problems. Universities need flexible intellectual property practices to work collaboratively with industry and effectively commercialize inventions. Flexibility is essential to effectively manage and commercialize inventions with startup and well-established companies. This flexibility includes collaborative research agreements, licensing agreements and other collaborations.

RESOURCES AND ASSETS

South Dakota universities have innovative faculty, researchers and students that serve as a cornerstone of the state's knowledge economy. University faculty and researchers have started numerous successful technology-based companies and collaborate with South Dakota industry partners.

Some of the spinoff companies include:

- Alumend
- VRC Metal Systems
- Secure Markings
- Novum Nano
- Prairie Aquatech
- Medgene

Industry partners include:

- Raven Industries
- Sanford Research
- Avera Research Institute
- SAB Biotherapeutics

key metrics

Data on key metrics collected in 2021 will serve as a baseline and this data will be updated annually. The information will be available on the South Dakota EPSCoR website, and the REACH Committee will do a review of the strategic plan every two years. Key metrics on the three drivers of the plan — ideas, talent, and companies — used to evaluate success are included in the following tables.

Ideas = the ability and capacity to generate new ideas and transform them into value in the marketplace.

TABLE 1: RESEARCH ACTIVITIES

Table 1 shows the Board of Regent university and private sector research and patent activities information between the years 2012 and 2021.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
BOR Grant & Contract Expenditures (in Millions)	\$111.7	\$96.8	\$83.7	\$83.4	\$89.9	\$94.6	\$97.7	\$104.7	\$91.4	\$81.8
BOR Disclosures	73	64	63	56	52	73	44	38	39	34
BOR Patents Filed	23	37	34	30	39	25	26	17	17	21
BOR Patents Issued	2	1	7	9	9	11	14	7	16	9
License Agreements	3	15	19	16	13	9	12	5	6	5
Private Sector Research	\$112	\$164	\$135	\$139	\$151	\$199	\$201	\$194	N/A	N/A
SD Patents Issued	129	136	128	128	156	151	157	172	165	N/A

SOURCES OF DATA

South Dakota Board of Regents Fact Book

https://www.sdbor.edu/mediapubs/factbook/Documents/FY21_FactBook.pdf

Private Sector

<https://www.nsf.gov/statistics/states/interactive/show.cfm?stateID=53,43&year=0>

Patents

https://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.htm

Grant and Contract Expenditure data include external funding from federal, state and private sector source expenditures.

The 2012 and 2013 data reflects some of the federal stimulus funding. COVID-19 impacted 2020 and 2021 expenditures. From 2014 through 2019 academic and private sector research expenditures steadily grew, as did the number of patents issued in South Dakota. During this period several of the patents and innovations were commercialized by start-up companies such as Prairie Aquatech, Medgene, VRC Metals and Nanopareil.

**TABLE 2: R&D EXPENDITURES AT SD HIGHER EDUCATION INSTITUTIONS
FY 2020 (IN THOUSANDS)**

Institution	All R&D	Federal	State	Institution	Business	Nonprofit	Other
SDSU	\$60.9	\$22.5	\$16.5	\$3.1	\$1.9	\$3.8	\$13.1
USD	\$29.3	\$13.0	\$1.7	\$13.9	\$0.0	\$0.7	\$0.0
SDSMT	\$14.5	\$10.7	\$1.2	\$1.6	\$0.7	\$0.01	\$0.3
DSU	\$4.4	\$4.0	\$0.03	\$0.2	\$0.2	\$0.01	\$0.0
BHSU	\$1.5	\$1.3	\$0.1	\$0.1	\$0.0	\$0.0	\$0.0
NSU	\$0.2	\$0.1	\$0.07	\$0.07	\$0.0	\$0.0	\$0.0
BOR	\$111.0	\$51.6	\$19.5	\$19.0	\$2.8	\$4.6	\$13.4
OLC	\$0.5	\$0.5	-	\$0.01	-	-	-
Augustana	\$1.0	\$1.0	-	\$0.06	-	-	-
Total	\$112.0	\$53.1	\$19.5	\$19.1	\$2.8	\$4.6	\$13.4

SOURCES OF DATA

National Center for Science and Engineering Statistics | NSF 22-311

<https://nces.nsf.gov/pubs/nsf22311/assets/data-tables/tables/nsf22311-tab005.pdf>

**TABLE 3: R&D EXPENDITURES AT HIGHER EDUCATION INSTITUTIONS
FY 2013-2020 (IN THOUSANDS)**

Institution	2013	2014	2015	2016	2017	2018	2019	2020
SDSU	\$63.8	\$58.3	\$58.4	\$60.7	\$63.4	\$63.5	\$66.8	\$60.9
USD	\$33.2	\$30.7	\$25.7	\$25.9	\$28.4	\$30.4	\$32.0	\$29.3
SDSMT	\$12.2	\$10.5	\$15.0	\$15.4	\$15.5	\$15.1	\$13.0	\$14.5
DSU	\$1.6	\$1.4	\$1.2	\$2.2	\$2.3	\$3.6	\$3.7	\$4.4
BHSU	\$3.1	\$2.4	\$2.4	\$2.8	\$2.1	\$1.6	\$2.0	\$1.5
NSU	-	-	-	-	-	-	-	\$0.2
Total	\$113.8	\$103.4	\$102.6	\$106.9	\$111.7	\$114.7	\$117.5	\$110.9

SOURCES OF DATA

Higher Education R&D Expenditures Ranked by FY 2020 R&D Expenditures: FYs2010-2020

<https://nces.nsf.gov/pubs/nsf22311/assets/data-tables/tables/nsf22311-tab020.pdf>

R&D Expenditures include institutional expenditures supporting research including new faculty start-up packages, institutional research competitions and other expenditures supporting research from institutional funds.

Talent = producing, nurturing and attracting talent to generate new and valuable ideas and start and grow the companies.

TABLE 4: TRIBAL COLLEGES

Table 4 shows the 2019-2020 student information for three Tribal Colleges in South Dakota: Oglala Lakota College (Kyle), Sinte Gleska University (Mission), and Sisseton Wahpeton College (Sisseton).

Tribal College	Location	Undergrad Enrollment	Graduate Enrollment	Associates Degree	Bachelor Degree	Master Degree	Percent Native American
Oglala Lakota College	Kyle	1,222	29	107	64	3	96%
Sinte Gleska University	Mission	375	63	46	27	11	94%
Sisseton Wahpeton College	Sisseton	125	0	16 (8 Certificates)	N/A	N/A	90%

SOURCES OF DATA

National Center for Education Statistics
<https://nces.ed.gov/collegenavigator/?s=SD>

TABLE 5: SOUTH DAKOTA GRADUATES (2019-2020)

Table 5 shows all South Dakota graduates in academic year 2019 - 2020.

Institution	All Degrees			
	Certificate	Associate	Bachelor	Graduate
Black Hills State University	49	42	406	67
Dakota State University	21	52	351	123
Northern State University	17	18	251	66
South Dakota School of Mines & Technology	24	3	417	101
South Dakota State University	47	87	1933	544
University of South Dakota	48	27	1313	818
Board of Regents Universities Total	206	229	4671	1719
Augustana University	0	0	400	160
Dakota Wesleyan University	0	1	171	27
Mount Marty University	5	17	111	59
Presentation College	0	10	154	7
University of Sioux Falls	0	5	330	163
Private Universities Total	5	33	1166	416
Oglala Lakota College	16	107	64	3
Sinte Gleska University	8	46	27	11
Sisseton Wahpeton College	8	16	0	0
Tribal Colleges Total	32	169	91	14
Mitchell Technical College	147	308	0	0
Lake Area Technical College	237	595	0	0
Southeast Technical College	332	614	0	0
Western Dakota Technical College	207	202	0	0
Technical College Total	923	1719	0	0
Total Graduates	1166	2150	5928	2149

SOURCES OF DATA

National Center for Education Statistics

<https://nces.ed.gov/collegenavigator/?s=SD>

TABLE 6: SOUTH DAKOTA STEM DEGREES (2019-2020)

Table 6 shows all South Dakota graduates with STEM degrees in academic year 2019 - 2020.

Institution	STEM Degrees		
	Associate	Bachelor	Graduate
Black Hills State University	14	74	3
Dakota State University	36	234	104
Northern State University	6	54	0
South Dakota School of Mines & Technology	3	417	101
South Dakota State University	23	1346	429
University of South Dakota	0	661	367
Board of Regents Universities Total	82	2786	1004
Augustana University	0	132	10
Dakota Wesleyan University	0	90	0
Mount Marty University	8	41	52
Presentation College	9	116	7
University of Sioux Falls	4	147	0
Private Universities Total	21	526	69
Oglala Lakota College	12	6	0
Sinte Gleska University	4	9	3
Sisseton Wahpeton College	3	4	0
Tribal Colleges Total	19	19	3
Mitchell Technical College	59	0	0
Lake Area Technical College	159	0	0
Southeast Technical College	293	0	0
Western Dakota Technical College	85	0	0
Technical College Total	596	0	0
Total Graduates	718	3331	1076

SOURCES OF DATA

National Center for Education Statistics

<https://nces.ed.gov/collegenavigator/?s=SD>

TABLE 7: SOUTH DAKOTA EDUCATION DEGREES (2019-2020)

Table 7 shows all South Dakota graduates with Education degrees in academic year 2019 -2020.

Institution	Education	
	Bachelor	Graduate
Black Hills State University	80	42
Dakota State University	54	16
Northern State University	81	50
South Dakota School of Mines & Technology	0	0
South Dakota State University	119	51
University of South Dakota	121	155
Board of Regents Universities Total	455	314
Augustana University	25	128
Dakota Wesleyan University	22	13
Mount Marty University	21	7
Presentation College	0	0
University of Sioux Falls	33	72
Private Universities Total	101	220
Oglala Lakota College	16	1
Sinte Gleska University	4	8
Sisseton Wahpeton College	0	0
Tribal Colleges Total	20	9
Mitchell Technical College	0	0
Lake Area Technical College	0	0
Southeast Technical College	0	0
Western Dakota Technical College	0	0
Technical College Total	0	0
Total Graduates	576	543

SOURCES OF DATA

National Center for Education Statistics

<https://nces.ed.gov/collegenavigator/?s=SD>

TABLE 8: SOUTH DAKOTA GRADUATE RACE AND ETHNICITY (2019-2020)

Table 8 shows South Dakota graduates' race and ethnicity in academic year 2019 - 2020.

Institution	White	Native American	Black	Hispanic	Other
Board of Regents Universities					
Black Hills State University	82%	3%	1%	5%	9%
Dakota State University	83%	1%	3%	4%	9%
Northern State University	85%	2%	2%	3%	8%
South Dakota School of Mines & Technology	83%	1%	1%	5%	10%
South Dakota State University	87%	1%	2%	3%	7%
University of South Dakota	83%	1%	3%	4%	9%
Board of Regents Universities Total	83%	1.4%	2.2%	3.4%	10%
Private Universities					
Augustana University	85%	1%	3%	0%	11%
Dakota Wesleyan University	85%	2%	2%	7%	4%
Mount Marty University	77%	3%	6%	7%	7%
Presentation College	66%	3%	11%	10%	10%
University of Sioux Falls	83%	1%	4%	2%	10%
Tribal Colleges					
Oglala Lakota College	3%	96%	0%	1%	0%
Sinte Gleska University	6%	94%	0%	0%	0%
Sisseton Wahpeton College	6%	90%	4%	1%	0%
Technical Colleges					
Mitchell Technical College	88%	3%	1%	4%	4%
Lake Area Technical College	89%	3%	1%	2%	5%
Southeast Technical College	82%	3%	5%	4%	6%
Western Dakota Technical College	77%	7%	2%	5%	9%

SOURCES OF DATA

South Dakota Board of Regents Fact Book

https://www.sdbor.edu/mediapubs/factbook/Documents/FY21_FactBook.pdf

National Center for Education Statistics

<https://nces.ed.gov/collegenavigator/?s=SD>

TABLE 9: TARGET INDUSTRY SECTOR EMPLOYMENT GROWTH

Table 9 shows employment and graduate data from SD BOR institutions from the five key target industry sectors: agriculture, energy and environment, manufacturing, human health, and IT and cybersecurity.

Sector	Employment 2011	Employment 2021	Projection 2025	Graduates 2012	Graduates 2021	2020 National Average Earnings Per Job
Agriculture	50,280	59,718	61,240	229	352	\$47,061
Energy & Environment	19,626	21,257	21,758	500	453	\$87,390
Manufacturing	16,645	18,870	18,953	499	662	\$84,050
Human Health	24,935	32,407	34,293	890	1,624	\$98,329
IT/Cybersecurity	12,223	15,913	17,572	159	446	\$129,199

Agriculture, including animal science and ag and related sciences, demonstrated growth.

Energy and environment, including biological and biomedical sciences, natural resources and conservation, atmospheric and environmental studies, biochemistry, physics, plant science, and wildlife and fisheries science, has also demonstrated growth.

Manufacturing, including general engineering technology, engineering, physical sciences, transportation and materials moving, engineering-related fields, chemical and biological engineering, civil and environmental engineering, electrical engineering, geological engineering, geospatial science and engineering, and materials chemistry and engineering, grew in employment.

In South Dakota the **human health** sector, including health and related professions, basic biomedical sciences, biomedical engineering, nursing, nutrition, exercise and food science, pharmaceutical sciences, pharmacy, physicians, audiology, occupational therapy, physical therapy, and medicine, grew in employment.

The **IT and cybersecurity** sector, including CIS and support services, cyber operations, and information systems, grew in employment.

SOURCES OF DATA

South Dakota Board of Regents Fact Book

https://www.sdbor.edu/mediapubs/factbook/Documents/FY21_FactBook.pdf

South Dakota Board of Regents Dashboards

<https://www.sdbor.edu/dashboards/Pages/default.aspx>

U.S. Department of Commerce; Bureau of Economic Analysis

<https://apps.bea.gov/itable/itable.cfm>

Companies = the innovation implementation vehicle where the new ideas, the new value and the talent come together.

TABLE 10: ECONOMIC DEVELOPMENT

Table 10 shows SBIR information for South Dakota between the years 2012 and 2020.

	2012	2013	2014	2015	2016	2017	2018	2019	2020
SBIR Submissions	40	32	32	26	24	18	26	13	38
SBIR Awards	5	5	7	8	3	8	8	18	18
SBIR Award Amount	\$1.22 M	\$1.06 M	\$1.96 M	\$2.65 M	\$1.41 M	\$3.00 M	\$3.92 M	\$7.69 M	\$6.80 M

SOURCES OF DATA

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (SBTT)

<https://www.sbir.gov>

TABLE 11: TARGET INDUSTRY SECTOR EMPLOYMENT GROWTH

Table 11 shows the target industry sector employment growth for the years 2011, 2021, and 2025, as well as the 2020 national earning average for each sector.

Sector	2011	2021	Projection 2025	2020 National Average Earnings Per Job
Agriculture	50,280	59,718	61,240	\$47,061
Energy & Environment	19,626	21,257	21,758	\$87,390
Manufacturing	16,645	18,870	18,953	\$84,050
Human Health	24,935	32,407	34,293	\$98,329
IT/Cybersecurity	12,223	15,913	17,572	\$129,199
All Sectors	568,061	606,172	633,473	
GDP	\$43,649	\$61,167		

SOURCES OF DATA

U.S. Department of Commerce; Bureau of Economic Analysis

<https://apps.bea.gov/itable/itable.cfm>



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