South Dakota Science and Infrastructure Plan

South Dakota EPSCoR Research Symposium

July 31, 2024

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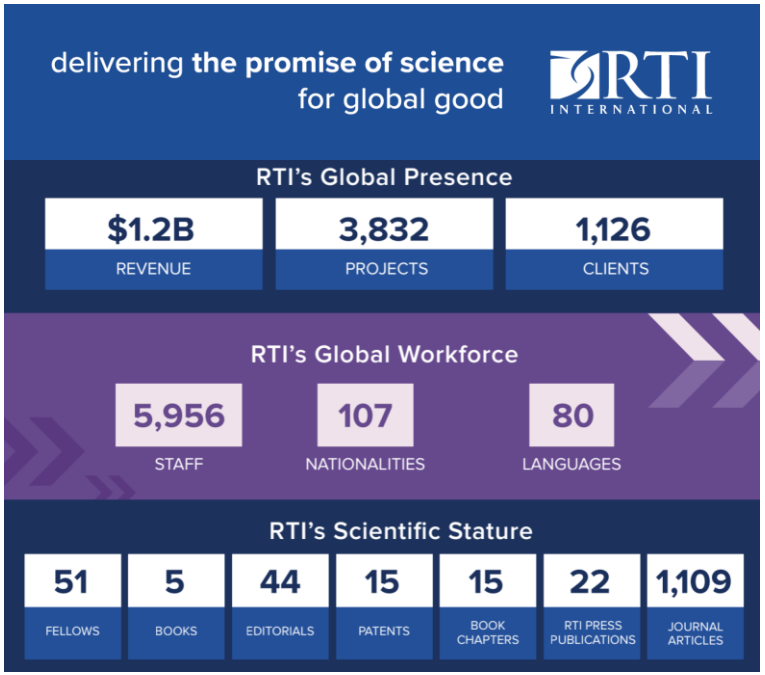
RTI INTERNATIONAL

Who is RTI International?



Center for Applied Economics & Strategy

Research, analysis, benchmarking, and evaluation at the intersection of science and technology, innovation, the economy, and society.

Some of our clients

NCSES

NIH SEED Helping Innovators Turn Discovery Into Health

SC EPSCoR

KY EPSCoR Research Innovation Education
Advancing Research, Innovation and STEM Education in Kentucky

STaR Division Science, Technology & Research

RTI Team

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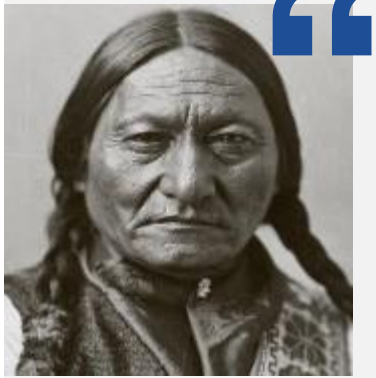
Note: Blue box indicates team members who are subject matter experts on federal research funding agencies.

South Dakota Science Plan Objectives

1. **Update State S&T Plan:** Develop a vision and strategy for strengthening S&T areas that increase South Dakota competitiveness in:
   - STEM education and workforce
   - Research competitiveness
   - Commercialization and innovation
   - High-tech industry growth
2. **Develop institutional S&T plans:** Explore how institutional research objectives can contribute to and benefit from South Dakota's broader S&T strategy.
3. **Advise the Board of Regents** on how it can better target state investments to support federally supported research growth.

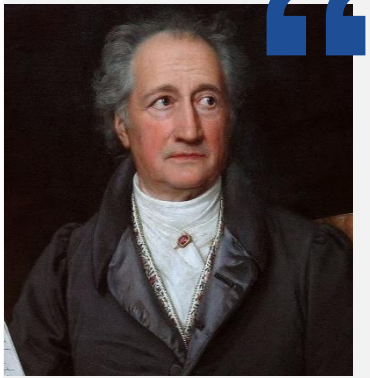
The Vision

What type of economic opportunities will South Dakota leave for the next generation?



Let us put our minds together and see what life we can make for our children.”

– CHIEF SITTING BULL



Whatever you can do or dream you can do, begin it. Boldness has genius and magic and power in it. Begin it now.”

— JOHANN WOLFGANG VON GOETHE

Current S&T Plan Vision

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

"South Dakota needs to think bigger. What is the vision and how do we move towards it? This will require us to be more targeted and specific."

Today, let’s discuss vision and goals

And share preliminary findings from phase 1 of the study

HIGH-TECH INDUSTRY GROWTH

RESEARCH COMPETITIVENESS

STEM EDUCATION

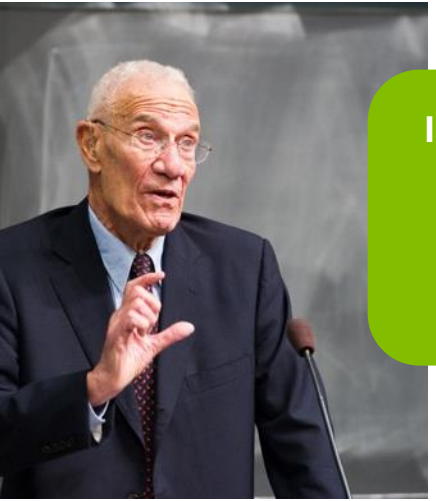
COMMERCIALI-ZATION AND INNOVATION

How can South Dakota build and attract more high-tech industry?

In which areas does South Dakota have world-class research or competitive strengths?

How can South Dakota STEM produce critical thinkers and communicators with applied experiences?

What factors generate durable economic growth?



Increase in factors of production—i.e., labor, industrial capital, raw materials

But also, advances that lead to new or improved goods and services that increase sales

New processes, business models, etc., that enhance productivity and lower costs

- Both impact corporate growth and competitiveness
- 7/8 of economic growth explained by technical change (Solow)

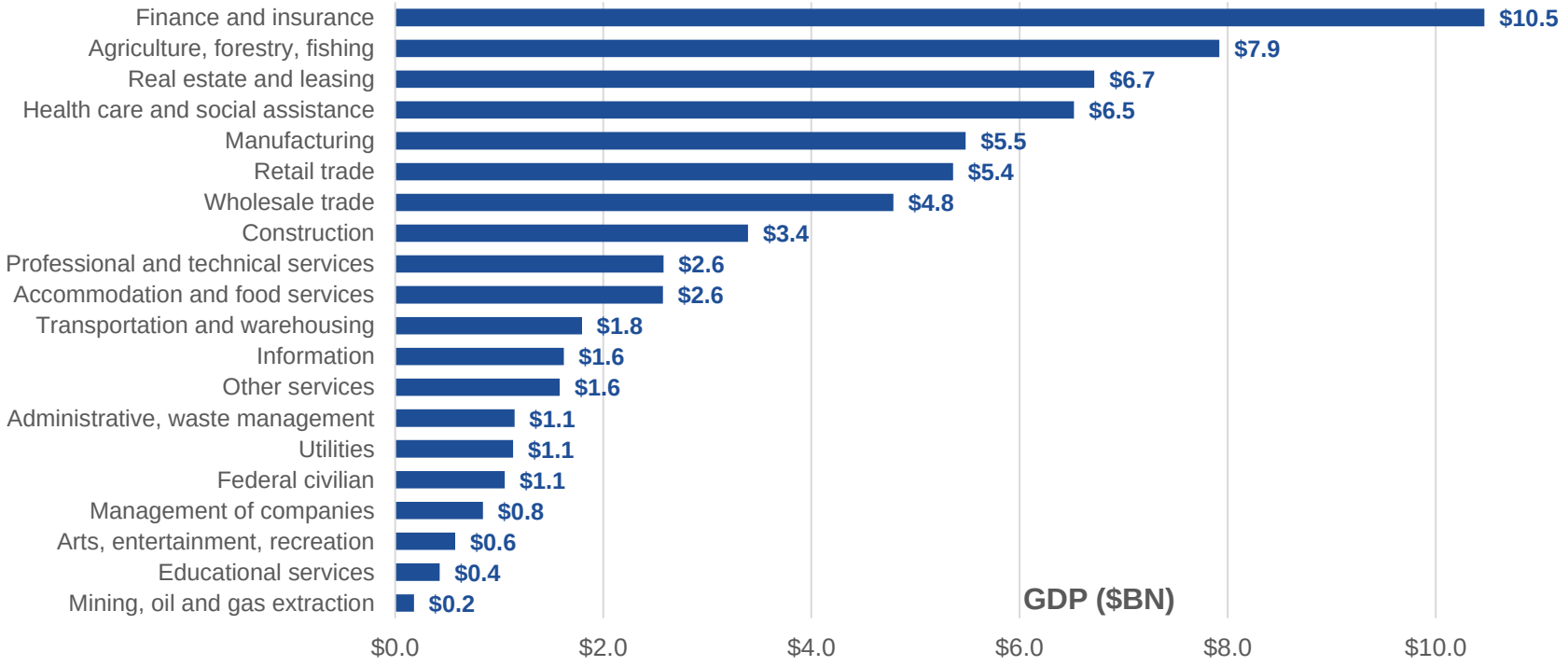
Source: Solow, R. M. (1959). Investment and Technical Progress.

What is the current state?

Some of South Dakota's largest industries by GDP…

Finance, Agriculture, Real Estate, Health Care, Manufacturing

Figure 1. South Dakota GDP by Industry, 2023

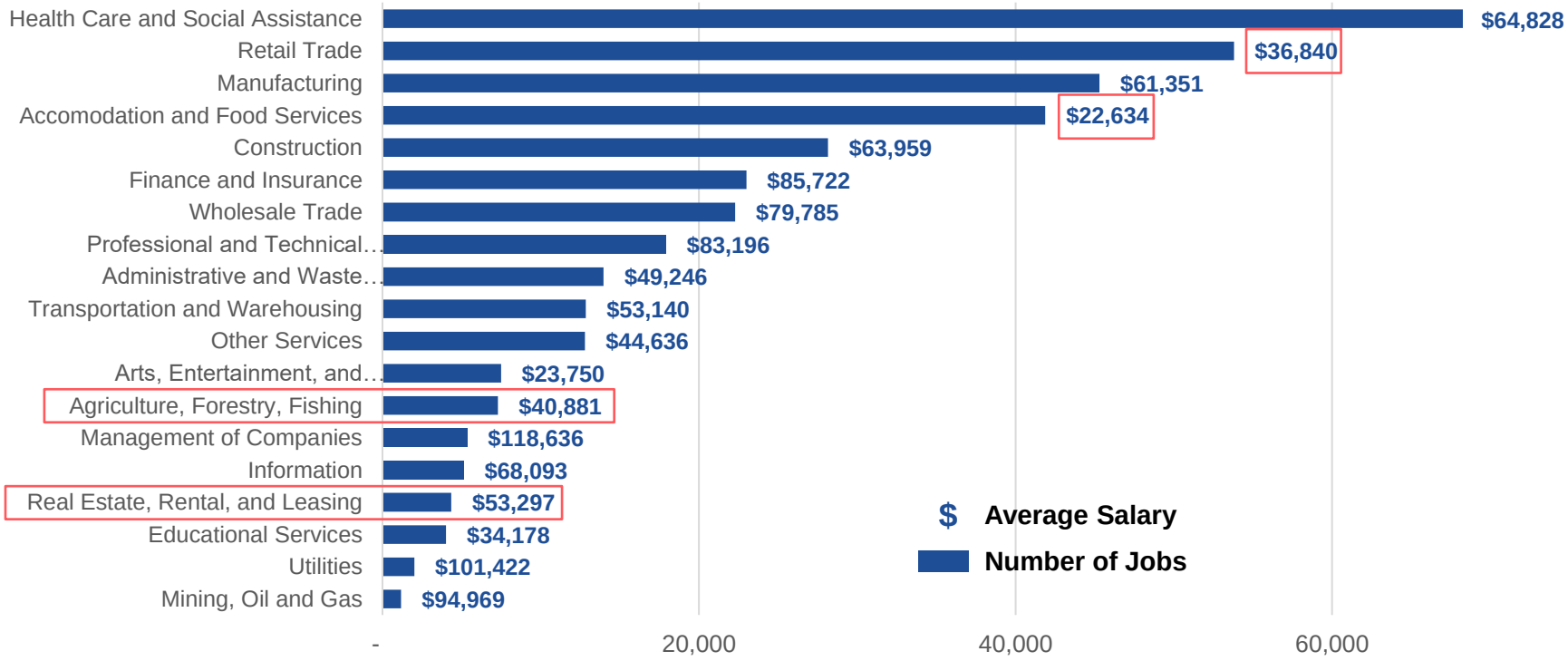


Source: U.S. Bureau of Economic Analysis

Have lower employment, because of technological advances

Some of the largest employer industries have low average salaries

Figure 2. South Dakota Industry by Employment and Average Salary, 2023

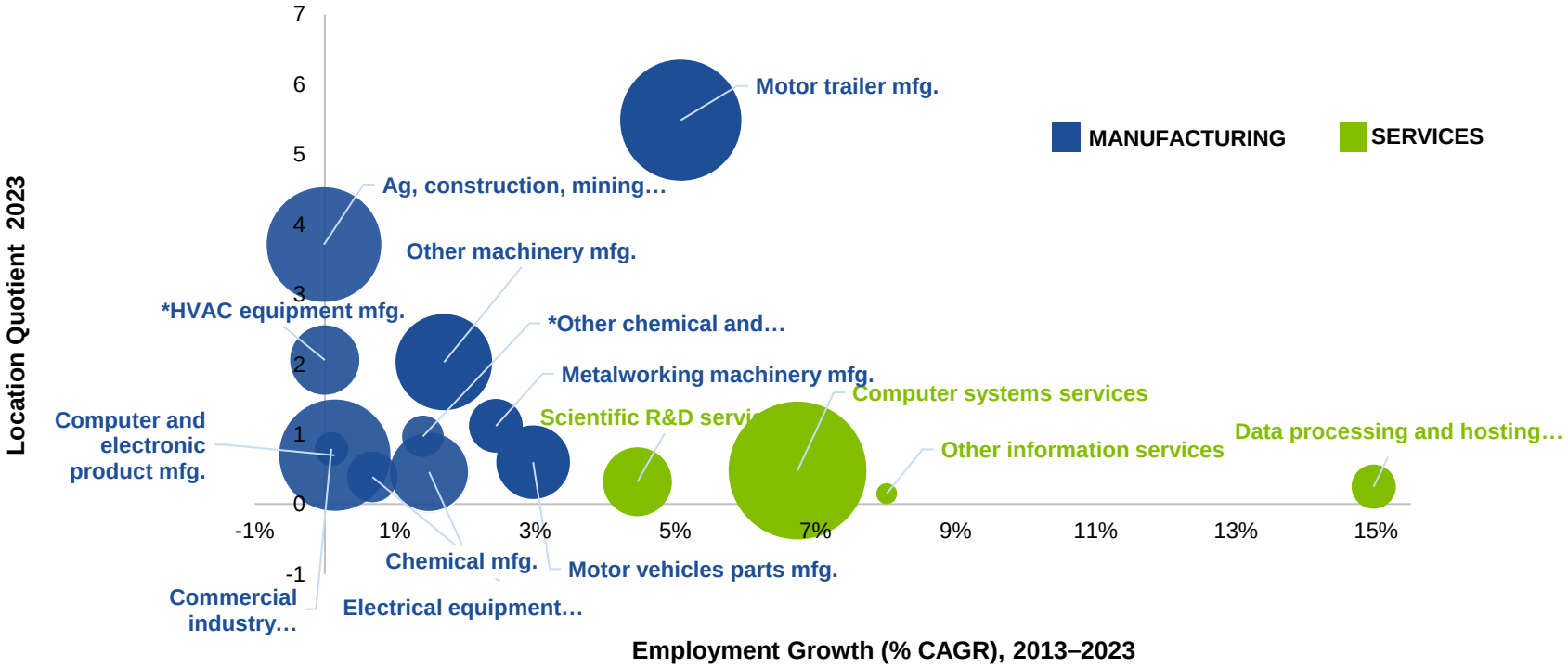


Source: U.S. Bureau of Labor Statistics Quarterly Census for Employment and Wages

South Dakota R&D-intensive industries are adding jobs

High-tech services are growing faster than manufacturing

Figure 3. South Dakota Specialization (Location Quotient) and Compound Annual Growth in High-Tech Manufacturing and Service Industries, 2013–2023

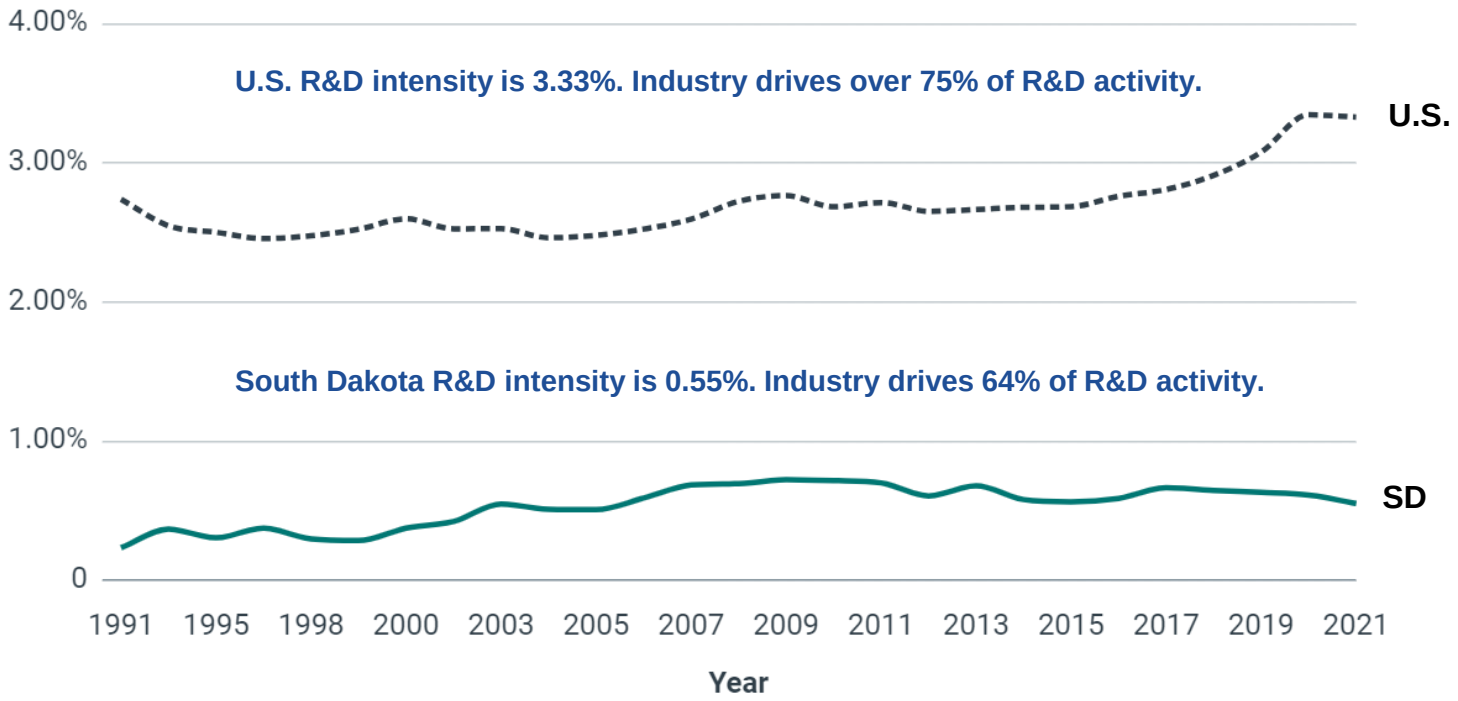


Source: RTI analysis of U.S. Bureau of Labor Statistics, Quarterly Census for Employment and Wages

What is the role of private and public R&D in economic growth?

Industrialized economies have R&D intensities of 2.73%.

Figure 4. South Dakota and U.S. Gross Expenditures on R&D as a Share of GDP, 2021



Source: National Center for Science and Engineering Statistics, State S&E Indicators

R&D-driven companies in South Dakota include

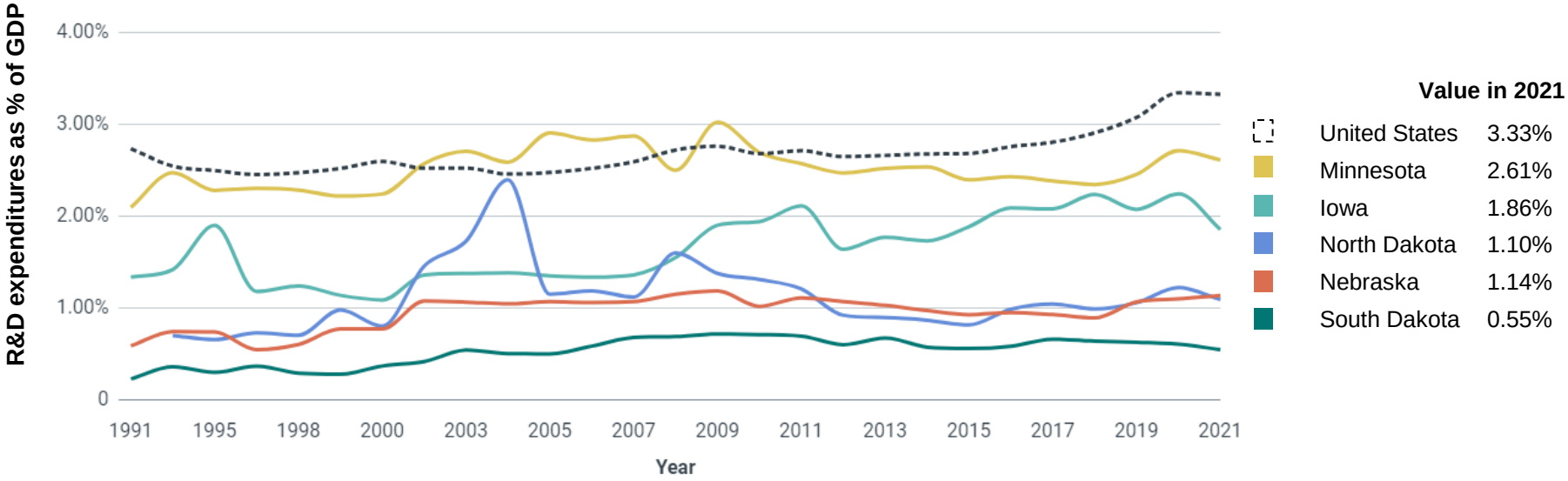
Both manufacturers and service providers

Source: South Dakota Office of Economic Development

South Dakota R&D intensity lags its neighbors.

Leaders are Minnesota, then Iowa, followed by Nebraska and North Dakota

Figure 5. Comparison of U.S., South Dakota, and Select Neighboring State Gross Expenditures on R&D as a Share of GDP, 2021



Source: National Center for Science and Engineering Statistics, State S&E Indicators

Industry R&D growth is key to durable economic growth, but university R&D is also an economic driver.

PRIVATE SECTOR

Reason to invest

- Better quality, better design of existing products
- Improvements to production processes that lower cost
- Stronger customer engagement and delivery systems
- Entirely new products and services

Desired outcomes

- Stay cost competitive
- Reinforce brand
- Retain market share
- New products and services that lead to new business line revenue and market share

UNIVERSITIES

Reason to invest

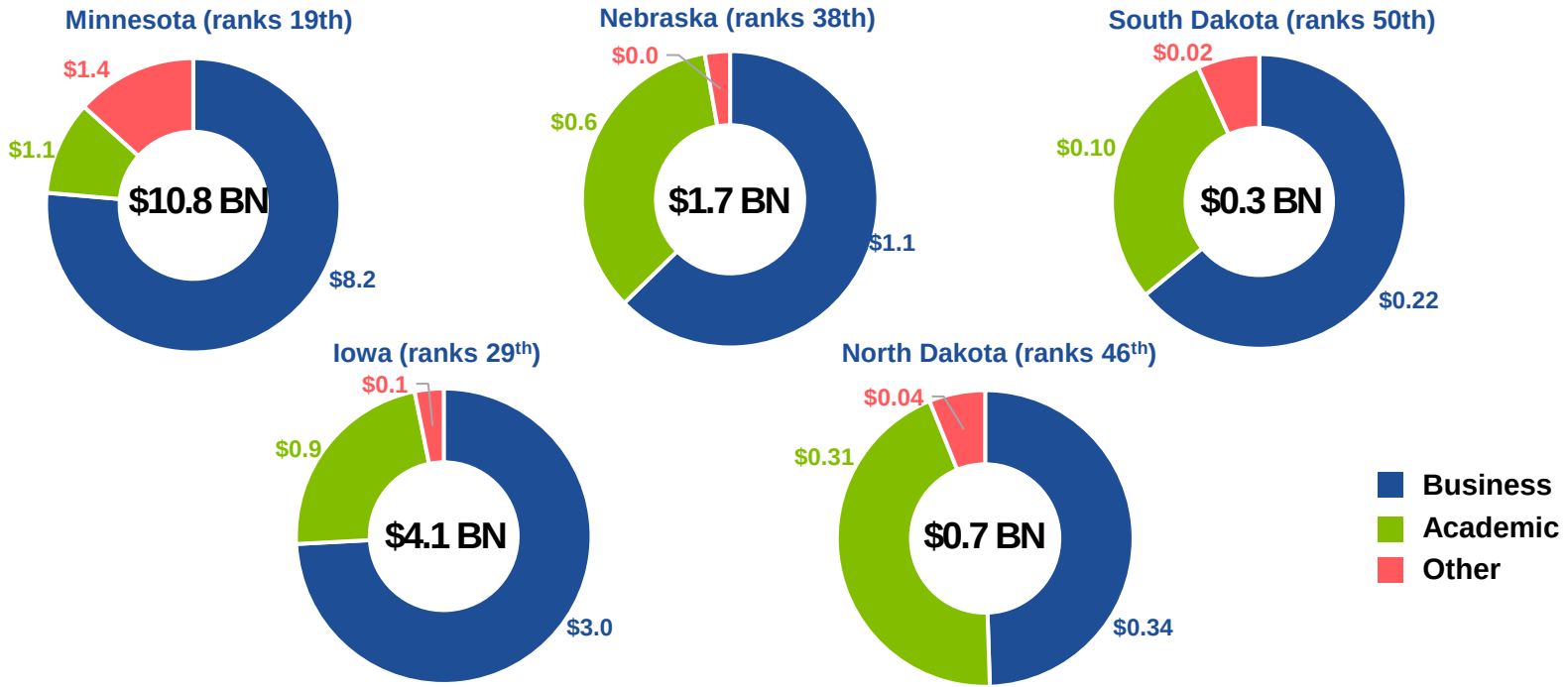
- Provide applied research experiences for undergrads
- Provide financial support for graduate students, faculty, research staff, administrative staff
- Increase size of research program
- Attract graduate students and faculty
- Attract industry partners

Desired outcomes

- STEM graduates with stronger critical thinking skills
- Growth in federally funded research programs
- Increased research stature
- More industry partnerships
- Increased potential for licensing and commercialization

Different states have different business R&D-to-academic R&D ratios, but the total amounts matter.

Figure 6. Comparison of South Dakota and Select Neighboring State Gross Expenditures on R&D ($ BN), 2021



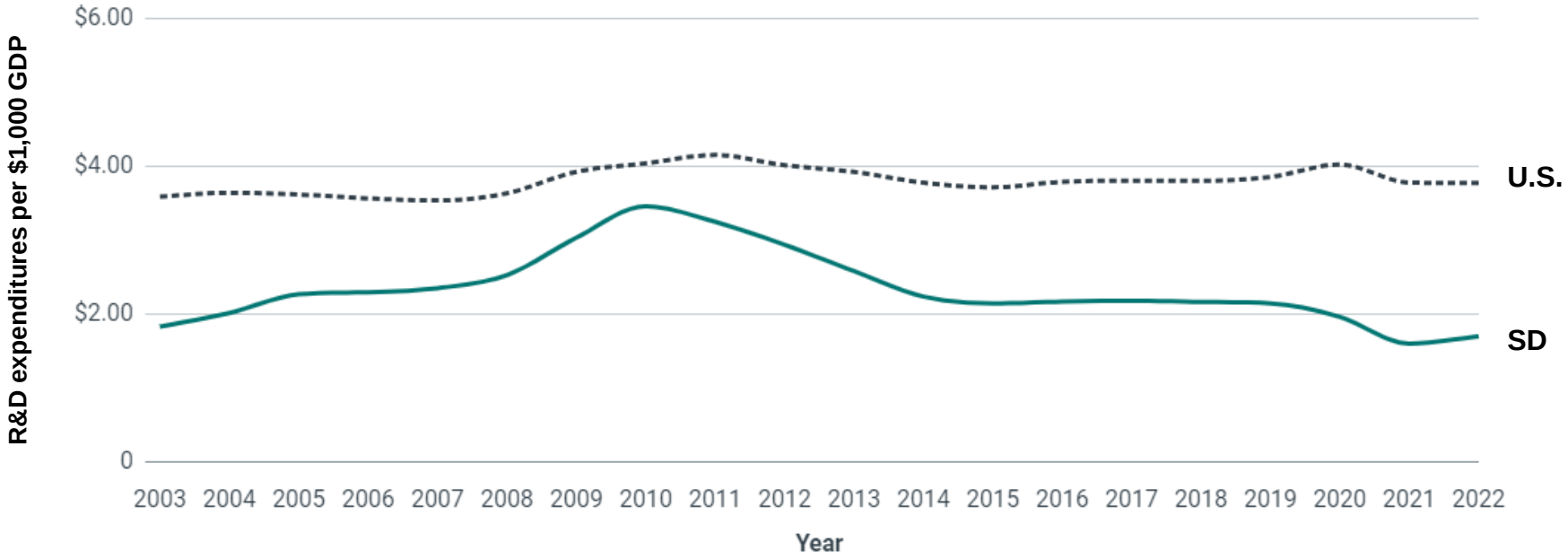
Source: National Center for Science and Engineering Statistics, State S&E Indicators

Preliminary findings for expanding South Dakota federally funded research

First phase of study focused on role of university research

South Dakota academic R&D expenditures have not kept pace with GDP growth

Figure 7. U.S. and South Dakota Academic R&D Expenditures per $1,000 of GDP, 2022



Source: National Center for Science and Engineering Statistics, State S&E Indicators

Four types of federal research programs

Scholarships and Fellowships

- NSF S-STEM
- DOE TRIO
- NSF Cyber Corps Service
- DOD Cybersecurity
- NASA Fellows
- NSF NRT

01

Programmatic

- NSF REU
- USDA Agricultural Extension
- NSF Tribal Colleges and Universities
- NSF I-Corps

02

Research Capacity Building

- NSF EPSCOR, E-CORE, E-RISE
- NIH INBRE
- NASA EPSCOR

03

Competitive

- NSF CAREER
- NIH COBRE
- NIH R01

04

College and Universities in Study

Board of Regents Universities

- Black Hills State University
- Dakota State University
- Northern State University
- South Dakota State University
- South Dakota School of Mines
- University of South Dakota

Tribal Colleges

- Oglala Lakota College
- Sinte Gileska University
- Sisseton Wahpteon College

Overarching Observations

- All South Dakota primarily undergraduate institutions and tribal colleges are pursuing some combination of scholarships, programmatic, and research capacity-building federal grants.
  - **Intended outcomes:** Improve college access, provide applied research experiences for students, and build research capacity through new hires, research support, and equipment.
- At PUIs, tribal colleges, and larger research universities, STEM departments tend to be the most research active, especially in terms of federal research.
- South Dakota institutions with STEM PhD programs have the highest federal R&D expenditures. They pursue all four types of federal grants.

SWOT for expanding federal research: PUIs

STRENGTHS

- High enrollment in some STEM classes (biology, chemistry, computer science), although lower enrollment as majors
- Undergrad students who want to attend graduate school or professional schools interested in research experiences

WEAKNESSES

- Few faculty with federal research grants
- High teaching loads (3:3, 4:4)
- Small absolute number of STEM faculty compared to other degree fields

OPPORTUNITIES

- Strong interest and expansion of opportunities for EPSCOR states by federal government
- Can be more targeted in research focus
- Can leverage SURF, Sanford Research, industry for research, educational outreach

THREATS

- Competition for students and declining college-going rates

Expanding federal research at Tribal Colleges

- Similar SWOT to South Dakota PUIs in terms of:
  - Small total number of STEM faculty relative to larger BOR institutions
  - Stated goal of some tribal colleges of performing more federal research and creating STEM graduate programs, such as Oglala Lakota College's new Environmental Sciences Master's degree
  - Limited research administration capacity, in addition to small number of faculty and STEM students, presents challenges to scaling up research activity
- One key difference in research focus is tribal college focus on performing research that addresses community needs (use-inspired research)

SWOT for expanding research: Larger research universities

STRENGTHS

- Most faculty supportive of expanding federal research with concomitant investment in infrastructure
- Largest federal funders are NIH, NSF, USDA

WEAKNESSES

- Research strategies not yet fully developed
- Challenges recruiting high-quality graduate students impedes research productivity
- Mix of pre- and post-award operating challenges tiring for faculty

OPPORTUNITIES

- CHIPS and Science Act increases research funding opportunities for EPSCOR states
- State can help promote and elevate SD research
- Can leverage SURF, Sanford Research, industry for research, educational outreach

THREATS

- Pending retirements and recruitment challenges (faculty and students) pose challenge to building competitive research

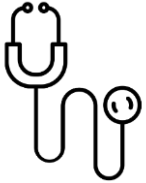
Where should South Dakota focus?

The current S&T Plan points to key industries

that require scientific and technological advances to remain competitive

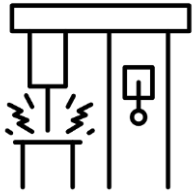
Value-Added Agriculture

Human Health



IT and Cybersecurity

Materials and Advanced Mfg



Energy and Environment

Source: Icon created by various artists from the Noun Project

It also points to research opportunities

- Precision agriculture
- Bioproducts and bioprocessing
- Cybersecurity
- Underground physics
- Earth science observations
- Inflammation, immunology, cancer
- Proteomics, genomics, bioinformatics
- Etc.

Next phase focuses on

South Dakota high-tech industry, workforce, and commercialization

Figure 8. Phase 2 Timeline: 8/01/24–1/31/25

Task		Aug	Sept	Oct	Nov	Dec	Jan.
Phase 2 Project		→	→	→	→	→	→
Task 1	Convene kick-off call	■					
Task 2	Review and analyze data		■				
Task 3	Perform interviews (some in-person)			■			
Task 4	Develop initiatives				■		
Task 5	Develop institutional plans and SD S&T Plan					■	■

However beautiful the strategy, you should occasionally look at the results.

– Winston Churchill

Please reach out!

Provide inputs into the plan

1. If you have questions, comments, or ideas for how your institution or South Dakota can better advance STEM education and research, please contact us.
2. Please join us for a Student Breakout Session from 1-2pm.

Breakout Session: What You Value about Research and STEM Education at Your College

Join RTI researchers Jessica Wilkinson and Jennifer Ozawa in a session to share your insights into what makes a good research and education college experience. The goal of this session is to gather information about how South Dakota can continue to advance STEM research and careers in the state based on what is working well from students' perspectives. This session will provide participants with an opportunity to network with other students and share their experiences.

Thank you!