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THE INNOVATION ECONOMY

How Indiana embraces and fosters an economy where innovation thrives will largely decide its future. Indiana rebounded strongly compared to many states following the COVID-19 pandemic, but the effects of the crisis also laid bare some of the state's economic weaknesses, including the need for greater technological competitiveness. Innovation involves introducing a new product, service, or process into the economy, and technological advancement driven by innovation links to economic prosperity more than ever before. Indiana has fallen behind in its ability to foster innovation and technology, which has limited its productivity.

Major economic and technological shifts raise concerns for the economy in Indiana, including:

- By 2028, nearly 168,000 highly skilled jobs requiring proficiency in science, technology, engineering, and mathematics (STEM) may need to be filled in the state.¹
- Indiana has more jobs susceptible to automation than any other state. A 2021 study estimated that about 900,000 jobs—29% of Indiana's job base—could be lost.²
- Artificial intelligence (AI) presents new challenges and opportunities. Whether AI primarily replaces jobs in Indiana or becomes a tool to complement human work will also have a significant impact on its economy.
- Increased broadband access—including digital connectedness across rural communities—has the potential to improve access to economic opportunity, as long as service provision is reliable throughout the state.

Indiana's traditional economic strengths include industrial clusters in manufacturing, transportation and warehousing, construction, and retail trade. Manufacturing has been and remains a supercluster. The percentage of workers employed in this sector in Indiana is more than two times the national

percentage. However, software development, research and development, engineering, and other advanced knowledge services that drive innovation employ a smaller share of people in Indiana when compared nationally. The state's biosciences cluster composes a large part of Indiana's manufacturing. It contributes significantly to employment in research and development (R&D), engineering, and advanced manufacturing.

Investments in advanced manufacturing and life sciences manufacturing offer strong near-term opportunities to maintain or even increase Indiana's economic performance. In the long term, sustained investments in professional and scientific services must be a priority for the state.

A strong innovation-driven economy needs a highly skilled and versatile technical and entrepreneurial workforce and access to resources and infrastructure. This requires a conducive policy environment that encourages their development. Meeting these challenges necessitates strategies to promote digital adoption; support digital skills and STEM education; improve broadband access; and foster innovation, entrepreneurship, and commercialization of research. Each offers opportunities to strengthen Indiana's economy for future success and to raise the standard of living. Building partnerships between government, educational institutions, businesses, and communities is also crucial for these efforts.

This brief examines how the existing Indiana policy environment addresses challenges and opportunities to strengthen the foundation for innovation and technology across the state.

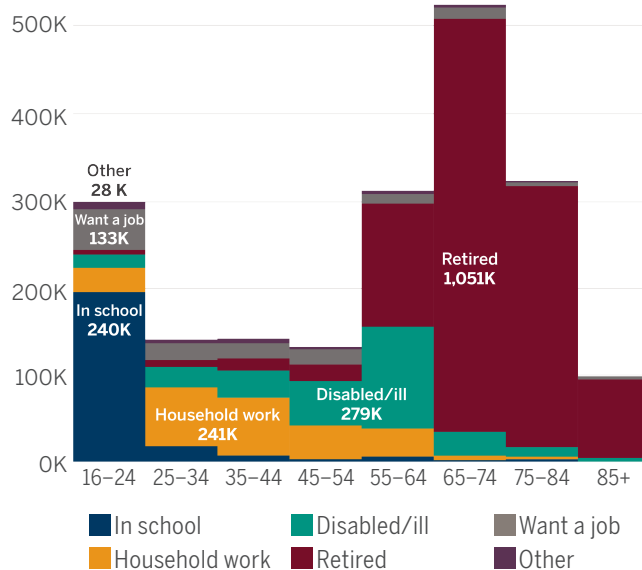
ECONOMIC RECOVERY IN INDIANA SINCE THE COVID-19 PANDEMIC

Indiana's economic downturn during the COVID-19 pandemic was not as dramatic compared to other states. Yet post-pandemic recovery in Indiana has been more anemic than in many other states. A broad range of key indicators point to the same concern: Indiana lags much of the country in economic performance since the pandemic.

In 2023, after adjusting for inflation, gross domestic product (GDP)—the total value of all goods and services made in the U.S.—grew by 6.3%. Indiana, however, experienced only 5.8% growth, ranking 39th among all states. The slower growth suggests that Indiana's average GDP per person of \$58,505—below the U.S. average of \$66,814—will rise less in the future compared to other states. This slower growth will result in a continued relative decline in Hoosiers' future incomes and living standards. However, the slower GDP growth rate in Indiana has not increased unemployment. The April 2024 unemployment rate in Indiana was 3.6%—higher than 30 of the 50 states and less than the national rate of 3.9%. Unemployment is not the paramount problem confronting Hoosiers, both historically and relative to the rest of the nation.

On the other hand, Indiana's labor force participation rate—the share of the population involved or intending to be involved in economic activity—is more concerning. Indiana's labor force participation has fallen consistently over the past two decades. In 2000, it was 69%, compared to 67% nationally. By April 2023, Indiana's labor force participation rate had fallen to 63%, similar to the national rate. Lower labor force participation in Indiana can be attributed primarily to the “aging out” of retirees from Indiana's workforce (Figure 1).

FIGURE 1. Hoosiers not in the labor force



Source: STATS Indiana and the Indiana Department of Workforce Development <https://www.hoosierdata.in.gov/infographics/labor-force-nonparticipants.asp>

Incomes in Indiana have been among the most stagnant in the country. The average Indiana annual income in 2023 was \$57,304, reflecting an increase of 2% from the previous year. Despite this, the average income in the state fell considerably below the national average of \$63,442. Personal incomes beyond Indiana borders were nearly 9% greater. Income includes many possible sources but is primarily comprised of salaries and wages. Between 2013 and 2023, Indiana workers' average wages for all occupations, as a percentage of national averages, have lost ground, moving from 88% of the national average to 86%.³

Labor productivity provides the basis for higher wages and wage growth, and a more productive workforce adds value to the economy. Indiana's annual labor productivity growth from 2007 to 2023 was among the slowest in the country. This suggests that, although workers in Indiana are employed at high rates, they work predominantly in companies and industries experiencing only low increases in productivity.

BUILDING A STRONG INNOVATION ECONOMY IN INDIANA

Building a strong innovation economy paves the way for stronger incomes, wages, and standard of living for Hoosiers. Although investments in knowledge, research, and science have been adequate, translating and commercializing these investments into innovation and technology is lagging. Tepid growth in incomes and wages suggests efforts to convert research and scientific knowledge into innovation and technology could be bolstered. Taking full advantage of this knowledge presents a challenge and an opportunity for Indiana to reach its economic potential.

Indiana’s leaders must address several gaps in the state’s economy to build a strong environment for innovation and technology. Gaps arise when education, research, and related infrastructure investments are either underdeveloped or missing in regions where opportunities exist to create and grow innovative firms and industries. Key targets for the Indiana innovation economy include:

- 1. Developing and maintaining a ready workforce
- 2. Improving readiness for automation and AI
- 3. Creating a conducive environment for entrepreneurship and early business growth
- 4. Improving knowledge creation and technology transfer for industry
- 5. Improving financing for the innovation ecosystem
- 6. Balancing existing industry strengths with new industry expansion

Business leaders and policy makers already understand the barriers facing the state’s innovation economy. However, finding solutions and the resources to close them can be difficult. For example, education provides the foundation for workforce development. Developing the skills and knowledge needed to find and keep a job usually requires advanced training or schooling beyond high school. Yet Hoosiers have a relatively low overall education attainment level, narrowing the scope of achievable workforce development goals. In addition to improving education attainment, policy makers must address how to grow Indiana’s skilled workforce. Having more highly skilled workers would strengthen the state’s overall innovation capacity. Such a workforce would foster knowledge creation and technology transfer and improve the use of advanced automation tools and processes.

1. DEVELOPING AND MAINTAINING A READY WORKFORCE

The innovation economy relies on knowledge resulting from education, skills, and human capital. Indiana lags the rest of the country in terms of educational attainment (Table 1). Less than one-fifth of Hoosiers have completed a bachelor’s degree, while nationally nearly 22% have graduated college. The gap between national and state trends in graduate education is even more striking. Only 1 in 10 Hoosiers have earned a graduate degree, compared to 15% for the country. In terms of this crucial measure of human capital, Indiana ranks 41st for an undergraduate degree and 43rd for a graduate degree.

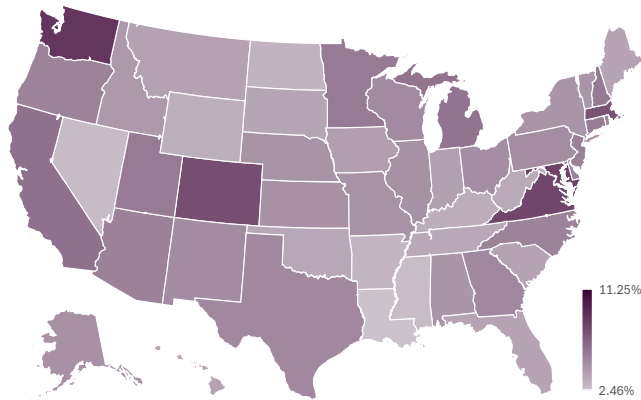
TABLE 1. Educational attainment in Indiana

EDUCATIONAL ATTAINMENT	PERCENT OF POPULATION 25 AND OLDER	
	INDIANA	UNITED STATES
Less than 9th grade	4%	5%
9th to 12th, no diploma	6%	6%
High school graduate or equivalent	32%	26%
Some college, no degree	19%	19%
Associate degree	9%	9%
Bachelor’s degree	19%	22%
Graduate degree or higher	11%	14%

Source: StatsAmerica, U.S. Economic Development Administration <https://www.statsamerica.org/sip/Education.aspx?page=all>

A workforce equipped with skills in engineering and science fuels innovation. Indiana is among the states with the strongest workforces equipped with these skills in science, technology, engineering, and mathematics (STEM). Science and technology workers without a college degree (STWs) combined with STEM workers accounted for 24.4% of the Indiana workforce in 2019, compared to 23.2% nationally. The share of STWs was even higher in the Indiana workforce compared to the rest of the country—15.7% compared to 12.8% respectively. However, only 8.7% of the Indiana workers had STEM college degrees, falling below the national figure of 10.4%.

FIGURE 2. Individuals in science and engineering occupations as a percentage of all occupations



Source: National Center for Science and Engineering Statistics
<https://nces.nsf.gov/indicators/states/indicator/se-occupations-to-all-occupations>

A majority of jobs in the state (58%) require skills training between the two- to four-year degree level (also called middle-skill jobs). However, only about 47% of workers can fulfill these jobs.⁴ Targeting this level of training to close this skill gap represents a workforce development opportunity that is both wide in potential application and relatively quick in payoff. These middle-skill jobs include the trades as well as occupations with specializations related to information technology, robotics and automation, advanced manufacturing, healthcare, and education, among others.

Training programs, like those community colleges offer, can prepare the workforce for these occupations. Additionally, students complete these programs relatively quickly to help satisfy the demand for technological skills. For example, students studying advanced manufacturing, engineering, and applied science at Ivy Tech Community College in the “Flexlab”—a shared space outfitted with advanced

automation and robotics technologies accommodating various specialized program needs—can be engaged in their careers in two years.

The intersection of workforce challenges that affect Indiana workers’ ability to be employed in higher technology industries (especially at the level between high school and the four-year degree) and the trend toward automation is meaningful for the economic futures of workers and the businesses that employ them. A strong innovation economy requires a workforce capable of filling a wide range of jobs requiring automation, which can bolster innovation and support the growth of technology industries.

Many of these jobs pay well and are considered middle-skill jobs because they require some education beyond high school, but not a four-year degree. For example, students in the Advanced Automation and Robotics Technology Program (AART)⁵ at Ivy Tech could find jobs with a median salary of \$64,714 (above the state average).⁶ This training applies to a wide range of positions, including process technician, automation technician, computer-aided design technician, design engineer, materials engineer, quality auditor, and robotic technician. Ivy Tech belongs to the Artificial Intelligence Incubator Network, a partnership of community colleges, Intel and Dell Technologies, which supports the demand for higher education AI skills.⁷

Indiana consistently lacks the necessary workers with skills in human-computer interactions. For example, the Evansville, Indianapolis, and Columbus metropolitan areas must address the challenge of filling jobs in automation, robotics, and programmable logic controller skills (among others). Almost all skills in human-computer interaction for these urban areas face a gap.⁸ Finding solutions to meet the needs of businesses and respond nimbly to the (often rapidly) changing state of technologies will require flexibility. The requirements and training levels vary for these highly demanded positions.

2. IMPROVING READINESS FOR AUTOMATION / AI

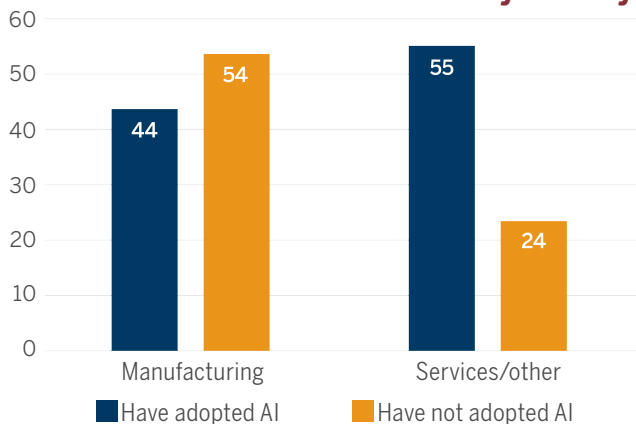
Automation and artificial intelligence hold much promise for Indiana businesses. AI adoption can drive revenue gains and lower costs.⁹ For industry more broadly, AI has the potential to enhance activities related to product

development, innovation, and a wide range of business processes. However, AI use faces barriers including cost, access and technological readiness, awareness, and workforce, among others. Other technological needs (specifically, cybersecurity)¹⁰ also can impede automation and AI adoption.

Despite what appears to be a national trend toward AI adoption, a 2021 Purdue University study¹¹ found relatively low levels of AI preparedness or engagement in Indiana. Among 36 firms surveyed, about 1 in 5 had plans to adopt AI within the next 18 months and almost 4 in 10 had no plans to do so. AI adoption requires access to a skilled workforce: More than 6 in 10 businesses identified lack of AI talent as a barrier.

A 2023 Central Indiana Corporate Partnership (CICP) survey¹² found a majority of manufacturers (54%) had not yet adopted AI in one or more business functions. This figure was more than twice what firms in services/other industries reported (24%), pointing to a gap in AI readiness for Indiana's historically strong and crucial manufacturing sector (Figure 3).

FIGURE 3. Artificial intelligence adopted in one or more business functions or units by industry



Source: Central Indiana Corporate Partnership https://www.cicpindiana.com/wp-content/uploads/2024/04/CICP_AI-Survey-Report.pdf

3. CREATING A CONDUCTIVE ENVIRONMENT FOR ENTREPRENEURSHIP AND EARLY BUSINESS GROWTH

Enacting policies that consider the unique challenges facing new and small businesses is another way to create conditions to encourage innovation in Indiana. Regulatory

and policy action to support business investment and activities may not often distinguish between businesses by size in setup or implementation. Policy makers should consider how actions intended to support business can affect new and small businesses. They should also address making compliance, access to support programs, and legal and technical assistance easier for new and smaller businesses.

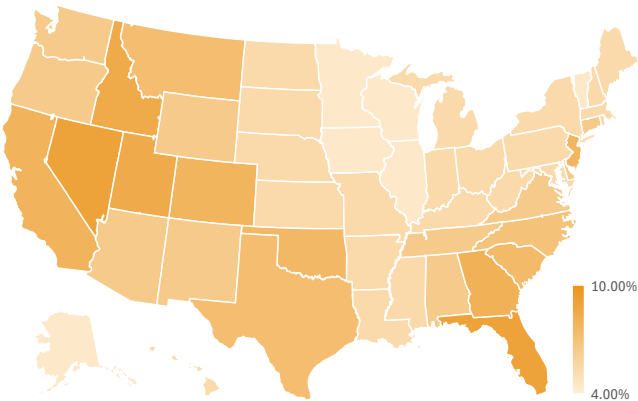
New and small businesses may not be able to access government programs in the same way as larger or more well-established ones. Information costs for new and small businesses can be higher than for larger or established businesses. Larger and well-established companies may have in-house government affairs staff; more access to legal and technical expertise; and greater ability to access data, market research, and related services. For a new company developing a new product, the cost of accessing the same information might be unachievable. Thus, considering how the broader business environment affects new and small businesses presents opportunities for policy improvements.

Startup activity plays a crucial role in commercializing new technologies and inventions. Before and since the pandemic, Indiana has lagged in forming new businesses, relative to the rest of the country.¹³

In addition to a smaller number of new businesses, Indiana startups have lagged the country in job creation. In 2021, Indiana startups created 3.81 jobs per 1,000 people during their first year of operation, compared to 4.74 jobs nationally. The job creation power of Indiana startups has also declined over time: In 2001, they created 5.27 jobs per 1,000 people. In addition, fewer Indiana startups become employer firms (hiring employees). Although startups in Indiana became employers at a higher rate than nationally before 2008, Indiana has fallen behind in this metric. In 2005, more than 1 in 5 Indiana startups became an employer (20%), compared to less than 1 in 10 by 2021 (9%). When Indiana startups create jobs poses another concern. They have been taking longer to reach the milestone of a first hire. In 2005, these firms engaged their first employees soon after they began their second quarter doing business

(1.34 quarter). By 2017, they hired employees when the third quarter was about to start (1.99 quarter).

FIGURE 4. States with the most jobs created by new businesses



These trends suggest Indiana is not tapping into the power of entrepreneurship effectively and that job creation in early business stages is a challenge. Creating a more conducive environment for entrepreneurship and early business growth can harness economic dynamism that drives prosperity, wages, and incomes generated from startup activity.

4. IMPROVING KNOWLEDGE CREATION AND TECHNOLOGY TRANSFER FOR INDUSTRY

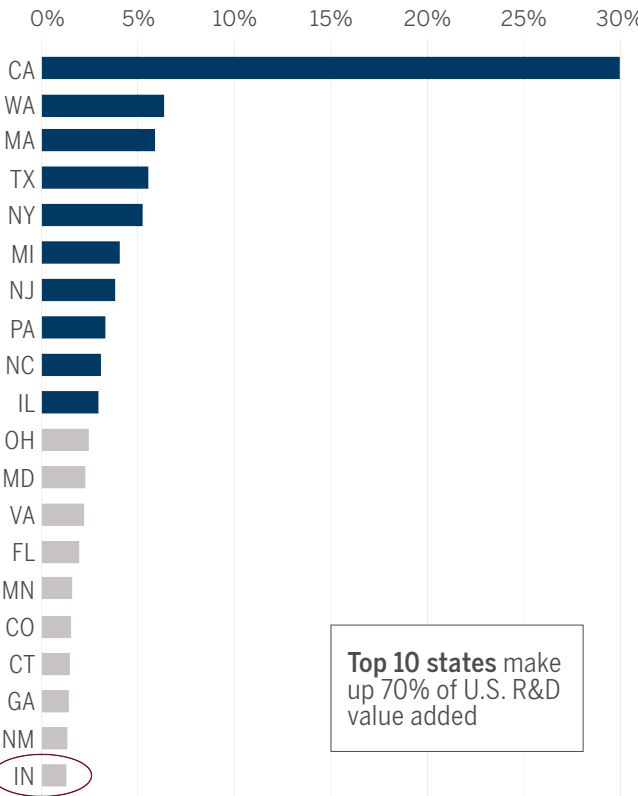
Strengthening entrepreneurship and bolstering the innovation ecosystem present important opportunities for Indiana. Innovative activity generates higher wages, income, and firm profitability. This is especially true if the activity requires unique, complex, and sophisticated knowledge. Innovation opens new industries and expands markets. Thus, innovation, especially involving new technologies, is a key strategy for enhancing living standards.

Innovation generally reflects a complex process spanning basic research, applied research, and development, where the results are introduced and diffused in the economy. Thus, innovation requires both discovery (invention) and commercialization as outcomes of this process.

Knowledge is the key ingredient for innovation, especially for new technologies. Two key sources of knowledge present

opportunities for policy. First, a robust and ready workforce is essential for the innovation economy. The second crucial source of knowledge is research and development (R&D). Investments in new knowledge provide the basis for innovations, particularly in new technologies.

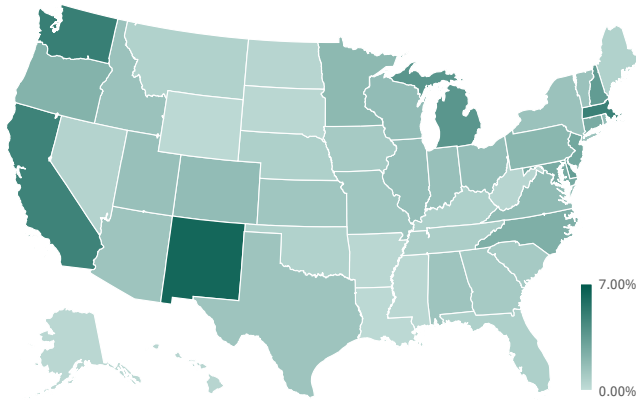
FIGURE 5. State share of U.S. R&D value added, 2021



Source: U.S. Bureau of Economic Analysis <https://www.bea.gov/news/blog/2024-05-09/experimental-rd-value-added-statistics-us-and-states-now-available>

In 2020, Indiana spent over \$10 million on R&D—ranking it 16th highest in the country. R&D expenditures accounted for 2.76% of GDP in the state—the 17th highest in the country. Thus, not only is Indiana one of the strongest states in the country for knowledge creation, but it also outperforms the return on that knowledge in terms of productivity, incomes, and wages. However, Indiana converts this knowledge to innovations that create higher-paying jobs and higher-productivity industries at a low rate, limiting its positive return on its investment in R&D.

FIGURE 6. Value added by R&D as a share of state GDP, 2021



Source: U.S. Bureau of Economic Analysis. <https://www.bea.gov/data/special-topics/research-and-development-satellite-account>

5. EXPANDING FINANCING FOR THE INNOVATION ECOSYSTEM

Indiana historically has had relatively limited early-stage financing available for innovation and technology. Addressing this issue is important, as financing constraints are a key barrier to R&D and commercialization of innovation, as well as early growth for entrepreneurial businesses. Tapping private sources (e.g. venture capital) and public financing (e.g. innovation research grants) can alleviate this problem by expanding the flow of capital more broadly and targeting potential high-growth ventures.

Venture capital finances the growth and scale-up of companies in their early stages of development, when a substantial element of risk is involved and procuring traditional modes of finance is difficult. It provides financing for high-potential entrepreneurial companies, including some that may become unicorns (privately held startup companies valued at over \$1 billion and not listed on the stock market).

Existing trends in Indiana highlight opportunities related to expanding the volume of venture capital, deal size, and industry scope. Indiana does not attract a significant amount of venture capital. In 2022, venture capital invested in Indiana accounted for \$2,091.37 per \$1 million of GDP. By contrast, venture capital invested more than four times this amount in the rest of the country—at \$9,898.93 per \$1 million of GDP.

The size of venture capital deals in Indiana is also smaller compared with other states. In 2022, venture capital deals in Indiana averaged \$3.53 million, about one-third of the average—\$10.14 million—for the rest of the country. Also, venture capital targets knowledge and technology-oriented companies and industries in Indiana less than elsewhere. In 2022, venture capital relative to employment in knowledge and technology-oriented companies was 0.07%. By contrast, in the rest of the country, venture capital relative to employment in knowledge and technology-oriented companies was nearly three times greater (0.19%).

While venture capital can provide early-stage financing, it is not appropriate for all innovative businesses. Many new businesses require smaller amounts of funding yet still face barriers accessing traditional forms of financing. These new businesses may be in early stages of R&D or product testing. Some may be very promising even though they may not have the exponential growth potential of venture capital-backed firms.

Thus, the opportunity to expand capital for entrepreneurs can take several forms. For example, the Indiana Economic Development Corporation (IEDC) renewed its agreement with Elevate Ventures, an Indianapolis venture capital firm, to increase annual funding for startups and development by 40% in 2024. With \$3 million in funding, the program aims to spur the growth of innovative startups with needed resources in the earliest stages of their development. This new program would provide \$20,000 to \$1 million in funding to startups with no requirement for matching funds. It replaced IEDC's and Elevate Venture's Community Ideation Fund and Nexus Pitch Competitions and is intended to double funding for early-stage startups, enabling them to survive the most challenging time confronting technology startups—between the creation of a product that can be commercialized and generating revenue that allows a company to compete in the marketplace.

Other sources for early-stage financing of innovative entrepreneurship can target businesses by size. The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs have a federal mandate to spur R&D and technological innovation for companies with 500 or fewer employees. The U.S. Small Business Administration coordinates the SBIR and STTR

programs, which require 11 federal agencies to allocate a share of their external R&D funding to small businesses. The participating agencies award SBIR funding for three project phases. With awards between \$50,000 and \$250,000, Phase I focuses on the technical merit, feasibility, and commercial potential of the proposed R&D project. Based on promising technical and commercial potential, Phase II recipients receive an award of \$750,000 covering two more years of project development. In Phase III, non-SBIR sources continue funding for commercialization objectives.

Indiana has not participated robustly in SBIR and STTR programs. The average annual federal SBIR and STTR funding per \$1 million of GDP in 2020–22 was \$82.58 in Indiana. By contrast, an average of \$172.00 per \$1 million of GDP of SBIR and STTR funding was awarded nationally. The gap between the figures for SBIR funding for Indiana and the United States is even greater. In 2020–22, the difference for SBIR considered alone was less than half as much as for the rest of the nation—\$61.50 per \$1 million of Indiana GDP versus \$149.57 per \$1 million of U.S. GDP.

Indiana has increased its support of early-stage financing of innovation and entrepreneurship by expanding the matching grants available to companies seeking SBIR funding. The Applied Research Institute (ARI)—a nonpartisan leader in technology innovation and strategy for Indiana—encourages using these grants to expand the funding for information technology, innovative startups based at universities, nonprofits, research institutions, and small businesses throughout the state.

6. BALANCING EXISTING INDUSTRY STRENGTHS WITH NEW INDUSTRY EXPANSION

Increasing strategic engagement and collaboration between relevant organizations in Indiana promises to accelerate economic gains and reduce complicated barriers facing the innovation economy. Strengthening connections between higher education institutions and industry will bolster the development of high-tech, innovative businesses. Improving the talent-to-industry pipeline can boost local economies and hasten economic gains from innovation for Hoosiers. It also promotes talent retention, which can address the challenge of losing skilled workers—often described as “brain drain”—particularly in smaller Hoosier communities.

Indiana’s higher education institutions cultivate skilled talent to support innovation. These institutions educate researchers who may become innovators, bringing discoveries made in labs into the marketplace. For example, Indiana University recently launched “IU Innovates” to accelerate and stimulate the delivery of innovation beyond the university. Universities also prepare the workforce to fill the jobs and grow the businesses created by these innovations. Future innovators will also spring from this workforce.

Taking advantage of activities in a targeted place or industry offers another opportunity for growth. In October 2023, the U.S. Economic Development Administration (EDA) designated Indiana as a federal tech hub. EDA administers this program to increase strategic U.S. investment in innovation and technology—especially emerging technologies.

A balanced strategy could embrace new activities for the state while also deepening historic strengths. An environment that favors greater innovation and technology use in promising new industries or historically strong industries can encourage further growth and future innovation.

Indiana is a member of a Midwest consortium of states that received a \$1 billion hydrogen hub designation from the U.S. Department of Energy. This award will focus on developing innovative uses of hydrogen to reduce carbon emissions across multiple manufacturing and transportation industries, especially those in the Chicago-Northwest Indiana region.

Indiana’s powerhouse life sciences sector, with \$77 billion in economic impact and 64,000 Hoosier employees, leads the nation in pharmaceutical exports and ranks third in overall life sciences exports. In 2022 alone, Indiana’s life sciences exports reached \$13 million. BioCrossroads—CICP’s initiative to grow the life sciences—introduced a comprehensive strategic framework to promote R&D and innovation, enhance the life-science ecosystem in manufacturing, upgrade the workforce and talent in life science, and bolster connectivity within and beyond state borders.¹⁴ This approach targets Indiana’s life sciences sector to develop strategic manufacturing hubs and

targeted investments to improve the state's domestic manufacturing capabilities.

Biocrossroads' initiatives aim to enhance Indiana's life sciences capabilities in key areas. For example, one promising area identified for development is neuroscience. By targeting neuroscience, these initiatives leverage the state's significant progress in addressing Alzheimer's and other neurodegenerative diseases. They could also capitalize on Indiana's strengths in pharmaceuticals—particularly in biomanufacturing and burgeoning fields like radiopharmaceuticals—where the state is already achieving remarkable progress.

Orthopedic design and manufacturing present more opportunities for innovative economic development. Warsaw, Indiana, in Kosciusko County in the northern part of the state, is home to the largest concentration of orthopedic design and manufacturing firms worldwide. Companies there work closely with physicians to develop solutions for unmet needs for orthopedics devices.

This strategy reflects Indiana's efforts toward building an innovation economy that can serve the life sciences industries. If successful, it provides a potential roadmap for integrating advanced research, a skilled workforce, and a robust manufacturing ecosystem. Achieving these goals hinges on more than just infrastructure and investment. It requires the cultivation of a strong talent pipeline. A skilled workforce is crucial for sustaining and advancing Indiana's life sciences sector, and an intentional focus on education and talent development is key. This approach also requires long-term commitment and a statewide focus to foster an environment where research and manufacturing not only coexist but thrive together.

A FINAL WORD

Policy that prioritizes Indiana's innovation economy has the promise to improve incomes, wages, and living standards. The return on policy investments—through new technologies, innovation and discovery, and commercialization of new products and services—will enable the state to tap into the gains from new business activity, job creation, higher productivity, and value-added economic activity. In turn, this will bring greater economic rewards to Hoosiers.

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candidates say about the innovation
economy

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