

ILLINOIS INNOVATION INDEX

2024 R&D Report

Illinois' Capacity for Innovation
& Economic Growth

INTRODUCTION

The Illinois Science and Technology Coalition (ISTC) is a firm believer in the power of research and development (R&D) within innovation to change and improve communities.

[The Organisation for Economic Co-operation and Development](#) (OECD) defines R&D as “creative work undertaken on a systematic basis to increase the stock of human knowledge, and the use of this knowledge to devise new applications.” Each dollar spent on R&D has the potential not only to radically transform an individual’s life, but also to transition the economies of states and nations into more sustainable and efficient forms. For example, investments in product development have contributed to reducing deaths from cancer and other diseases, launching new vehicles that safely transport children to daycare, and building educational tools that are adaptable and accessible for all.

Worldwide spending on R&D reached a pinnacle during the response to the COVID-19 pandemic from 2020 to 2022. The pandemic response reveals an important truth: the creation of new products and services is multimodal, multinational, and driven by diverse interests. The relationships between companies, higher education, and government became more entrenched as each collaborated to develop vaccines, treatments, and diagnostic tools at an unprecedented pace. The successes of these collaborations testify to the degree to which institutions can make a difference in addressing urgent challenges when motivation and resources align.

ISTC’s 2024 R&D Report will discuss the impact of R&D as the lifeblood of innovation in Illinois. Each year, ISTC aims to showcase Illinois’ strength in a number of vital sectors. While there is no global standard for the definition of R&D, this report will focus on the creation of new ideas, products, and services, highlighting the critical role of R&D in driving economic growth and addressing societal challenges in Illinois and beyond.

► [See 2024 R&D Report Methodology, Links, and Data Sources](#)

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▲ Photo Courtesy of Pedro Lastra

TOTAL R&D ACTIVITY

Definitions of R&D activities such as spending, expenses, and accounting vary. However, the [National Patterns of R&D Resources](#), produced annually by the [National Center for Science and Engineering Statistics \(NCSES\)](#), compiles the most robust domestic measures in one report. These measures are acquired through careful surveying of performing organizations and firms. For data years since 2016, the U.S. R&D expenditures data table within the NCSES' report combines R&D activity by large businesses and micro-businesses, higher education, government, and nonprofits.

..... According to the NCSES, in 2021, nearly 77% of total R&D activity was performed by businesses. Higher education institutions accounted for 11% of total R&D performed in the country. Federally performed R&D accounted for 8%, and combined activity for states and nonprofits accounted for just over 3% of total R&D activity. Total R&D spending in the U.S. reached an estimated \$789.1B in 2021 and was projected to reach \$885.6B in 2022.¹

ISTC has continued to report on the growing performance burden that has fallen on the private sector in the aftermath of the 2008 recession and critical austerity measures that followed. In constant 2017 dollars, which account for inflation, and utilizing projections by the National Science Foundation (NSF) for 2022, businesses will have made up more than 90% of 10-year growth in R&D performed in the U.S. since 2013. Counting intramural research performed and funded by businesses, which the NSF classifies as expenditures in its [Business Enterprise Research and Development \(BERD\) Survey](#), 49.5% of basic research and 87.6% of experimental development expenditures in 2021 were provided by businesses.

Over the past few years, including during the COVID-19 pandemic, U.S. companies spent more on research and development than their counterparts in Europe and many other parts of the world. The European Commission's global [EU Industrial R&D Investment Scoreboard](#) concludes that for major companies, the U.S. is the hub for information and communication technology (ICT) and biomedical leaders worldwide. The U.S. also plays host to the most new entrants to the scoreboard's top 2,500 global R&D leaders, as it has for decades; 96 new businesses based in the U.S. entered the top 2,500 this past year. China's business community ranked second most prodigious, with 78 new entrants. U.S. research dynamism is carried by the ICT sector, which often features new entrants into the top 2,500 with higher R&D intensity scores than larger incumbents in the ranking.²

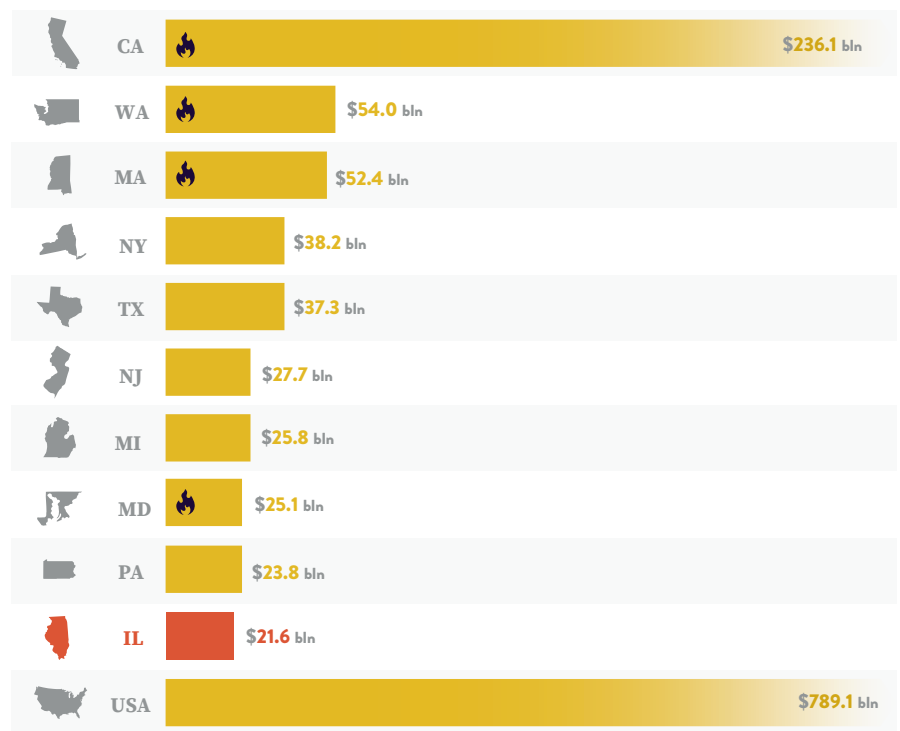
The NCSES reports that only a handful of states feature more innovative companies and research-intensive universities than Illinois. The state has strategically focused on industries and research fields where it has a competitive advantage, or a “right to win.” Illinois is home to a number of major R&D performers in crucial sectors, leveraging the research acumen of scientists at two federally funded Research and Development centers (FFRDCs): Argonne National Laboratory and Fermi National Accelerator Laboratory (Fermilab). Collectively, entities across the state invested \$21.6B in 2021 into creating crucial scientific knowledge and developing new products to improve consumers’ lives. This strategic focus and substantial investment underscore Illinois’ commitment to maintaining its position as a leader in research and innovation.



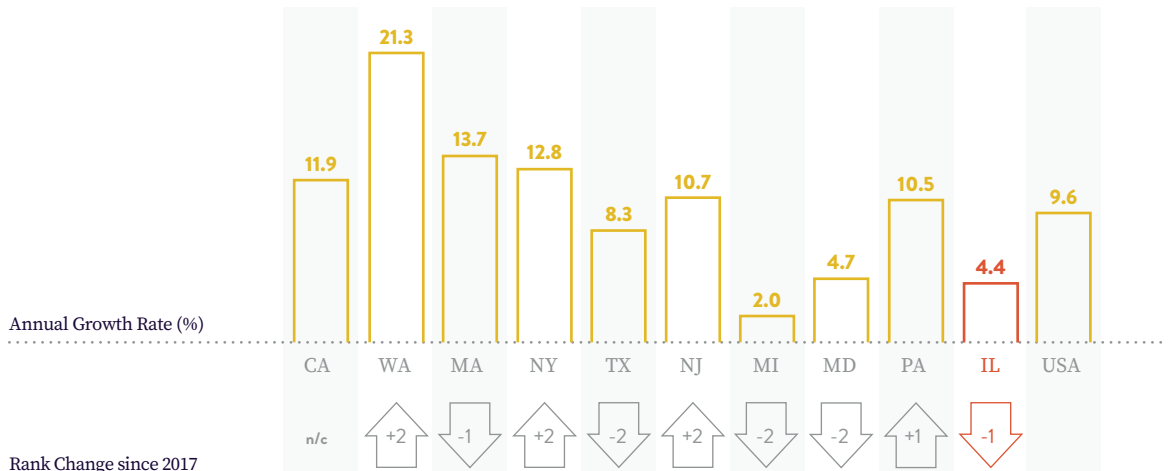
Total R&D

Top 10 States

2021



R&D Intensity over 5% (United States average is 3.3% for comparison)



Source: NSF National Center for Science and Engineering Statistics (NCSES), National Patterns of R&D Resources 2021-22 Data Update

R&D Growth Rate

This R&D report discusses growth trends in five-year and 10-year increments using compound average growth rate (CAGR), which provides an average year-over-year change on a given metric for a defined time period. In keeping with past efforts to analyze the R&D landscape, this report primarily cites five-year increments.

According to the NCSES, total R&D by all performers in the U.S. increased from \$553.6B to \$789.1B between 2017 and 2021, with a national average growth rate of 9.55%. Between 2017 and 2021, total R&D activity in Illinois increased from \$18.2B to \$21.6B, growing by a rate of 4.43%, well below the national average. This places Illinois 41st among all states in terms of R&D growth rate.

Pennsylvania, with a growth rate of 10.46%, surpassed Illinois in the national ranking, increasing from \$16B in 2017 to \$23.8B in 2021. Other top ten states for total R&D performed that had faster-than-average growth between 2017 and 2021 included Washington (21.3%), Massachusetts (13.7%), New York (12.8%), California (11.9%), and New Jersey (10.7%).³

R&D Intensity

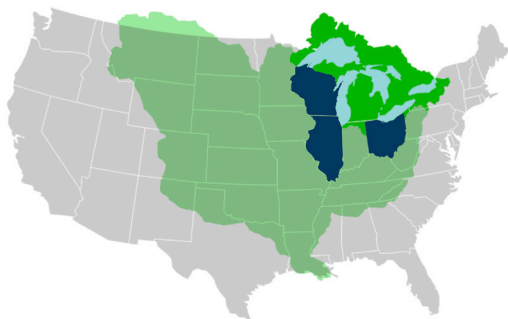
R&D intensity is measured as R&D spending relative to state gross domestic product (GDP). This is calculated by dividing total R&D expenditures by total revenue.

For individual companies, greater R&D intensity has been associated with an increase in both innovation originating internally and collaborative product designs. A study of the occurrence of high-growth periods for companies found that R&D-intensive firms with strong external positions, meaning a willingness to spend on knowledge from outside the company, were more likely to experience high-growth episodes (Aldieri, Sena, and Vinci, 2022).⁴ This study, which focused exclusively on manufacturing businesses from the U.S., Europe, and Japan, also found that knowledge spillovers related to a 1% rise in inter-industry R&D resulted in the probability of a business experiencing a high-growth episode increasing by 2.5%.

The EU Scoreboard notes that American companies had the highest amount of R&D per employee among businesses surveyed.² American companies continued to strengthen their R&D intensity during the pandemic, despite revenue downturns.

In 2021, Illinois' R&D intensity was 2.28%, placing Illinois 26th in the nation (including the District of Columbia) and lagging the national R&D intensity of 3.34%. The top five states in terms of R&D intensity were New Mexico (8.7%), Massachusetts (8.1%), Washington (7.8%), California (6.9%), and Maryland (5.6%).

Washington had the fastest-growing five-year CAGR for total R&D performed between 2017 and 2021 and also had the nation’s third-highest R&D intensity in 2021 by state. This high R&D intensity can be attributed to Washington’s thriving information technology (IT) sector, led by major corporations such as Amazon and Microsoft. These companies invest heavily in R&D to maintain a competitive edge and drive innovation. By contrast, Illinois’ consistently lower R&D intensity suggests that the state’s economy is less reliant on R&D-intensive businesses. Another possibility is that research costs, such as employing researchers and buying new equipment, are slightly lower in Illinois than other states. Illinois’ current strengths rest in multiple sectors such as pharmaceuticals, aerospace, food technology, financial technology, and automotive manufacturing. This diversity of sectors lends itself well to the state’s high GDP and revenue for businesses, but not to a higher than average R&D intensity. Illinois’ R&D intensity has been slightly below the national average for more than a decade.



▲ *Current, Great Lakes ReNEW*



GREAT LAKES RENEW

Current Leads Midwestern Coalition to Revitalize Great Lakes Region

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In January 2024, Chicago nonprofit [Current](#) received a \$15M award from the National Science Foundation (NSF) as part of the inaugural cohort of Regional Innovation Engines. The winning initiative, Great Lakes ReNEW, will serve as a convener of innovators, technologists, and employers in the water economy. The ultimate goals of this initiative are to make the Great Lakes the home and hub of water innovation globally and to transform the region’s blue economy and environment over the next 10 years. The tools and science it promotes will recover numerous resources like energy, nutrients, and critical minerals, such as nickel, cobalt, and lithium, while removing chemicals like PFAS.

ISTC had the opportunity to sit with the CEO of Current and Principal Investigator of Great Lakes ReNEW, Alaina Harkness, and Co-Principal Investigator of the Great Lakes ReNEW Project, Dr. Junhong Chen. Harkness, who was recently named [a Crain’s Notable Leader](#) in Sustainability, commented, “The

continued on next page ▶

mission of Great Lakes ReNEW is to turn waste into wealth and health by changing the way we manage and invest in one of our most precious natural resources: water. Today, we waste too much of our water and the valuable materials that it carries—materials that we need to power the electrification of society and the next wave of computing. Too much of our water is contaminated. The common challenge in both is precision separation: finding the highest and best use for every molecule.”

The team will focus not only on extracting valuable resources from the water, but also on removing waste and chemicals. Dr. Chen emphasized the importance of monitoring water quality in the Great Lakes region. He said, “Detection is vital. The first step towards removing these ‘forever chemicals’ from the waterways is figuring out where they are and in what quantities they exist. Standard laboratory equipment will need to evolve as we begin to have more regulations on things like PFAS in order for water and wastewater utilities to keep pace. Field measurement is a major goal and focus area for our team.” Researchers at Argonne National Laboratory and the University of Chicago will focus on calibrating precision sensing devices and improving their effectiveness. This is just one example of the many research projects ReNEW will support. Members of Current’s Research Consortium will form cross-disciplinary teams to tackle the challenges guided by end users in industry, utilities, and communities.

As industry drives demand for filtration, separation, and utilization, innovators are finding the sector ripe for small business growth. Current and its team will utilize funds from the NSF and other sources to leverage the support of state government stakeholders in Illinois, Ohio, and Wisconsin in the initial years to build on the legacy of the region’s water innovation hubs, including building a new accelerator for small businesses and startups in the blue economy. Current also aims to create a talent pipeline through education and workforce development programs at Chicago’s colleges and universities, including City Colleges of Chicago, and by offering climate education curriculum tailored to younger students, such as [its Blue EDU resources](#) for grades K-12. The NSF has set key deliverables for grant recipients, and Current and the coalition have the potential to receive up to \$145M in additional funding for this effort over the next 10 years. The initiative is a key step toward transformative water innovation and stewardship for the Great Lakes region.

BUSINESS R&D

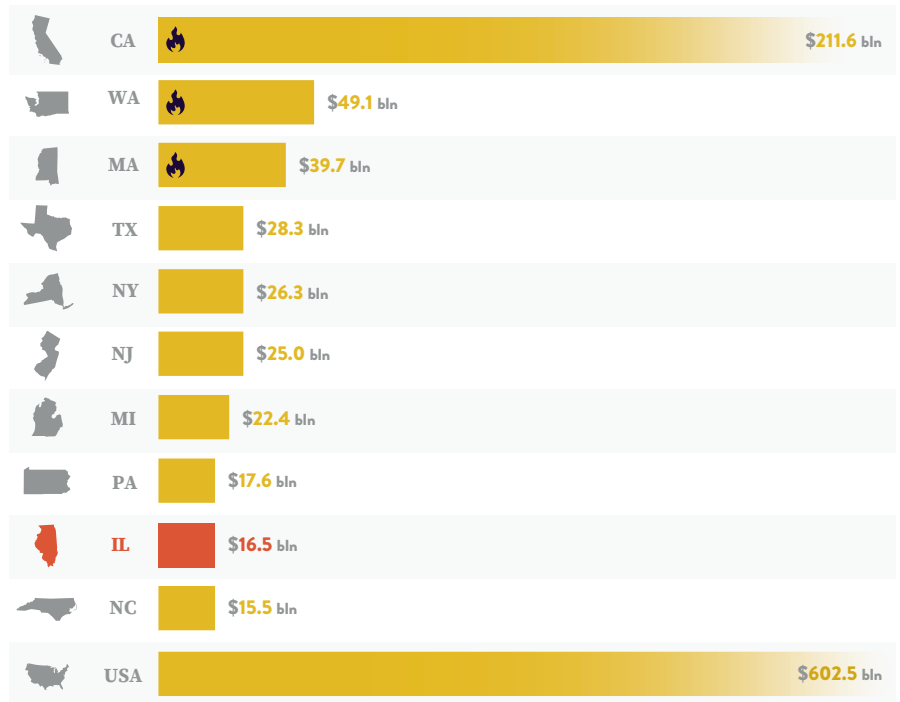
Illinois' economy is notable for cultivating strengths in a broad range of sectors. Long-standing cornerstones of the economy like manufacturing and agriculture technology businesses are complemented by the increasing presence of IT and fintech companies. During the pandemic, biomedical companies such as Baxter, AbbVie, Abbott Laboratories, and Medline led Illinois' COVID-19 response and contributed substantially to Business R&D in the state.

..... • More novel fields like generative AI and quantum, which have become ubiquitous in their application across multiple industry clusters, also contribute to the state's ecosystem of innovation and represent just a few niches in which innovators in Illinois are making paradigm-shifting investments every year.

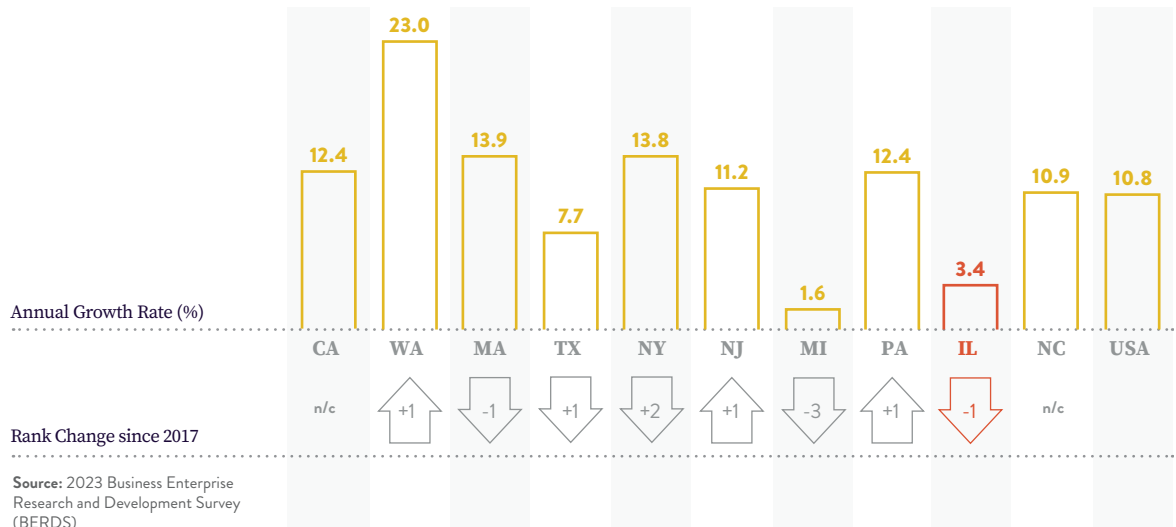
In 2021, Illinois' GDP was \$944.0B, constituting about 4% of the U.S. total. Spending on R&D by domestic businesses in Illinois topped \$16.5B in 2021, making Illinois the 9th-ranked state nationally in Business R&D expenditures.



Business R&D
Top 10 States
2021



Business R&D Intensity over 5% (United States Average is 2.9% for comparison)



Illinois’ five-year CAGR for Business R&D between 2017 and 2021 was 3.4%. This gives Illinois the second-lowest growth rate in the top 10 states ranked by overall Business R&D activity and indicates that a top-10 position for R&D expenditures may be hard to maintain. Within the top 10, only Michigan had slower growth, at 1.6%. North Carolina, the 10th-ranked state in 2021, is on track to surpass Illinois’ Business R&D performance within the next five years; the state’s five-year Business R&D growth rate, at 10.9%, is much more consistent with the national increase, at 10.8%.

During 2021, 93.4% of R&D performed in Illinois by businesses was intramural, in that the funding came from within a business. According to the NSF’s [BERD Survey](#), businesses nationwide in 2021 averaged 87.6% on this metric.⁵ The gap between Illinois and the nationwide average suggests that Illinois businesses must rely on their own resources to fund R&D projects more often than businesses in peer states.

Compared to 2017, Illinois saw reliance on businesses to cover their own R&D expenses rise by about 5 percentage points in 2021. During the time between 2017 and 2021, overall Business R&D expenditures rose by more than \$2B while external funding for these projects dropped by nearly \$570M. In 2021, Illinois stood out among the top 10 states for Business R&D expenditures as the only one that experienced a decline in federal funding for Business R&D. External funding sources contributed significantly to Illinois’ Business R&D in 2017, accounting for 11.5% of all R&D expenditures and totaling \$1.7B. However, by 2021, during the first full year of the pandemic, external funding for Business R&D in Illinois dropped to \$1.1B, representing only 6.6% of total R&D expenditures. Since 2017, externally funded Business R&D in Illinois has fallen by just under 10% year-over-year on average.

The national five-year CAGR for externally funded Business R&D between 2017 and 2021 was 5.17%. Several states in the Midwest ranked among the fastest-growing states in externally funded Business R&D, including Tennessee (1st; 42.68%), Kentucky (4th; 27.25%), and Arkansas (12th; 17.02%). Illinois ranked 46th, including D.C., by the same metric, at -10.0%.



Business R&D Expenditures by Source

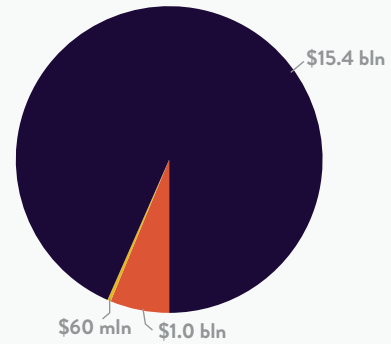
Illinois vs. USA

2021

Illinois

Total
\$16.5 bln

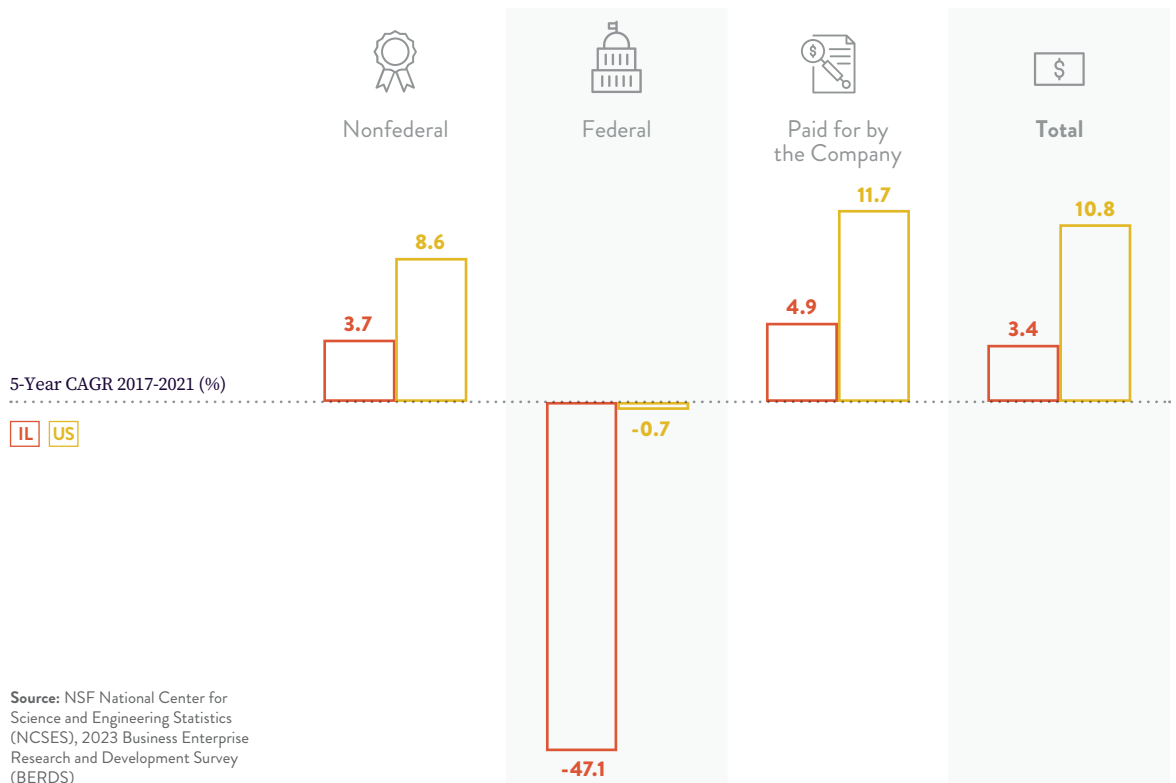
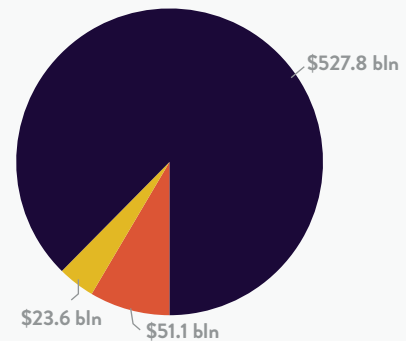
- Nonfederal
- Federal
- Paid for by the Company



USA

Total
\$602.5 bln

- Nonfederal
- Federal
- Paid for by the Company



Source: NSF National Center for Science and Engineering Statistics (NCSES), 2023 Business Enterprise Research and Development Survey (BERDS)

Illinois remains home to some of the strongest R&D-focused companies, including major employers and multinational corporations, as well as entrepreneurs and small businesses within STEM. [Intersect Illinois](#), an economic development organization devoted to advocating for business relocations to Illinois and the creation of more jobs in a diverse array of industries, notes that since 2022, nearly 50 new businesses have invested \$1M or more in Illinois. These major businesses include [Mars Wrigley](#), [Milwaukee Electric Tool](#), and [Gotion](#).

Business R&D Inputs

At \$16.5B, Business R&D in 2021 marked a record high for Illinois. The previous record was set in 2017, when Business R&D for the state reached \$14.4B. By one-year growth, between 2020 and 2021, Illinois' 16.9% surge exceeded the average national growth rate of 12.1%. The timing of this surge in Business R&D suggests that Illinois' pandemic-related expenditures were predominantly guided by the private sector. Between 2013 and 2021, Illinois fell from 7th among all states in Business R&D expenditures to 9th in 2021.

Drivers of innovation include not only the capital deployed to create new products and services, but also the talent present within a state's science and technology ecosystem. ISTC utilized reporting from the NCSES on employment to help visualize the combined need for both talent and investment to stimulate R&D innovations that drive the economy forward. The U.S. Census Bureau's American Community Survey (ACS) provides the most robust information available on people employed in the sciences. The survey population for the ACS relies on self-respondents, many of whom are gig workers or self-employed persons who do not appear in data from other entities, like the Bureau of Labor Statistics' (BLS) annual Occupational Employment and Wage Statistics Survey. Based on estimates from the Census Bureau, Illinois ranked 7th among all states for science and engineering (S&E) employees in 2021, at nearly 4.3M employees.⁶

The European Commission's World 2500 Industrial R&D Investment Scoreboard places several Illinois companies as leading innovators according to its 2022 metrics; eight Illinois-headquartered businesses rank in the top 1,000 for R&D expenditures.² Companies like Deere, Motorola, Kraft Heinz, Dover, ADM, and Mondelez, each of which ranked in the top 1,000, remain vibrant parts of the innovation landscape both nationally and internationally.



**Illinois
Business
R&D Input
& Output
Indicators**

Source: NSF National Center for Science and Engineering Statistics (NCSES); US Patent & Trademark Office (USPTO), accessed via the Wellspring Scout Data Platform; 2023 Business Enterprise Research and Development Survey (BERDS); Wellspring Scout Data Platform, Data Accurate as of July 9th, 2024

		INPUTS			
		Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
	Business R&D Expenditures 2021	\$16.5 bln	9 ↓ -1	3.4 IL	10.8 USA
	S&E Employment 2021	4,287,642	7 n/c	N/A IL	N/A USA
		OUTPUTS			
		Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
	Business Patents 2023	5,558	8 ↓ -1	-4.1 IL	-2.5 USA
	Private Industry Output 2021	\$855 bln	6 ↓ -1	3.3 IL	4.9 USA

Business R&D Outputs

A number of metrics are utilized to report on the actual outcomes of innovation investment. ISTC uses both total output and patent production. Total output is the real gross output of a sector of the economy. According to the [Bureau of Economic Analysis](#), gross output measures the total of an industry’s sales or receipts, including business-to-business sales and end-user sales.⁷ It does not include gross compensation and subsidies, as other measures like GDP would incorporate.

Some of the most innovative companies are those that invest a heavy percentage of their revenues into projects that will produce more patents. Over the long term, the anticipation is that the creation of new knowledge, new processes, and new products will result in higher private industry output. The combination of investment with Illinois’ talented workforce places the state near the top of both patent production and private industry output.

Wellspring’s Scout data platform aggregates information collected from the U.S. Patent and Trademark Office (USPTO).⁸ The USPTO does not classify patents coming from an entity like a business separately from patents created by faculty members at research universities. Using an aggregator like Wellspring allows for the allotment of patents into specific groups. Business patents are those patents housed in the Wellspring platform that the USPTO classifies as having had a principal investigator who is employed by a business. Illinois ranks 8th among all states in patents created by businesses headquartered in the state with 5,558



**Top 25
Patent
Producing
Companies**

Illinois

2023

patents created in 2023. States with better platforms for business growth, large cities, and robust talent sources trend toward the top of the national rankings in both business patent production and private industry output.⁹

STATE FARM Bloomington, IL	226
MOTOROLA MOBILITY Chicago, IL	150
ALLSTATE Glenview, IL	92
ILLINOIS TOOL WORKS Glenview, IL	65
JOHN DEERE Moline, IL	64
MEDLINE INDUSTRIES Northfield, IL	57
CHICAGO MERCANTILE EXCHANGE Chicago, IL	56
NUCURRENT 📌 Chicago, IL	4 55
PANDUIT Tinley Park, IL	47
KNOWLES ELECTRONICS 📌 Itasca, IL	17 44
TRADING TECHNOLOGIES INTERNATIONAL Chicago, IL	43
UOP Des Plaines, IL	42
WALGREENS Deerfield, IL	38
BAXTER HEALTHCARE Deerfield, IL	37
SHURE ACQUISITION HOLDINGS 📌 Niles, IL	14 31
ZEBRA TECHNOLOGIES 📌 Lincolnshire, IL	17 30
GROUPON Chicago, IL	29
SRAM CORPORATION 📌 Chicago, IL	14 29
PRECISION PALANTING Tremont, IL	26
OCIENT 📌 Chicago, IL	0 24
ABBVIE North Chicago, IL	24
MOLEX Lisle, IL	24
TRANSFORM SR BRANDS Hoffman Estates, IL	22
S&C ELECTRIC COMPANY 📌 Chicago, IL	4 22
HOLLISTER Libertyville, IL	22

■ 2023 Count

📌 New Arrival

■ 2019 Total for Comparison

Source: US Patent & Trademark Office (USPTO), accessed via the Wellspring Scout Data Platform, Data Accurate as of July 9th, 2024

Illinois' private industry output remained strong in the early years of the pandemic. Following a decline in 2020 at the onset of the pandemic, which mirrored trends seen in many states, output rebounded in 2021 to return to pre-pandemic levels. In 2021, output by Illinois-based companies resulted in nearly \$855B in economic activity, and continued growth is expected to push the state beyond \$1T in the next decade. However, Illinois' five-year (3.3%) and 10-year (3.1%) CAGRs for private industry output remain below the national average (4.9% for five-year, 4.4% for ten-year). Many other former hosts of manufacturing titans have also seen private sector output stagnate in the past 10 years, including Pennsylvania (3.1%), West Virginia (2.3%), Michigan (3.7%), Indiana (3.9%), and Ohio (3.9%). States that lead the way on 10-year CAGR for this metric include Utah (7.1%), Washington (6.6%), Idaho (6.3%), Florida (6.2%), California (5.7%), and Arizona (5.6%).

Sector by Sector

The NSF's BERD Survey provides a breakdown of R&D performed and funded by domestic businesses in each sector. This sector-by-sector analysis excludes externally funded R&D projects.

Business R&D in Illinois is primarily led by three entities: 1) healthcare R&D spending by pharmaceutical companies and medical equipment suppliers; 2) expenditures by companies in the IT and software development sector; and 3) Business R&D spending by machining companies. In Illinois, nearly 30% of all Business R&D is conducted in the chemicals sector, which encompasses pharmaceuticals, pesticides, synthetic fibers, cleaning compounds, paint, and other chemicals. Pharmaceutical R&D represents more than 90% of the overall chemicals sector's total.

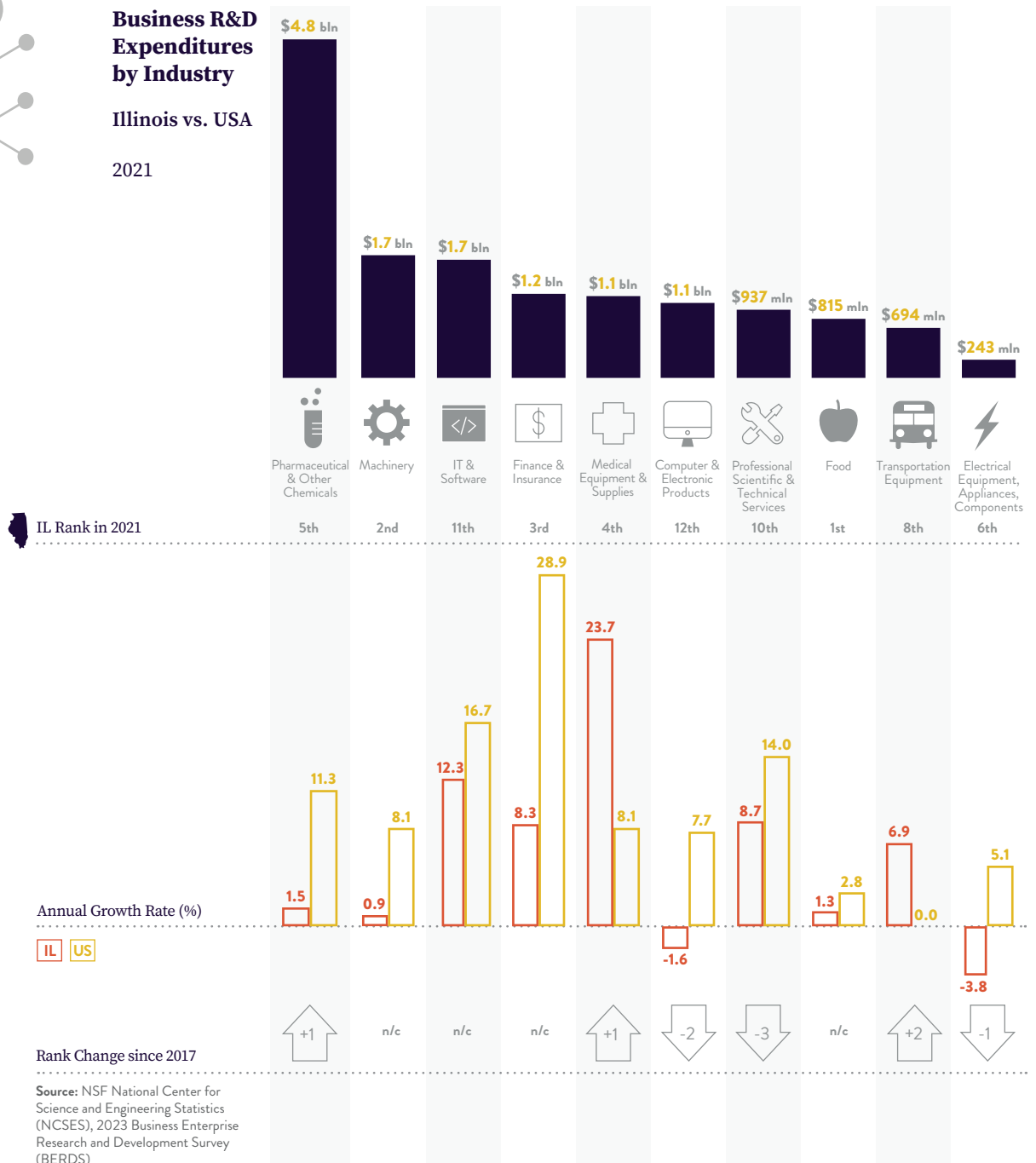
On a national level, slightly more than 27% of all R&D performed and funded by businesses falls under the IT sector. This sector includes R&D activities in publishing, data processing, data hosting, telecommunications, and various types of software development. Around 10.7% of all R&D financed and performed by Illinois companies in 2021 came from businesses in the IT sector, and expenditures by machining companies made up 11.2%.



Business R&D Expenditures by Industry

Illinois vs. USA

2021



Healthcare

In the U.S., a larger share of Business R&D was spent on pharmaceuticals than in any other country within the OECD. In 2021, businesses in the U.S. collectively spent about \$97.1B of their own funds on the development of pharmaceuticals and other chemicals, which was almost \$35B more than in 2017, a 32% increase in five years.

In 2021, Illinois ranked 5th in the nation for Business R&D expenditures in the chemical manufacturing sector (\$4.8B), which is primarily composed of pharmaceutical companies. Leading the charge among

Illinois pharmaceutical companies was AbbVie, which spent [12% of its net revenue on R&D in 2021](#). Manufacturing of other chemicals like paint products and synthetic fibers in Illinois made up less than 1% of the chemical manufacturing sector in 2021. Despite strong investment from pharmaceutical companies like AbbVie, Illinois' chemical manufacturing sector did not grow at the same pace compared with other states between 2017 and 2021. Illinois' five-year CAGR during this time was 1.5%, while the national five-year CAGR was 11.3%.

Biotech firms are the main drivers of the American healthcare sector's total R&D funding. In the European Commission's Scoreboard, 76.4% of biotech firms surveyed were American, while 79.1% of biotech investments were made by American companies. In 2022, there were 207 new entries by U.S. firms into the top 2,500 R&D spenders from the biotech sector.²

Compared with other states, Illinois has consistently been a home for major R&D companies in the medical equipment and supplies sector (\$1.1B; 4th in 2021), led by Chicago-area companies Abbott Laboratories and Baxter International. Chicago remains one of the nation's premier logistics hubs. Transportation and information infrastructure in the city is robust, and this has facilitated the development of the vibrant life sciences ecosystem and manufacturing sector for pharmaceuticals and medical products. Between 2017 and 2021, spending by businesses in Illinois on medical equipment and supplies-related R&D surged by about 23.7% year-over-year. Record-high spending during the pandemic culminated in Illinois moving above New Jersey and Wisconsin.

Information Technology, Electronics and Telecommunications

The U.S. is an international leader in R&D within the information and telecommunications sector. The U.S. Bureau of Labor Statistics defines businesses in the information sector as establishments involved in creating, disseminating, and processing information, cultural products, data, and communications. Businesses in the U.S. collectively spent \$146.5B of R&D on new IT and software in 2021. Illinois ranked 11th in the nation for IT-related R&D by private industry leaders (\$1.65B) in 2021. With a five-year CAGR of 12.3%, Illinois was close to the national average growth rate of 16.7% for Business R&D in the information sector.

Adjacent to the information sector is the manufacturing of computer and electronic products and electric appliances like batteries. In 2021, U.S. businesses spent \$94.2B on R&D related to new computer products, including semiconductors. Semiconductors, essential components in modern electronics, are used in a wide range of devices, from smartphones and computers to automobiles and home appliances. They play a crucial role in enabling technological advancement and driving

innovation across various industries. Research on semiconductors and other electrical components represented nearly half of all computer parts R&D by U.S. businesses in 2021.

Between 2017 and 2021, companies across the U.S. increased their investment in computer and electronic products from \$69.9B to \$94.2B, driven by increases in Maryland, Utah, Washington, Arizona, and Colorado. Several Midwestern states fell in the national rankings during that interval, including Illinois, which dropped from 10th in 2017 to 12th in 2021 for business-related R&D in the computer and electronic products sector, with R&D expenditures by Illinois businesses in the space decreasing by 1.6% on average each year.¹⁰

In the electrical equipment, appliances, and components industry, which includes manufacturers of electric engines, batteries, and light bulbs, American companies spent \$5B on R&D in 2021, up from \$4.1B in 2017. Illinois has begun to lose ground in this sector with, R&D spending by companies falling to \$243M from \$284M over the same span. Despite the presence of major Chicago employers like Molex leading Illinois' electronics and component manufacturing sector, the state no longer holds the industry advantage it once had. California drove most of the \$900M growth in U.S. electrical equipment and components R&D, increasing from \$741M in 2017 to \$1.3B in 2021. This growth can be partly attributed to California's world-leading lithium production and battery manufacturing industry.

Machining

Machinery manufacturing in the U.S. is a diverse sector that encompasses the production of gas-powered motors and engines, turbines, semiconductor machinery, and agricultural implements. Innovations in this sector include developments in machine fabrication, welding, assembly operations, and forging processes. With \$16.7B in R&D spending, the sector accounts for approximately 2.8% of overall Business R&D by American companies. However, innovations in machining play a crucial role in supporting manufacturing operations across a wide range of industries.

Between 2017 and 2021, Illinois experienced stagnation in this critical technology sector. Machinery R&D by companies in the state increased by an average of only 0.9% each year, compared with the U.S. average growth of 8.1% per year. Despite growing by only a little more than \$60M in five years, the state remained the second-largest home to machinery R&D in the nation.

However, Texas is quickly catching up to Illinois in machinery R&D, particularly in the semiconductor machining industry. Companies like Texas Instruments, based in Dallas, are at the forefront of semiconductor machining operations, contributing significantly to the state’s growth in this sector. As semiconductor investments continue to increase, it is likely that Texas will surpass Illinois in machinery R&D in the coming years.

Food Technology

The food sector accounts for a small portion of overall Business R&D in the U.S., but it plays a crucial role in supplying the nation with snacks, beverages, and other products for final consumption. R&D in the food industry often focuses on finding nutritious and accessible alternatives to current ingredients and developing more sustainable processes.

Business R&D spending in the food sector grew modestly between 2017 and 2021, rising by an average of 2.8% each year and reaching \$5.0B in 2021. The pandemic’s significant adverse impact on restaurants and the service economy contributed to the relatively slow growth in food-related R&D during this period; the sector did not experience substantial pandemic-driven R&D surges like those that boosted the medical sector.

Chicago is a regional hub for major food innovators like Mars Wrigley, Mondelez, and Kraft Heinz. The city’s robust telecommunications infrastructure and premium logistics offerings make it an attractive location for food sector companies. As a result, Illinois ranked 1st nationally in business-related food R&D spending in 2021, with a total investment of \$815M.



▲ Mars opens transformative snacking R&D Center on Goose Island



COMMUNITY HIGHLIGHT

MARS

MARS Snacking R&D Hub

Illinois remains the global leader in corporate R&D within the food technology sector. Chicago’s leadership in this sector is supported by its position in a premier logistics corridor and the presence of many industry-leading Fortune 500 companies, including Mars. In 2022, Mars shared its intention to create a world-leading Snacking R&D hub, and in January 2024, it delivered on that promise [with the opening of the new facility](#).

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Located at the global headquarters of Mars' Snacking business on Goose Island, the 44,000-square-foot, \$42M facility is dedicated to chocolate and nut testing, research, and innovation. As Mars looks to double its Snacking business in the next decade, this investment will continue to create new R&D jobs at the facility and in Chicago.

Mars' long history in Chicago dates back to the turn of the 20th century. The company opened its first large-scale factory in the city in 1929. Chicago was also the original home of chewing gum giant the Wrigley Company, which Mars acquired in 2008. Mars established operations on Goose Island in the early 21st century. Goose Island, historically an industrial hotbed whose companies were pivotal to cementing Chicago's reputation for manufacturing excellence, was declared a protected manufacturing district in the 1990s to prevent an erosion of manufacturing jobs and spur an industrial revival. Mars' investment highlights its commitment to revitalizing the city while pursuing confectionery innovation.

Today, Mars is one of the world's leading confectionery companies, with nearly \$50B in 2023 revenue in 2023. Mars employs over 133,000 Associates across its diverse and expanding portfolio of confectionery, food, and pet care products and services. The new Goose Island R&D hub is one of Mars' seven global innovation sites and will give Mars' 300 R&D Associates in Chicago runway to create and refine new products for the company's multi-billion-dollar snacking portfolio before they are scaled at large around the globe.

Sustainability was front-of-mind in the design of the Snacking hub. It will be powered 100% with fossil-fuel free renewable energy, covered by renewable energy credits from Mars' wind ridge farm in Ford Ridge, Illinois. "This state-of-the-art facility will serve as the epicenter for the kind of groundbreaking research and development that will shape the snacking category for generations to come," said Andrew Clarke, Global President, Mars Snacking. "Innovation has been at the heart of our success for over 100 years, and this significant investment reaffirms our unwavering commitment to staying ahead of the curve. With an assembly of trailblazing Associates, pioneering partnerships that ignite our creativity, and unparalleled technology at our fingertips, we will continue to push boundaries in our relentless pursuit of delivering extraordinary experiences for our consumers around the world."

Financial Technology

Financial technology companies, often styled as “fintech,” are led by banking and insurance institutions. Companies in the sector primarily engage in financial transactions and pool risk by underwriting insurance and annuities. The collection of bills is part of their service offerings, and innovations related to user experience often fall under R&D within the financial sector. In 2021, American companies spent \$20.9 billion on R&D in this sector.

Relative to the record spending on healthcare-related R&D by businesses in 2021, the financial sector experienced an even more significant increase in R&D investment. Between 2017 and 2021, the average year-over-year increase for Business R&D in finance and insurance was 28.9%. This substantial growth in R&D spending can be attributed to the rapid adoption of digital technologies and increasing demand for innovative financial services. The sector’s focus on innovation is driven by the need to stay competitive in an increasingly digital landscape and to meet the evolving needs of consumers and businesses.

Illinois has long been home to major insurance companies like State Farm and Allstate. Due to the presence of these leaders, Illinois has also historically been in the top five states for R&D in the finance sector. In 2021, Illinois ranked 3rd, behind only New York and California. Between 2017 and 2021, Illinois companies had an average increase in R&D spending of 8.3% year-over-year, demonstrating the state’s continued commitment to innovation in the financial sector.

Transportation

Technology-based economic development would be impossible without innovations in ancillary sectors like transportation and logistics. Investments in transportation machinery aid in the creation of new products and services in other sectors and amplify spillover effects. The transportation sector is led by vehicle manufacturers and their assembly line processes and by aerospace companies. Companies in this sector use advanced machining processes to create equipment for rail, space, water, air, and road transportation, investing heavily in R&D to enhance efficiency, safety, and sustainability.

While R&D spending by U.S. companies in the transportation sector has generally stagnated or decreased in many states, largely due to declines in aerospace product R&D between 2017 and 2021, Illinois experienced a significant surge in transportation-related R&D over the last five years. In 2021, Illinois companies invested \$694M of their own funds into developing new machining processes and prototypes, showcasing their commitment to advancing transportation technology. This surge was led by R&D related to the manufacturing of new motor vehicles, which nearly doubled in Illinois.

From 2017 to 2021, businesses in Illinois increased their transportation sector R&D expenditures by \$162M, representing a year-over-year average increase of 6.9%. Much of this investment was in the development of prototypes for electric vehicles and other processes. This sustained growth in R&D investment elevated Illinois from 10th to 8th among all states. Illinois is well positioned for continued growth in this sector due to its geographic proximity to rivers and waterways that are important to international trade.



▲ Photo Courtesy of SIUE Photographer Howard Ash.



COMMUNITY HIGHLIGHT

SOUTHERN ILLINOIS UNIVERSITY EDWARDSVILLE

SIUE

National Corn-to-Ethanol Research Center at SIUE Driving Innovation Downstate

The National Corn-to-Ethanol Research Center (NCERC) is a designated Biorefining Center of Excellence located at the Southern Illinois University Edwardsville (SIUE), a “go-to” technology scale-up facility for the global first-generation biofuels, advanced biofuels, and bioproducts industries. NCERC combines scientific expertise with practical, “boots on the ground” operating knowledge to bridge lab-scale shake flasks to 22,000L fermenters operating under industrial conditions, contributing to the development of technologies related to biochemical conversion. Since its opening in 2003, over 90 technologies developed at NCERC have proceeded to the commercial marketplace, including technologies for feedstock conversion, fermentation yield improvement, microorganism development, antimicrobial control, downstream processing, final product purification and harvesting, processing monitoring and testing, and data system optimization, among others.

As an R&D facility for the corn-to-ethanol industry, NCERC has helped to evaluate innovative technologies to improve ethanol yield, lower carbon intensity scores, and improve co-product quality. The center has spearheaded initiatives focused on measuring and converting cellulose in corn kernel to ethanol. One of these initiatives was led by the research team of Dr. Yan Zhang, which includes Dr. Mingjun Ma, Dr. Jie Dong, and Krystin Polhemus.

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Dr. Jie Dong's group at SIUE focuses on studying an important piece to a process that creates butanol without carbon emissions. An acetogen being researched for this purpose was studied by the group to discover its underlying kinetics during the process. A portion of the work was done at the NCERC using their 5-L bioreactors. Dr. Dong's group optimized the fermentation conditions for the acetogen and achieved a high acetate yield from both formate and lactate. These studies provide valuable data for OSU and UIUC to construct microbial consortia. "Butanol utilization has important implications for the transportation industry. Our current car engine can run on pure butanol without further modifications. Additionally, butanol is a promising jet fuel precursor and offers one route to solving the Sustainable Aviation Fuels Challenge initiated by the U.S. Department of Energy, and other federal government agencies."

Additionally, NCERC has developed a low-cost, low-energy pathway to convert various wastes, including municipal solid waste, agricultural residue, and energy crops, into sugars and ethanol, which is currently the most sought-after feedstock for making sustainable aviation fuel. NCERC is active in bench-top, basic scientific research, and it has been awarded multiple funding streams from government agencies to support its research into engineering microbial consortia to make butanol without emitting carbon dioxide.

As an open innovation platform, NCERC has helped one of the largest chemical companies in the world over the past 10 years to optimize various biopolymer pathways from bench-scale to the production of metric tons of quantity.

Outside of NCERC Southern Illinois University-Edwardsville ranked #1 in research expenditures for Carnegie Classified Doctoral/Professional Universities (D/PU) in FY22. In FY24 SIUE has 117 active externally funded research projects with more than \$7.8M in funding awarded.

Professional, Scientific and Technical Services

R&D by consulting companies is categorized under the heading of professional, scientific, and technical services by the collectors of the BERD Survey. The U.S. Bureau of Labor Statistics defines this sector as an industry that includes architectural and engineering services, computer systems design, management and consulting services, and scientific R&D support.

American companies invested heavily in R&D activities within the professional, scientific, and technical services sector, spending \$32.1 billion in 2021, a significant increase from the \$19.0B spent five years prior. This represents a national growth rate of 14% year-over-year during the five-year period. Although Illinois had a robust CAGR of 8.7% year-over-year during the same time frame, it was outpaced by the national average. As a result, Illinois fell from its position as 7th-ranked among all states in 2017 to 10th in 2021, being surpassed by Washington, Pennsylvania, and Virginia. Despite this decline in ranking, Illinois remains a significant contributor to R&D in the professional, scientific, and technical services sector, with its companies continuing to invest in innovation and development.

HIGHER EDUCATION R&D

Strong research programs and investment into high-caliber technologies promote a university's regional and national reputation. Research at universities can provide building blocks for more findings at later stages of development and can lend support to other entities like businesses and government agencies. Universities serve as engines for growth in rural areas and serve populations that may not otherwise have access to the societal benefits that new science can provide. These tests and studies require time, effort, and capital investment. ISTC includes Higher Education R&D in this report because expenditures proxy the overall efforts and investments of different entities into research at universities in each state. The NSF's Higher Education Research and Development (HERD) Survey compiles all separately accounted-for R&D at higher education institutions across the U.S. and delineates this data by state.¹¹

..... • Nationally, FY2022 was a record year for investments in Higher Education R&D. The annual total of \$97.7B represents an all-time high for research expenditures in the U.S. This surge in funding is underscored by the impressive one-year growth rate between FY2021 and FY2022, which stood at 8.9% nationally.

Illinois colleges and universities demonstrated a robust commitment to scientific research in FY2022, collectively investing a record high of \$3.2B, up 8.5% from \$2.9B in FY2021, a noteworthy year-over-year increase. Between 2018 and 2022, Illinois maintained a CAGR of 5.3%, slightly below the national rate of 5.4%.

R1 universities in Illinois include [Northwestern University](#), [the University of Chicago](#), [the University of Illinois Urbana Champaign](#), and [the University of Illinois Chicago](#). R2 universities include [DePaul University](#), [Illinois Institute of Technology](#), [Illinois State University](#), [Loyola University Chicago](#), [Northern Illinois University](#), and the [Southern Illinois University System](#).

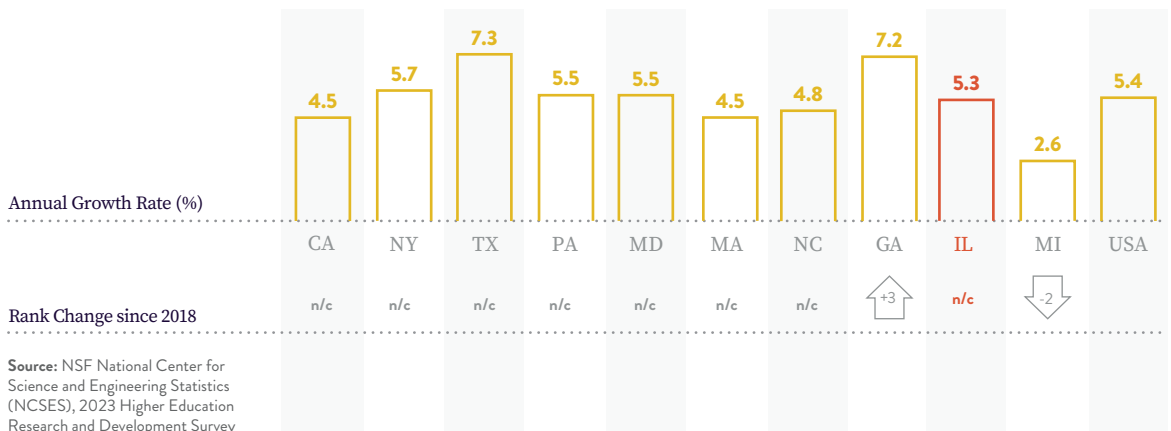
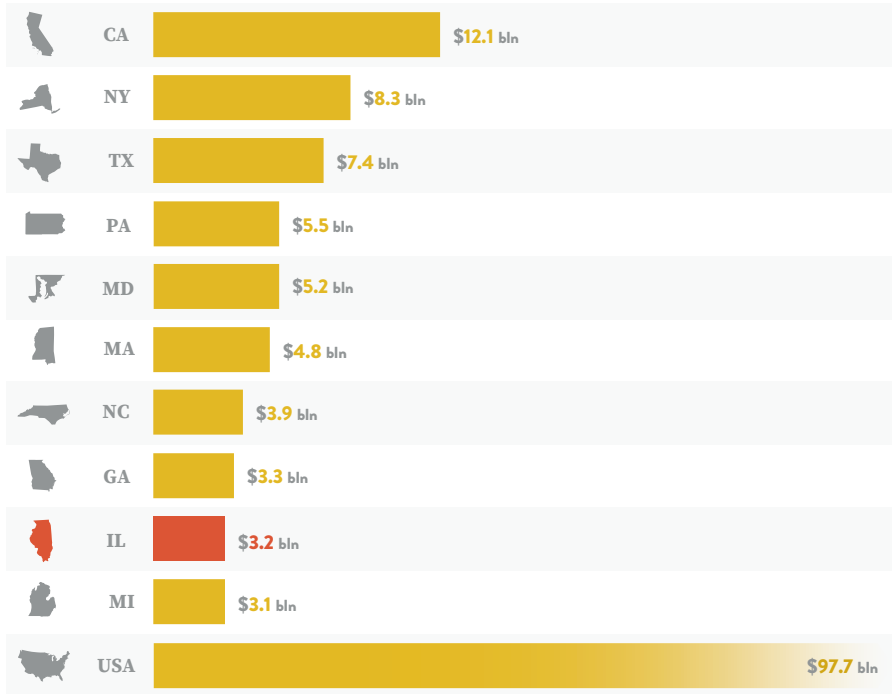
In 2018, Illinois ranked 9th in Higher Education R&D spending at \$2.6B, just behind Midwestern neighbor Michigan. In 2022, Illinois ranked 9th again but actually eclipsed Michigan's overall Higher Education spending; instead it was Georgia that outranked Illinois. In terms of five-year CAGR, Georgia's average growth sat at 7.2%, whereas Illinois' was 5.3% between 2018 and 2022. Over those five years, Georgia's colleges and universities spent \$157M more per year on average, while Illinois spent \$118M more each year on average.



Higher Education R&D

Top 10 States

2022

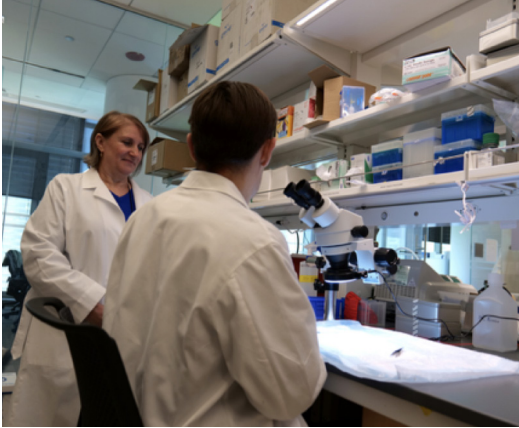


Source: NSF National Center for Science and Engineering Statistics (NCSES), 2023 Higher Education Research and Development Survey

Illinois ranked between 8th and 10th for research funding over the last decade. Michigan outperformed Illinois from FY2016 to FY2020 on Higher Education R&D but fell behind during FY2021. Illinois and Michigan both surpassed \$3B in research expenditures for the year for the first time ever in FY2022, but Illinois stayed ahead by continuing to attract higher investments from the federal government and nonprofit leaders. Illinois' university systems, University of Illinois and Southern Illinois University, as well as private universities like Northwestern and the University of Chicago had record-breaking years in external funding for research projects in 2021 and 2022.

Nationwide, \$53.9B of all R&D performed by institutions of higher education was provided by the federal government in 2022, which represented 55.3% of all R&D performed. For every dollar spent on

research by colleges and universities responding in the [HERD Survey](#), 55 cents are sourced from the federal government.¹² This represents a slight increase relative to past years of reporting. Among the top 10 states in Higher Education R&D for 2022, Illinois ranked 2nd behind Maryland (78.5%) in the percentage of funds received from the federal government, deriving 61.5% of its university research funding from federal sources.



▲ **Dr. Irina Balyasnikova (left) and the team investigate cutting-edge technologies that employ unique targeting modalities to activate the cells of a patient's immune system against glioblastoma, the most aggressive tumor in adults.** Photo courtesy of Northwestern University.



COMMUNITY
HIGHLIGHT



Northwestern
University

NORTHWESTERN UNIVERSITY

Tumor Research

Interview with Dr. Irina Balyasnikova

Dr. Irina Balyasnikova, PhD, is a professor of Neurological Surgery at Northwestern University and a member of the Lou and Jean Malnati Brain Tumor Institute (MBTI). In addition, she is a key researcher at the Robert H. Lurie Comprehensive Cancer Center and a mentor for students at Northwestern's Driskill Graduate Program in Life Sciences. Her research recently featured at the [MIT Science2Startup Conference](#) on April 10, 2024.

Dr. Balyasnikova and the team at the MBTI investigate cutting-edge technologies that employ unique targeting modalities to activate the cells of a patient's immune system against glioblastoma, the most aggressive tumor in adults. The development of these approaches, such as chimeric antigen receptor genetically modified T cells, called CAR Ts, and genetically engineered multi-specific antibodies and nanoparticles, are generously funded by the NIH, the Pat and Shirley Ryan Family Fund, and the Chicago Biomedical Consortium (CBC). Dr. Balyasnikova recently received the CBC Accelerator Award, which supports translational research to propel therapeutic discoveries from the lab bench to the market and provides university researchers with early commercial guidance.

"The Chicago Biomedical Consortium continues to provide me with mentorship and professional counseling from their team of experts who are helping me with scaling," Dr. Balyasnikova

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commented. “I was very impressed by the diligence of the Entrepreneurial Fellows, and they helped prepare me for the biotechnology conference at Cambridge.” Additionally, she credited her clinical colleagues at Northwestern, including Dr. Roger Stupp, Dr. Amy Heimberger, and Dr. Rimas Lukas, who each provided much-needed advice during her journey to presenting at MIT.

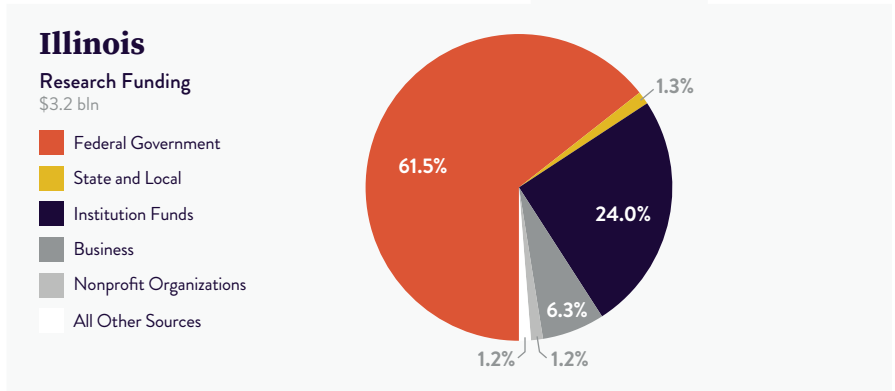
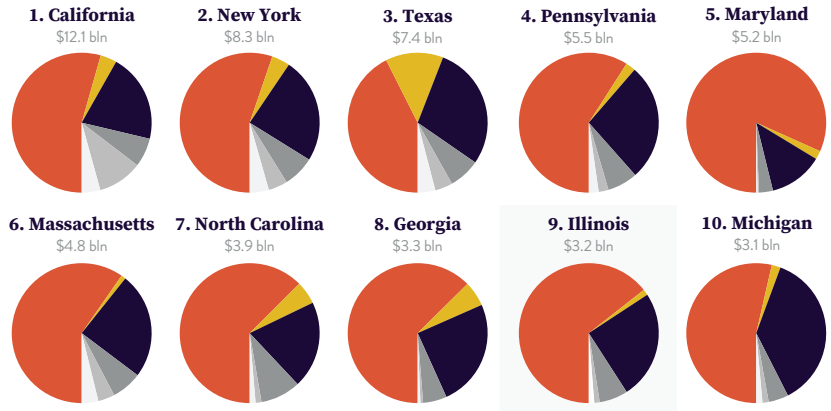
The MBTI is home to Dr. Balyasnikova’s studies and many other talented investigators. It is the national leader for medical research on brain tumors and patient care and provides specific recommendations on treating meningioma, low-grade gliomas, metastatic brain cancer, chordoma, glioblastoma, and pediatric brain tumors. The MBTI and Robert H. Lurie Comprehensive Cancer Center, in collaboration with the Feinberg School of Medicine, holds a Specialized Program of Research Excellence grant.

Overall, Northwestern University researchers were awarded more than \$1B in federally funded award dollars in FY2023, with more than half coming from the NIH. This funding will go to support 4700+ projects related to drug therapies, medical devices, and other technological innovations. One of these projects focuses on the improvement of mass spectrometry equipment used for research in Dr. Balyasnikova’s laboratory. Knowing how various novel treatments and delivery processes impact the cells of animals is an important early step in testing. Dr. Balyasnikova noted to us that she is working with a colleague at the Feinberg School of Medicine to “add an additional imaging approach to the work we are doing on brain tumors. These processes have to be robustly checked in multiple experimental models. Providing additional imaging can improve our ability to monitor patient responses.” You can read more about Dr. Balyasnikova’s research at [Northwestern.edu](https://northwestern.edu) and the [Robert H. Lurie Comprehensive Cancer Center webpage](#).

Higher Education R&D by Source of Funds

Top 10 States

2022



Source: NSF National Center for Science and Engineering Statistics (NCSES), 2023 Business Enterprise Research and Development Survey (BERDS)

ISTC has previously reported that reliance on institutions’ own funds had been steadily increasing since the global financial crisis of 2008–2009. A reversal seems to have taken place over the last several years in Illinois, as the burden has shifted more to the federal government. In 2018, 26.3% of R&D performed by universities in Illinois was intramural, whereas this fell to 24.0% in 2022. Funding from the federal government for R&D at Illinois universities has increased 6.8% each year on average since 2018, when the federal government invested \$1.5B in Illinois’ colleges and universities, reaching a record-high \$1.9B in 2022. Meanwhile, institutional funding only rose by 2.9% each year, a nearly 4 percentage point gap. Expanding the timeline to look at increases in funding by source between 2010 and 2022 shows that this percentage point gap is reversed: institutional funding for Higher Education R&D in Illinois rose by 3.28% year-over-year on average, whereas federal funding increased by 2.49% on average over that 13-year period. Recent surges in federal funding for universities are positively impacting universities in Illinois.

The full HERD Survey for FY2022 found that spending on R&D performed by American universities and their employees set a record high. Spending increased by 5.4% on average each year between 2018 and 2022. This is the highest nationwide five-year CAGR for Higher Education R&D since ISTC began producing the Innovation Index Series in 2013. Between 2021 and 2022, spending on Higher Education R&D increased by nearly \$8B, nearly twice as much as the previous largest one-year surge between 2017 and 2018 of \$4.5B.¹²



▲ Photo Courtesy of Dr. Phil Troyk and Illinois Institute of Technology



COMMUNITY
HIGHLIGHT

ILLINOIS
TECH

ILLINOIS INSTITUTE OF TECHNOLOGY

Research at Illinois Tech Leading to Better Outcomes for Visually Impaired People

Interview with Philip Troyk

Philip Troyk, PhD, is the Robert A. Pritzker Professor of Biomedical Engineering and the Executive Director of the Pritzker Institute of Biomedical Science and Engineering at the Illinois Institute of Technology. Dr. Troyk is also an instructor and Affiliated Professor in the Stuart School of Business at the university. His research focuses on neural prostheses — electronic instruments used to interface with the biological nervous system and mimic brain activity. These instruments are vital to the restoration of biological functionality in the brain, spinal cord, and peripheral nerves for those with impairments. Biomedical engineering research makes up a large part, although not all, of the research activities at Illinois Tech. Through the end of April, the university received \$46M in new awards in FY2024, 71% of which was from federal grants and other federal funding.

For the past 25 years, Dr. Troyk has led a multi-institutional team for the design and clinical testing of a brain-based visual prosthesis with the goal of providing artificial vision for people with vision loss. For this project, his eight-institution team, which includes Rush University, the University of Chicago, and the Chicago Lighthouse, is evaluating novel Wireless Floating Microelectrode Array (WFMA) devices implanted in human volunteers as part of a funded clinical trial through the NIH/ BRAIN Initiative. His leadership and experience are major reasons the Illinois Science and Technology Coalition named him an [Illinois Researcher to Know in 2024](#).

In the trial's first volunteer, 25 WFMA, comprising 400 microelectrodes, electrically stimulated the visual area of the brain with information captured by a camera that was mounted on glasses. Not having any connecting wires, the WFMA is powered by and communicated with through near-field magnetics. After two years of implantation and testing, the

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volunteer, who is totally blind, was able to use the intracortical visual prosthesis (ICVP) system to locate people in a room and find nearby objects. The technology is still in early stages, but due to the expertise of Dr. Troyk and his colleagues, including Dr. Frank Lane (Illinois Institute of Technology), Dr. Sepehr Sani (Rush University Medical Center), Dr. Vernon Towle (University of Chicago), Dr. Janet Szlyk (Chicago Lighthouse), and many of their collaborators around the country, progress is being made.

Dr. Troyk's work in the lab is highly cross-disciplinary and encompasses all aspects of neural prosthesis design, including electronic design, electrode development, implant fabrication, and clinical testing. More trials will be necessary to determine if the artificial vision substitute will aid in navigation for those with vision loss. Dr. Troyk is exploring other uses for the WFMA technology, including stimulation for spinal cord injury or pain management, and is developing new WFMA models that combine the neural stimulation function with sensing of neural signals, both over the wireless link. Advancements in medical technology like these can improve the well-being of people managing neurological conditions.

Illinois stayed consistent with the federal growth rate with a 5.3% CAGR between 2018 and 2022. The percentage of funding received from state and local governments for research partnerships stagnated in Illinois between FY2018 and FY2022. According to the NSF, state and local investments in research at Illinois universities decreased to \$41.7M in 2022 from \$45.4M in 2018. As a share of total Higher Education R&D expenditures, nationwide state and local investments made up 5% of total funding in 2022, down from 5.4% in 2018. In Illinois, state and local investments made up 1.3% of all Higher Education R&D in 2022, down from 1.8% in 2018.

Higher Education R&D Inputs

Illinois crossed the threshold of \$3B in higher education research activity in FY2022. Spending by the federal government related to Higher Education R&D surged across the nation, with federal investments in research at universities increasing from \$49.1B in 2021 to \$53.9B. At 6.8%, Illinois' five-year growth for federal contributions to university research outperformed the national average of 6.5% for 2018–2022.

The state is somewhat unique among U.S. states in that its private and public universities contribute at about equal levels to statewide Higher Education R&D. In states like Massachusetts, Connecticut, New York, Tennessee, and Missouri, the Higher Education R&D landscape is dominated by private universities. Meanwhile, states like Maine, Alabama, Arizona, Texas, and Florida feature public universities that perform a larger amount of R&D activities and projects. Illinois joins states like North Carolina and Pennsylvania in a smaller group of states in which private and public universities make roughly equal contributions.

Additional metrics beyond funding, such as the number of R&D personnel and the amount of available research space, are shown to have an impact on scientific productivity and the creation of more research at universities. Dr. Tom Coupé's research at the Kyiv School of Economics revealed that higher-paying universities attracted scholars who produced more patents. He also found that for every 1% increase in staff at American universities spending over \$20M on research, there was a 1.75% increase in university patents.¹³ Metrics on R&D personnel come from the NCSES and include head counts of the talent employed in each state by the university ecosystem. Additional data from the NSF reports on existing lab space and the amount of lab space being constructed each year. Higher personnel counts and R&D spending may work in tandem to help states increase research publication production. Increased funding allows for the employment of more staff to dedicate time and effort to creating studies and writing papers. This funding also facilitates the creation of more research space and improved equipment, heightening the precision of studies. Larger pools of researchers can generate knowledge overflows and foster more collaboration. Collaborative research often catalyzes innovation.

Illinois is a national leader in R&D employment for businesses and universities. For R&D personnel employed at universities and colleges in the state, Illinois ranked 5th in the nation in 2022, with a growth rate exceeding the national average between 2018 and 2022. Illinois' CAGR was 4.3% for academic R&D personnel during that span, higher than the national growth rate of 2.6% in the same period. Between 2018 and 2022, there were 1,440 research positions created on average each year at universities in Illinois.

ISTC has reported in the past that Illinois was falling behind other states in the availability of research space and wet laboratories, but this trend seems to have reversed during the 2021 and 2022 data years. Illinois' five-year CAGR between 2018 and 2022 for S&E research space outpaced the national average (3.42% vs. 1.78%).



**Illinois
Higher
Education
R&D Input
& Output
Indicators**

		INPUTS			
		Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
	Research Funding 2022	\$3.16 bln	9 n/c	5.3 IL	5.4 USA
	R&D Personnel 2022	46,408 people	5 ↑+2	4.3 IL	2.6 USA
	S&E Research Space 2021	10.5 mln sq. ft.	4 ↑+2	3.4 IL	1.8 USA
		OUTPUTS			
		Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
	S&E Publications 2021	15,272	6 n/c	1.6 IL	2.4 USA
	University Patents 2023	310	8 n/c	-3.9 IL	-4.1 USA
	Gross Licensing Income 2022	\$73.9 mln	10 ↓-6	-29.3 IL	6.7 USA

Source: NSF National Center for Science and Engineering Statistics (NCSES); Association of University Technology Managers (AUTM); Wellspring Scout Data Platform, Data Accurate as of July 9th, 2024

Higher Education R&D Outputs

Higher Education R&D outputs, primarily in the form of scientific knowledge, result from significant investments of time and resources in university research. This knowledge is disseminated through various channels, with research publications being a primary medium for communicating findings to both the public and fellow practitioners. The scientific method, underpinned by principles such as replicability and falsifiability, is upheld through rigorous peer-review processes. While not all scientific knowledge directly translates into innovations, published research serves as a foundation for future discoveries and insights. Illinois universities have a rich history of producing impactful research. Notable examples include contributions to the domestic semiconductor industry, development of healthier food options, and numerous pharmaceutical innovations.

Beyond publications, university patents represent a more tangible step toward innovation. These patents encompass potential services, processes, goods, and ideas in the realm of invention. Universities generate approximately 5% of all patents nationwide, and these inventions can significantly contribute to societal advancements. This section of the report examines the landscape of Higher Education R&D outputs in

Illinois, focusing on research publications and patents as key indicators of the state's academic research productivity and potential for innovation.

Illinois' innovation engine is the R1 and R2 universities that call the state home. The University of Illinois Urbana-Champaign, The University of Chicago, and Northwestern University each continually rank in the top 100 for university patent production and licensing revenue for the U.S. as a whole. Patent information in this report comes from the USPTO via the Wellspring Scout platform. Data collected on research publications comes from the NSF's NCSES and licensing revenue from the Association of University Technology Managers (AUTM).⁸

More than 15,000 articles and other publications were created by Illinois university faculty between January and December of 2021, the most recent year for which data was available from the Science and Engineering Indicators Dataset, which was published in December 2023.¹⁴ Illinois remained in 6th place for S&E research publications, consistent with its placement in 2017 and 2020. Illinois ranked 7th in ISTC's last [R&D Report, published in 2022](#).

In addition to research publications, university faculty participate in the innovation ecosystem by creating ideas that can eventually be turned into products and services for sale in the private sector. Means testing, commercialization, and the scaling of production do not occur within the university space, although university research departments often have large suites of technologies that could be profitable if sold at market. Licensing is a process whereby university faculty and others can gain access to knowledge, products, or technologies created within a lab or other research environment at a university. The university executes an agreement with the entity licensing the novel idea and, in an optimal situation, generates running returns and royalties on the new product or services that the entity grows.

Licensing income can be used by universities to reinvest in programming for entrepreneurs and greatly benefits many research-intensive universities, including those in Illinois. ISTC analyzes licensing royalties as an output from Higher Education R&D. The Association of University Technology Managers (AUTM) provides data on gross licensing income for a given year utilizing its survey.¹⁵ Information is submitted by university technology transfer offices each year. These royalties are often dominated by so-called "jackpot" licenses, particularly within the pharmaceutical research space. This report factors in licensing income as an output of the various investments and personnel decisions a university can make to create innovation.

Licensing income fell significantly in Illinois from 2018 to 2022. Illinois universities drew in \$294.7M during FY2018 and \$310.7M in FY2019, according to AUTM's data. This fell to \$160.9M in 2020 due to a drop in licensing revenue at Northwestern, with Pfizer's Lyrica losing its patent protection in 2018. The total gross income for universities in Illinois fell further still in 2022, dropping to \$73.9M. In five years, Illinois fell from 4th in licensing revenue to 10th among all states in 2022.



▲ Photo Courtesy of Dr. Laura Rice



UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Dr. Laura Rice Leads Research to Meet the Needs of People with Long-Term Disabilities

Interview with Dr. Laura Rice

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A smart bathroom optimized for safety and mobility disabilities. A tai chi telewellness program. Fall detection devices for people who use wheelchairs. All of those are projects associated with the Rehabilitation Engineering Research Center on Technologies to Support Aging-in-Place for People with Long-Term Disabilities, also known as RERC TechSAge. Anchored at the University of Illinois Urbana-Champaign, this collaborative grant center has more than a decade of experience researching innovative solutions for persons with disabilities.

The center is one of many institutes and research facilities on the Urbana campus. In FY2023, Illinois researchers received \$806M+ in more than 4,600 separate research awards. The funded research projects spanned fields from the creative arts and quantum physics to research on cancer, water, agriculture, railroad transportation, and more. Illinois' flagship university system has a legacy of innovation and a diverse research portfolio. Interdisciplinary research is at the heart of both the TechSAge mission and the goals of the Collaborations in Health, Aging, Research, & Technology (CHART) program.

Led by Illinois Health and Kinesiology Associate Professor Laura Rice, TechSAge researchers are working to meet the lifestyle needs of people with long-term disabilities by conducting advanced engineering research and developing innovative

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technologies. Dr. Rice is an expert on the management of secondary impairments associated with physical disabilities and increasing quality of life and community participation for persons with disabilities. She was awarded the Distinguished Lecture Award by the Academy of Spinal Cord Injury Professionals in 2019 and is a 2024 Illinois Science and Technology Coalition Researcher to Know.

TechSAge leadership also includes collaborators from multiple universities, including the Georgia Institute of Technology, Georgia State University, and the University of Kansas; the consulting firm Person in Design; and corporate and community partners.

Over the next several years, Dr. Rice and her team will focus on prioritizing support for successful aging among people with long-term disabilities. Their projects include researching and developing meaningful, useful self-care technologies, including “smart bathroom” technology designed to maximize safety and independence; monitoring and managing falls in real time; and independent indoor navigation support for older adults with vision impairments.

Additionally, TechSAge’s “Innovation Incubator” will serve as an important resource to support the development of early-stage, rapid response pilot projects that align with the program’s mission. Four projects will be developed targeting primarily body functions and structures and activity.

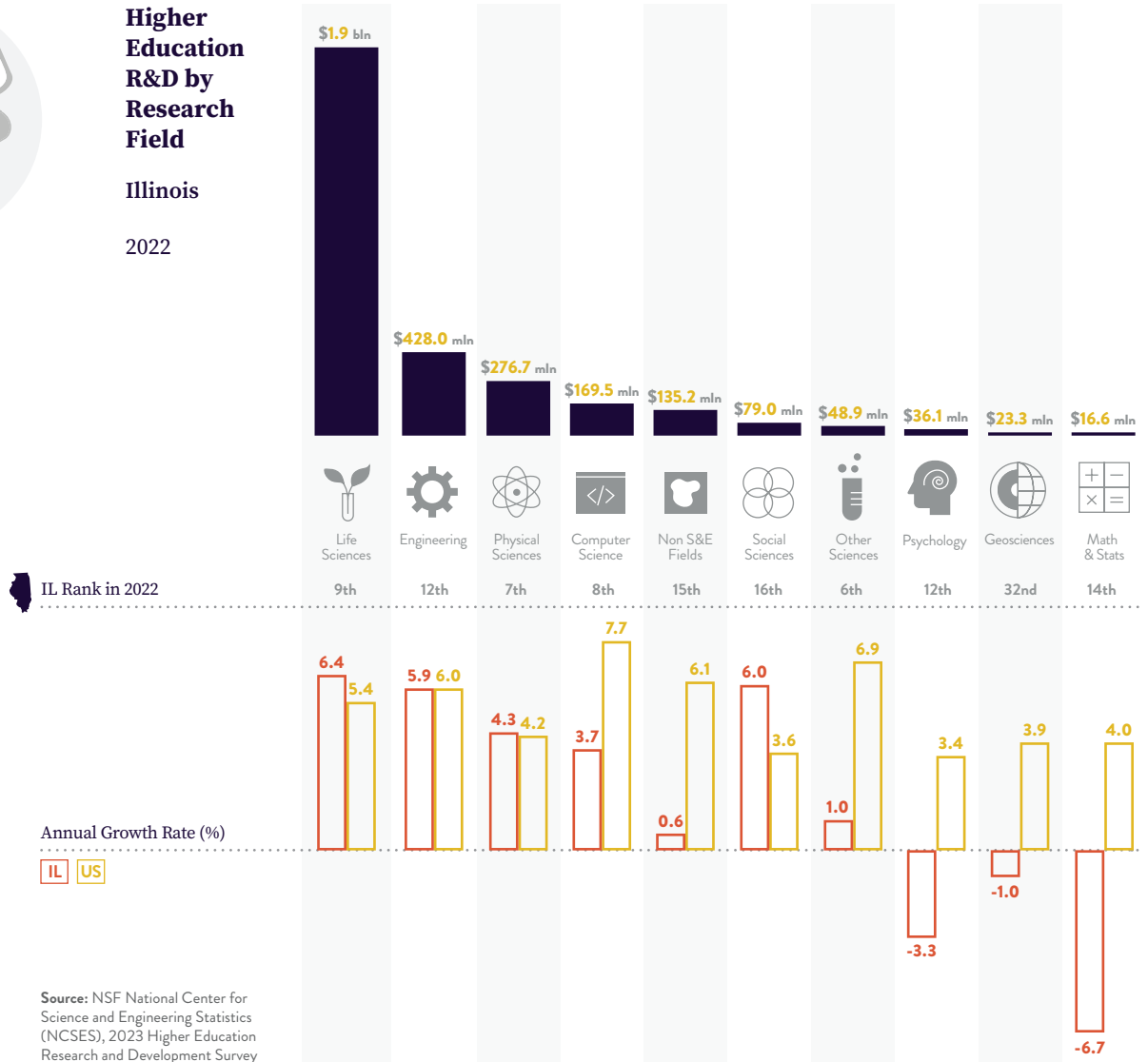
At the forefront of innovative research for individuals with long-term disabilities, TechSAge exemplifies the commitment of Urbana researchers to enhancing the lives of citizens in Illinois, across the nation, and around the world.

According to the USPTO, 334 university patents were created in 2023. These are patents for which the principal investigator for the patent, according to the USPTO, was employed as a researcher at a university in Illinois. ISTC relies on [Wellspring and its Scout platform](#) for sorting through the types of patents that are created in Illinois each year. Illinois ranked 8th on the university patent metric in 2023, a rank it has held for the last four years. Nationally, university patent creation slowed considerably during the pandemic, with a fall of 1.16% year-over-year on average from 2019 to 2023. In Illinois, patent creation dropped by about 2.46% on average each year during the same period.⁸



Higher Education R&D by Research Field

Illinois
2022



Source: NSF National Center for Science and Engineering Statistics (NCSES), 2023 Higher Education Research and Development Survey

Higher Education R&D Classified By Research Field

The NSF’s classification system for Higher Education R&D requires institutions to categorize research expenditures according to NSF codes, which group similar research projects together. This system simplifies the diversity of codes used in the [Integrated Postsecondary Education Data System \(IPEDS\)](#), offering a clearer view of how universities allocate research funding. This classification is crucial for understanding which institutions attract federal funding for specific research areas. For example, despite ranking 72nd in overall research spending, the State University of New York’s (SUNY) Polytechnic Institute in Marcy, New York, ranked third in engineering R&D expenditures nationwide. Such detailed categorization, where 99.6% of SUNY Poly’s research funds were engineering-related, highlights the concentration of resources in specific fields. Some types of interdisciplinary and multidisciplinary research can be difficult to classify, and for this reason there is a catch-all category of “sciences, not elsewhere classified” or “other sciences.”

This approach not only aids in comparing funding across institutions but also provides insights into state-level contributions to national economic strategies. Trends in these fields can indicate shifts in federal priorities or changes in a state's innovation landscape, making it essential for policymakers and researchers to track R&D investments by field. This perspective helps stakeholders assess how effectively universities contribute to broader research goals and economic development initiatives at both state and national levels.

Illinois' universities are major contributors to the life sciences innovation ecosystem, ranking 9th compared with other states in 2022, and within chemical and molecular engineering. Illinois also remains a national leader in research in computer and information sciences (8th in 2022), physical sciences (7th; up one spot from 2018), psychology (12th), engineering (12th), and "other sciences," which often includes multidisciplinary or interdisciplinary sciences research (6th).

Life Sciences

In 2022, spending on life sciences R&D represented just under 58% of all Higher Education R&D each year in the U.S., with a total of \$56.5B in spending. This is by far the largest of all research fields. Life sciences R&D spending includes basic research on bioactive materials, new studies on pathology, diagnostic testing, and other types of lab work, like those being utilized to study inflammation.

Illinois ranked 9th in life sciences Higher Education R&D expenditures in 2022, with a total of \$1.9B in spending. Between 2018 and 2022, Illinois' five-year CAGR of 6.4% for life sciences exceeded the national average of 5.4%. Despite this faster-than-average growth rate, Illinois dropped in ranking between 2018 and 2022 from 8th to 9th. Ohio now ranks 8th in life sciences expenditures, with an exceptionally high average annual growth rate of 8.7%.

In Chicago, the [Chan Zuckerberg Initiative](#), a major nonprofit philanthropic leader, announced the creation of an inflammation-focused biohub in Chicago, with a \$10M investment over the next 10 years in the city. Their team will also build connectivity and incentivize collaboration between each R1 university in the state of Illinois to facilitate information sharing on bioinformatics. The opportunity to create a cross-institutional team of some of the world's brightest biomedical minds is just part of why Chan Zuckerberg chose to invest in Illinois.

Outside of Chicago, life sciences research in Illinois is a major focus of the state's namesake University System, and the University of Illinois Urbana Champaign is a national leader in research into agricultural sciences,

biological materials and fermentation. In 2023, the EDA named the Illinois Fermentation and Agriculture Biomanufacturing (iFAB) Tech Hub, which focuses on precision fermentation, as one of 31 official designees of the inaugural Tech Hubs program. The [EDA's Tech Hubs program](#) promotes place-based innovation across the country by organizing a competition between multiple major U.S. scientific corridors and hubs.

The iFAB Tech Hub will leverage Central Illinois' reputation for bioprocessing excellence to improve supply chain resilience. iFAB is led by the University of Illinois' Integrated Bioprocessing Research Laboratory (IBRL), a commercialization-focused team that was created through a \$43M state investment in 2018. In July 2024, the iFAB Tech Hub was selected from among the program's semi-finalists as one of the recipients of an implementation grant, valued at \$51M. Additional R&D and innovation at the University of Illinois' College of Agricultural, Environmental and Consumer Sciences (ACES) will also be supported by this grant.

Physical Sciences

Illinois' five-year CAGR has slightly outpaced the national average for physical sciences, with investments increasing by 4.3% each year since 2018, compared to 4.2% nationally. Illinois universities ranked 7th in the nation for investments into physical sciences research, climbing above Pennsylvania between 2018 and 2022.

Physical sciences includes research in elementary particle physics, optics, high-temperature plasma sciences, and material physics. Each of Illinois' R1 universities ranked in the top 25 for physical sciences Higher Education R&D in 2022 nationally. Major investments from the federal government in Chicago contributed to the state's 7th place ranking for physical sciences research in 2022. Between 2018 and 2022, 84.6% of the overall growth in Illinois for physical sciences R&D at universities was due to increases in expenditures at Northwestern, University of Illinois-Chicago, and the University of Chicago.

Computer and Information Sciences

Illinois universities were the 8th-largest spenders, by state, on computer and information sciences (CIS) research in 2022. Between 2018 and 2022, CIS research grew by 3.7% on average in Illinois, slower than the national rate of 7.7%.

CIS includes all research on the design and development of new computer capabilities related to communication, data storage, and data manipulation. The creation of new software and databases for the management of information is also included in this field.

The University of Illinois System remains a national leader in CIS research, ranking 6th among reporting universities in 2022. University of Illinois physicist Larry Smarr wrote a 1982 critique of America's technological preparedness in computing for the NSF. The result was the creation of the [National Center for Supercomputing Applications \(NCSA\)](#) at the university. Among the many innovations developed through this joint venture by the university and the NSF was the creation of the Mosaic web browser, which was the precursor to Microsoft's Internet Explorer browser.

The University of Chicago also has a robust research environment for CIS, including the [Chicago Quantum Exchange \(CQE\)](#). CQE is a community of researchers, including UChicago faculty, that combines engineering know-how with the research might of national laboratories like Fermilab and Argonne National Laboratory. Quantum information sciences is an emerging sub-field of both engineering and computer sciences related to the construction and operation of new supercomputers.

Engineering

Illinois universities ranked 12th in the nation in R&D expenditures related to engineering research in 2022. Illinois' five-year CAGR was 5.9% between 2018 and 2022, just below the national average of 6%. Illinois features two engineering schools that rank in the top 25 of R&D expenditures in the nation by institutions; the McCormick School of Engineering at Northwestern and the Grainger School of Engineering in Urbana.

Engineering includes studies of the creation of new materials and the exact properties of these materials under different conditions. More classic engineering research also includes aeronautical, astronautical, computer, electrical, civil, and industrial engineering. While the interdisciplinary nature of engineering research, especially that of engineering dealing with electronics and computers, make classification difficult, the NSF does report the category separate from other STEM areas. Recent federal investments like the EDA's Tech Hub Implementation funding for the iFAB hub will be utilized in part by engineering researchers.

Quantum

Outside of the traditional science and engineering research categories, Illinois is creating a vast ecosystem for quantum research and talent development. Quantum research is a focus that resists easy classification. Thus, many research engagements within the quantum field may have fallen into other categories, such as engineering, computer sciences, mathematics, and physical sciences.

Quantum technology combines principles of [quantum mechanics](#) and [quantum computing](#). Quantum physics examines the smallest known quantifiable particles of both light (photons) and electricity (electrons). The measurement of these microscopic elements is important for creating next-generation computers. While binary codes are the legacy basis for electronic communication and modern computers, quantum computers currently in development move beyond this model by relying on the nature of quantum mechanics to store information on qubits, which are capable of staying in a state between the values of 0 and 1, when the quantum information is in a state called superposition. When this superposition collapses—a process that occurs over mere milliseconds—calculations and other information transfers can occur much faster than in traditional electronic computers.

The proximity of Chicago to industry leaders like [Discover Financial](#) and [IBM Quantum](#) and the availability of cutting-edge research tools at Fermilab and Argonne place Illinois in an enviable position. Illinois is a national leader in quantum computing research, playing host to four out of the nation's ten quantum data centers. Due to this premier location a California based Quantum startup [announced in July](#) that they plan to build a quantum campus that will include the [Illinois-DARPA Quantum Proving Ground](#). Psiquantum is a member of CQE.

Chicago was also selected by the U.S. Economic Development Administration (EDA) for the creation of a first-in-the-nation quantum information sciences tech hub. Named the Bloch Tech Hub, the joint venture between CQE and P33 will focus on making scientific discoveries through the use of quantum more achievable while creating new good-paying jobs for Chicago residents. iFAB and Bloch Tech Hub represent two of the 31 Regional Technology Hubs that were originally announced as part of the CHIPS and Science Act in 2022.

Social Sciences

Illinois' five-year CAGR for social sciences R&D was 6% between 2018 and 2022, higher than the national average of 3.6%. This is a considerable improvement from the five-year CAGR of -5.1% between 2014 and 2018. Illinois ranked 16th in the nation for Higher Education R&D in the social sciences in 2022, down one spot from 2018.

Social sciences as a category includes research on economics, political sciences, sociology, anthropology, criminology, history, urban studies, and certain types of geography and business development. These fields focus on research using quasi-experimental design and target topics related to human decision-making.

Social sciences R&D had been trending downward for many years in Illinois. However, the COVID-19 pandemic called increased attention to the critical importance of research into global health disparities and access to medicine, spurring activity in this field. This research combines traditional scientific methodology with a social sciences lens.

Psychology, which also combines social sciences methodology with research on brain chemistry, grew nationally by about 3.4% each year between 2018 and 2022. However, Higher Education R&D expenditures on Psychology research at Illinois universities fell during the same period from \$41.2M to \$36.1M. Illinois' universities ranked 12th nationally for psychology research in 2022, down from 8th in 2018.

Mathematics and Statistics

Higher education expenditures in Illinois for R&D related to new applications in mathematics and statistics fell from \$21.3M in 2018 to \$16.6M in 2022. Illinois' five-year CAGR for expenditures in mathematics dropped by 6.7% each year in that time frame. This amounted to an overall drop of approximately \$5.3M. Illinois universities ranked 14th nationally in 2022, down from 10th place just five years prior.

While Illinois' performance of R&D related to mathematics fell sharply, the national rate of investment increased by about 4% each year between 2018 and 2022. Investment in the U.S. overall increased from just over \$753M to \$879.5M.



▲ Photo Courtesy of Dr. Colin Kuehl



Illinois Researchers Analyzing Impact of Social Media Messaging Using Machine Learning Tools

Interview with Dr. Colin Kuehl

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Social media connects individuals to information, news, ideas, and to each other. Public agencies across the U.S. utilize social media to communicate with constituents about matters of importance. Dr. Colin Kuehl, Assistant Professor of Political Science and Environmental Studies at Northern Illinois University, and Dr. Nic Guehlstorf, Chair of the Department of Political Science at Southern Illinois University Edwardsville, are embarking on a study to analyze the impact of social media outreach on constituent behavior. The results of this study will have important

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implications concerning the effectiveness of messaging by government agencies in the Midwest and beyond as well as adding to the body of literature regarding the relationship between social media and public administration.

As part of their research, Dr. Kuehl and Dr. Guehlstorf plan to utilize a machine learning tool known as BERT (Bidirectional Encoder Representations from Transformers) to analyze and process natural language. This natural language processor will examine the breadth of social media posts by various state and local agencies focused on sustainability to identify different conceptual trends in public administration messaging. Both researchers have a background in comparing messages that intended to shape public behavior and communication strategies focused on sustainability. The goal of utilizing the large language model is to increase the breadth of the study by analyzing a larger number of tweets from hyper-local government entities, which increasingly use social media outlets to communicate necessary information to their constituents.

In an interview with ISTC, Dr. Kuehl discussed how machine learning would be used in the project and stressed the importance of collaboration, saying, “We were generously gifted a \$40K award by the Illinois Innovation Network [IIN] to utilize a machine learning tool for this project. The SIUE Center for Predictive Analytics will also play a major role in adapting machine learning tools to the questions we are asking. The grant will be used to build our team that will gather data and pretrain models using the social media accounts for local government entities in Illinois, Wisconsin, Indiana, Iowa, and Michigan.” A portion of the IIN grant will be used to train a graduate research student in R and Python to assist in the data analysis.

“Without BERT, it would be very difficult for one individual or team of students to categorize 5,000 tweets. With the assistance of machine learning, we can categorize hundreds of thousands of tweets by messaging frame and focus. This big data then allows us to show messages over long periods of time and across different places,” said Dr. Kuehl. The work, which would normally be conducted with the assistance of graduate and undergraduate students in social science research, will now be accomplished through the support of BERT. However, Dr. Kuehl emphasized that this will not diminish the role of graduate students in social science research, as the computer model will still need to be calibrated with the assistance of students coding by hand.

UNIVERSITY-INDUSTRY COLLABORATION

Understanding university-industry collaborations is crucial for assessing the health of a region's innovation ecosystem. These partnerships often face challenges related to communication, role definition, facility usage, and ownership of research outcomes.¹⁶

Despite these hurdles, successful collaborations can result in shared grant opportunities, patent creation, and co-authored research publications. Government funding often provides the foundation for basic research, while business funding tends to drive more applied research and development. The interplay between these funding sources is critical for the success of university-industry collaborative R&D projects. By analyzing data on these collaborations, policymakers, industry leaders, and academic institutions can make informed decisions about resource allocation and strategic partnerships to enhance innovation outcomes.

..... • Higher Education R&D expenditures funded by industry partners, according to the HERD Survey, reached \$5.7B nationwide in 2022, a record high. Most Higher Education R&D expenses are financed through the federal government and an institution's own funds, but business investments in R&D projects at universities are important as well. Between FY2021 and FY2022, funding from businesses for university R&D projects increased by \$587M. This was [the largest one-year dollar increase on record](#) for business investments in Higher Education R&D.¹² In 2021, Higher Education R&D funding provided by businesses stayed consistent with the two prior years. Funding by businesses for Higher Education R&D hit \$5.0B in 2019, \$5.2B in 2020, and \$5.1B in 2021. Since 2018, there has been a larger amount of funding provided by businesses that university researchers can utilize to finance their projects.

Federal investment and allocation of resources as well as state grant programs can incentivize university-industry collaborations. The National Institute of Standards and Technology (NIST), in addition to the NSF and the EDA, has made several investments in Illinois related to creating partnerships. The NIST is a federal agency that promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology. The NIST provides support to corporations and universities in the R&D landscape through various programs, such as the [Manufacturing Extension Partnership \(MEP\)](#). It also supports the U.S. Small Business Administration (SBA) by providing technical assistance on both the [Small Business Innovation Research \(SBIR\)](#) program and

the [Small Business Technology Transfer \(STTR\)](#) program, both of which provide financial support to small businesses. The STTR program in particular is beneficial for academic institutions, as only businesses that license university technology are eligible for the program. Incentivizing more small business participation in the marketplace allows for more competition, and these carve-outs are important to the continued creation of new businesses.

It was [announced](#) in May 2024 that through its new Technology, Innovation and Partnerships (TIP) directorate, the NSF will allot \$1.2M to a pilot of an AI-powered tool known as Halo. Halo Cures is a software company, based out of Chicago, that provides collaboration solutions for R&D teams. It has onboarded thousands of innovators from across the globe onto its platform. The pilot will first focus on emerging research institutions and will allow Halo to connect researchers at those schools with corporate R&D teams in the materials science and engineering sector. Emerging research institutions are those schools receiving less than \$50M in federal R&D expenditures. Fostering connections with emerging research institutions will allow companies to access technologists and innovations relevant to their missions that may normally go unnoticed.

Agriculture is another sector in which federal investments foster crucial connections between academic leadership and emerging businesses. The [Illinois Fermentation and Agriculture Biomanufacturing \(iFAB\) Tech Hub](#), is just the most recent example of Illinois' leadership in university-industry collaboration within precision agriculture. The hub has received promises of technical and financial support from over 30 organizations, ranging from nonprofits to corporations, amounting to nearly \$680M in external support. Additional R&D and innovation at the University of Illinois' College of Agricultural, Environmental and Consumer Sciences (ACES) will also be supported by the EDA's Tech Hub Implementation grant. This award represents a major achievement for Illinois as well as [a win for women-led innovation](#).

ISTC believes businesses can capitalize on the resources and expertise available at Illinois' universities. One initiative that unlocks the benefits of industry-university partnership is the Illinois Innovation Voucher program, which aims to expand opportunities for small-to-midsize businesses to participate in collaborative research and development. The program was signed into law by Governor Pritzker in 2021 and fully funded in the 2023 legislative session on the back of major investments into laboratories and facilities at Illinois' universities. Innovation Vouchers target STEM practitioners in the private sector that want to bring ideas to market through the assistance of researchers at any of Illinois' qualifying institutions of higher education. Small and medium-sized enterprises can partner with a non-profit institution of higher education to [apply for a voucher](#) that offers up to \$75,000 in support for eligible projects.



▲ Photo Courtesy of Dr. Meera Raja (Compete)



COMMUNITY
HIGHLIGHT



CHICAGO BLOCH TECH HUB

Chicago Quantum Exchange, University of Chicago, P33, Duality, and Others Partner to Pursue Innovations in Quantum Information Science and Technology (QIST)

ISTC recently sat down with Meera Raja, the interim Regional Innovation Officer for Bloch Tech Hub-Chicago and P33's SVP of Deep Tech, to discuss the city's quest to be the world's leading hub for quantum information science and technology (QIST). Chicago's 'Bloch Tech Hub' was designated as a U.S. Economic Development Administration (EDA) Tech Hub in October 2023, which unlocks opportunities for grants from the EDA and other government agencies like the Department of Commerce, the National Science Foundation, and the Department of Energy.

QIST is a growing field that has the potential to revolutionize multiple industries, such as finance, transportation, manufacturing, healthcare, and defense and develop countless technical and nontechnical jobs. The Bloch team aims to drive quantum technology from the lab to industry, enabling full sectors to work together to build quantum solutions for society's most pressing concerns, unlocking the full promise of quantum. Raja stated, "We want to de-risk quantum solutions by bringing together technologists and industry leaders. Our goal is to grow the Chicago MSA economy by demystifying the ways quantum can be incorporated into multiple different sectors." The team will also aim to build a robust, enabling ecosystem of infrastructure and workforce to meet the growing needs of the field. This work is spread across 7 different projects; if all projects are funded the team estimates that the Hub will deliver \$60B in regional economic impact over the next decade. The federal government awarded the Bloch Tech Hub with a \$500,000 grant to continue the team's activities in July of 2024.

The Bloch Tech Hub is made up of a strong coalition of industry partners, startups, higher ed, and nonprofits, with select projects led by IBM, and Inflection, as well as university and community

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college leadership. Illinois has an accomplished history of creating new computing technology. Raja noted that one of the first sectors that will potentially see the impact of advancements in quantum technology is the finance space. Encryption and quantum cryptography are ripe for innovation. Creating a pipeline of tech talent to enable smart development in the future will require that major employers adopt technologies within the quantum space, and financial institutions seem to be willing to take this leap.

Led by efforts like the Chicago Quantum Exchange and by conveners at Fermilab and the University of Chicago, Illinois has been working to build a robust quantum ecosystem for more than a decade. The region received 40% of the 2018 National Quantum Initiative (NQI) center funds to build four NQI centers across the state; is home to Duality, the nation's first quantum startup accelerator and No. 2 in the nation for deals made by quantum startups; and has one of the country's largest quantum-ready talent pipelines, awarding almost 60,000 degrees and certificates annually in quantum-relevant skills. "There is potential for major downstream impact; this is why this technology is very exciting despite the novelty, and why we are so excited to be involved in creating a path forward," said Raja. Readers can stay in tune with The Bloch Tech Hub by visiting the websites of [P33](#), [ISTC](#), or [Innovate Illinois](#).

University-Industry Collaboration Inputs

Collaborative research agreements between private industry and higher education institutions require mutual commitment and clear communication of responsibilities. These cross-sector engagements allow businesses to leverage academic expertise and resources while offering universities opportunities for applied research. Initiating these projects necessitates investments in personnel and facilities, primarily funded through internal budgets of universities and businesses, with additional support from various government levels. Inputs on these projects are the internal budgeting and external fundraising that principal investigators and project leads must account for when considering the possibility of R&D collaboration.

Illinois' entrepreneurial ecosystem provides growing resources to foster these engagements. Organizations like ISTC, institutional nonprofits such as the Chan Zuckerberg Initiative, and federal government programs offer initial funding and support to small businesses seeking to improve their

offerings. These opportunities allow businesses and academic partners to pursue shared grant funding for their collaborative teams and facilities.

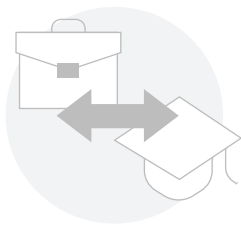
Wellspring's Scout Platform tracks grant recipients and allows users to view past awardees by entity type. These 'shared grants' represent additional funding sources for university-industry collaborators to advance R&D projects and drive innovation. They complement the internal investments already made by collaborators for proposal creation and preliminary testing, serving as an additional input to the creative activity of these partnerships.

Higher Education R&D activities tracked by the NSF's HERD Survey focus exclusively on separately accounted for research expenditures. One component of this reporting compiles R&D projects and examines their funding sources. Surveying each states' institutions of higher education provides insight into how much funding higher education institutions received in support from business partners. These partners utilize university resources to commercialize products and services or to source talent for ongoing projects, and they often sponsor projects through university resource offices (sponsored projects) or research parks (tenancy and other engagements).

Wellspring's Scout platform aggregates federal grant-making by government agencies into one dataset utilizing grants.gov.¹⁷ Grouping together government-sponsored grants that were awarded to principal investigators from both a business entity and an Illinois university reveals the amount of interest the federal government and businesses have in the research occurring at academic institutions in Illinois. Shared grants can also serve as indicators of a strong level of institutional and business support for universities. Universities that receive the highest amount of intramural support from agencies, via SBIR, STTR, or other programs, often perform and assist in research on cutting-edge science that benefits national defense or energy infrastructure.

According to Wellspring's Scout platform, 29 shared grants were passed through for collaborative research at Illinois universities in 2022. Most of these grants came from the U.S. Department of Defense, while a smaller portion came from the Department of Energy through the STTR program. A sizable number also came from the European Union's R&D apparatus. The state ranked 10th in 2022 on this metric, per Wellspring's platform. In both Illinois and the U.S. overall, the total amount of shared grants has fallen slightly year-over-year since the onset of the pandemic. From 2018 to 2021, Illinois averaged around 33.5 shared grants a year, slightly higher than the 29 received in 2022. Likewise, the U.S. averaged 884.8 shared grants per year on average between 2018 and 2021, but only 787 overall shared grants were awarded to university-industry collaborators in 2022.

In Illinois, Higher Education R&D activity funded by businesses has grown 3.58% year-over-year on average since 2018. In 2022, funding provided by businesses amounted to \$198.2M in research activity by universities and colleges in the state, and Illinois continued to rank 8th in the nation for the amount of Higher Education research expenditures funded by businesses. As a percentage of total R&D activity by universities and colleges in Illinois during 2022, business investments made up 6.3% of all funding sources, ranking Illinois 12th in the nation by composition. For comparison, the national average for Higher Education research activities funded by business partners was 5.8% in 2022. In 2018, Illinois ranked 10th on the same metric, indicating that some states have outpaced Illinois in attracting business partners for university research activity.



University-Industry R&D Collaboration Input-Output Indicators

Illinois

2022-2023

Source: NSF National Center for Science and Engineering Statistics (NCSES); Wellspring Scout Data Platform, Data Accurate as of July 3rd, 2024

INPUTS

	Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
Uni R&D Funded by Industry	\$198.2 mln	8 n/c	3.6 IL	4.8 USA
Shared Grants 2022	29	10 ↓ -2	-3.2 IL	-2.0 USA

OUTPUTS

	Value	IL State Rank (5 year change)	Annual Growth Rate (%)	
Co-assigned Patents 2023	49	9 n/c	-3.3 IL	-3.9 USA
Co-authored Publications 2023	726	10 ↑ +3	9.0 IL	2.9 USA



▲ Photo Courtesy of Illinois State University/ Redbird Scholar magazine



ILLINOIS STATE UNIVERSITY'S Sustainable Energy Consortium

[The Sustainable Energy Consortium \(SEC\)](#) at Illinois State University is advancing sustainable energy education, interdisciplinary research, and industry partnerships. The SEC supports majors and graduate programs within the

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Department of Technology at Illinois State University by organizing sustainable energy forums to encourage advocacy for renewable technologies on campus and within local communities. Additionally, the Consortium invites energy and sustainability experts to campus for workshops and seminars, enriching the educational experience for students and the public.

The SEC dedicates itself to applied research in sustainable and renewable energy by seeking grant opportunities and fostering collaboration across disciplines. Through industry partnerships, the Consortium maintains the relevance and applicability of its research, supporting connections within student research initiatives and promoting innovative solutions to energy challenges. For example, the SEC conducted a case study for Carle Health to evaluate the feasibility of microgrid system implementation for its three facilities in the area, which helped it to improve the hospitals' energy resilience by installing a microgrid consisting of a photovoltaic system, a battery storage system, and an electric vehicle charging station. Leveraging the expertise of its members, the SEC advances renewable energy technologies, policy development, and sustainability practices, contributing to the global transition toward a low-carbon future. The Consortium facilitates workshops, conferences, and training programs that promote interaction and understanding beyond the academic community.

The SEC supports the NSF-sponsored SUPERCHARGE (STEM-based University Pathway Encouraging Relationships with Chicago High Schools in Automation, Robotics, and Green Energy) program to increase participation in STEM fields among underrepresented populations. Through this project, SEC faculty and students collaborate with Chicago Public Schools (CPS) and community-based organizations to provide after-school programs in robotics, automation, and renewable energy. Last year, 45 students at CPS attended the after-school programming. The NSF aims to help these students self-actualize and find STEM-related career opportunities. Through workshop activities, guest speakers from industry offer their expertise to the students and provide students with opportunities to gain lifelong mentors.

Additionally, the SEC is leading efforts to establish a research coordination network for net-zero carbon energy transitions,

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partnering with prestigious institutions such as Syracuse University, The Ohio State University, Rice University, and seven other universities. This network aims to drive collaborative research efforts toward achieving ambitious sustainability goals, leveraging its member institutions' collective expertise and resources to address complex global energy challenges. This is in keeping with the SEC's goal to "accelerate the transition to a sustainable future by enhancing education, research, and industry partnerships."

University-Industry Collaboration Outputs

Partnerships between universities and industry typically intend to result in either shared, or co-assigned, patents or in new research articles. States that feature more investment by business partners should see co-assigned patent numbers increase in years following the investments that researchers, at both public and private schools, receive from business partners at research parks and through sponsored projects. Dr. Branco Ponomariov's study, "Effects of university characteristics on scientists' interactions with the private sector: An exploratory assessment," found that business R&D at universities positively influenced faculty interactions with the private sector. His survey of U.S. university faculty supported this conclusion.¹⁸ ISTC anticipates that increased funding and partnership will result in more co-authored publications statewide.

Wellspring's Scout aggregator reported that Illinois ranked 9th in co-assigned patent generation in 2023 and 10th in co-authored publications.⁸ Co-assigned patents declined slightly in 2023; however, as patent applications take years to be accepted, more 2023 patents could be issued in years to come. Co-authored publications have surged by more than 200 yearly publications over the last few years in Illinois. In 2019, Illinois universities created 514 co-authored research publications in partnerships with businesses, according to Scopus data reported by the Wellspring aggregator.¹⁹ In 2023, 726 co-authored publications were created by university researchers in partnership with businesses. Illinois' five-year CAGR for the metric was 9.0% between 2019 and 2023, much higher than the national average of 2.9%.

Illinois' number of co-authored publications and co-assigned patents place Illinois above the national average CAGR for the creation of knowledge and intellectual property. Among U.S. states, by five-year CAGR, Illinois ranked 20th for co-assigned patents and 9th overall for increases in the number of co-authored research publications. This indicates that Illinois

universities have stronger collaborative ecosystems than most states and that the state's researchers have a significant impact on the scientific community, both private and public.

Anchored by the university system in Illinois, corporate relationships help crystallize work performed in the lab. A strong example for the future of these collaborations comes from the NSF's [Regional Innovation Engines program](#), which awards funds to teams of innovators across the country to catalyze the development of technological solutions for urgent societal challenges while bolstering economic growth. The Engines program granted an award to the [Great Lakes ReNEW project](#), which aims to clean and revitalize the economies surrounding the Great Lakes. The project is helmed by Chicago-based water innovation hub Current, in collaboration with partners representing academia, industry, nonprofits, and other organizations, including ISTC. Great Lakes ReNEW conducts research in the fast-evolving field of precision separation, which grants opportunities for businesses and municipal water suppliers not only to meet federal obligations around clearing PFAS, microplastics, and other contaminants from wastewater sources, but also to extract and obtain critical minerals like nickel, cobalt, and lithium for commercial use, including for battery production. Through the NSF Engines program, the project has the potential to receive up to \$160M in investments over the next 10 years.

To expand Illinois' capacity for innovation and economic growth, the state must capitalize on the trend of increasing co-authored publications. By doubling down on these mutually beneficial R&D engagements between universities and businesses, Illinois can strengthen its position as a hub for cutting-edge research and technological advancement. Encouraging and facilitating more collaborative research engagements could help bridge the gap in Business R&D investment and potentially lead to increased funding in the future, as companies grow to further recognize the value of partnering with Illinois' world-class academic institutions. State funding for programs that connect research institutions to major industry leaders would allow more businesses of all sizes access to Illinois' research excellence.



▲ Photo Courtesy of Michele Marie Photography



CHICAGO BIOMEDICAL CONSORTIUM National Institutes of Health (NIH) and Searle Funds Partner to Support Biomedical Innovators

Research shows that the probability of translating a basic science project into a therapeutic is infinitesimal. Not only does uncovering fundamental mechanisms take decades of basic research, but academic researchers, on their own, have neither the resources, the expertise, nor the network to turn this knowledge into a molecule that will combat disease. The Chicago Biomedical Consortium (CBC) provides Illinois' academic innovators with the resources, education, connections, project management, and funding necessary to translate their fundamental discoveries into potential new therapies.

Generously funded by the Searle Funds at the Chicago Community Trust, the CBC, under the leadership of Michelle Hoffmann, PhD, has reorganized itself in the last three years to combine basic science with the business and operations of biotech to turbocharge Illinois academic research into new therapies that build Illinois' innovation economy.

One of the first projects the new CBC funded came from the lab of Dr. Shana Kelley, who is a Northwestern professor and President of the new [Chan Zuckerberg Biohub](#). She and a talented research professor, Dr. Ranjit Singh, have developed a new way to target a particularly stubborn cancer gene called KRAS, responsible for 20-25% of all cancers. KRAS drugs have eluded researchers for decades. Dr. Kelley and Dr. Singh found a way around this by identifying a gene that, when knocked out, leads to the selective degradation of the cancer-causing KRAS. This approach has immense therapeutic potential and clinical translation. Dr. Singh told ISTC, "CBC has been fantastic in providing us with connections to other researchers to determine the most effective pathway to translation. Their network of experienced researchers helps our team find medical chemists who can produce molecules at scale. These resources help us find ways to make the binding molecule more potent, selective, and impactful on patients."

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1 Schulthess, Duane et al. "The Relative Contributions of NIH and Private Sector Funding to the Approval of New Biopharmaceuticals." *Therapeutic innovation & regulatory science* vol. 57,1 (2023): 160-169. doi:10.1007/s43441-022-00451-8

The CBC provided financial support after their team analyzed the almost 100 current KRAS projects funded by pharma and venture capital to validate that Dr. Kelley's and Dr. Singh's idea was singular. During this pre-funding period, the CBC staff helped identify the exact models used by industry to develop first-generation drugs so that Kelley and Singh could do comparable experiments. After funding, when the Kelley team had further validated their results with genetics, the CBC helped find and manage the medicinal chemists needed to design the new drug-like molecule that could inhibit the target.

In the last three years, the CBC has vetted almost 40 projects and fully funded three advanced projects like that of Dr. Kelly and Dr. Singh, as well as 17 smaller projects that have the potential to move into the more developed phase. The CBC has also obtained a critical [federal grant from the NIH to expand the program from three universities to nine Illinois institutions](#). Satish Nadig, MD, PhD, the principal investigator on this new expansion called [Chicago Biomedical Consortium Hub for Innovative Technology and Entrepreneurship in the Sciences \(CBC-HITES\)](#), is not only the Director of Northwestern Medicine's Comprehensive Transplant Center but also a physician-scientist focused on developing new therapies to make organs more readily available to transplant recipients. Dr. Nadig first became involved with the CBC when his collaborator, [Evan Scott, PhD](#), another Northwestern professor, was funded by the CBC to develop a novel molecule to improve transplantation (Nadig's work) and reset the immune system to prevent diseases like Type 1 Diabetes.

² Pereira, Flavia et al. "KRAS as a Modulator of the Inflammatory Tumor Microenvironment: Therapeutic Implications." *Cells* vol. 11, 3 (2022): 398. doi:10.3390/cells11030398



▲ Photo Courtesy of Bradley University



COMMUNITY
HIGHLIGHT



Bradley University Expands Business and Engineering Convergence Center with Funding Assistance from the National Institute of Standards and Technology

Merging mindsets is more than a philosophy at Bradley University. The idea of providing an integrated approach to learning is made into a tangible reality in the form of a building: the Business and Engineering Convergence Center (BECC). The BECC brings different disciplines and majors together to discover or create real-world solutions.

Bradley's largest building project ever, the 200,000-plus-square-foot BECC brings under one roof the Foster College of Business and the Caterpillar College of Engineering and Technology. Also housed in the building is Turner Center for Entrepreneurship, which reaches out to the community through classes and workshops for those developing or growing their own businesses, as well as 28 classrooms, eight computer labs, and 200 faculty and staff offices.

Its newest addition will be a cutting-edge laboratory designed to train engineering students to manage and understand electrification standards for reliable power production. This upcoming addition is made possible by \$950,000 in federal funding through the Scientific and Technical Research and Services program from the National Institute of Standards and Technology (NIST).

This new lab equipment will provide photovoltaic power production systems with battery backup, natural gas engines, and heat pump systems with variable speed compressors. These resources will allow Bradley University to train 32 students each year on modern strategies aimed at reducing dependence on fossil fuels in electrical power generation and use.

"Bradley University's vision is to be a leader in higher education nationally in promoting the use of sustainable energy on a college campus," remarked Dr. Krishnanand Maillacheruvu, interim dean of Bradley's Caterpillar College of Engineering and Technology

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and Foster College of Business. “We are proud to train the next generation of engineers to help develop the technology to enhance renewable energy for America’s future.”

Funding provided for the laboratory and related equipment upgrades will enhance Bradley’s ability to provide a technology-rich learning environment that will better prepare students for success and serve as a workforce development pipeline to business and industry partners.

Finding additional sources for funding, whether through federal programs like the NIST or by securing grants, is imperative in this work. It will also be an enhanced point of focus for the university, after Bradley was awarded a grant from the NSF totaling more than \$1.9 million. This will fund the university’s Partnerships for Enhancing ERI Research (PEER) through the Office of Sponsored Programs (OSP), which supports faculty and staff seeking external funding to conduct research, scholarship, creative work, curricular and pedagogical initiatives, and educational outreach.

“We are truly humbled that the NSF recognized Bradley University’s tremendous potential and invested heavily in this project,” remarked Bradley Andersh, PhD, Director of Bradley’s Office of Sponsored Programs. “While significant work will need to be done to achieve the project’s ambitious goals, we are confident that by working together, we will see the intended outcomes and position ourselves for an even more productive future.” The value of a Bradley University education is grounded in experiential learning, ensuring its students are prepared to meet tomorrow’s challenges.

FFRDCS R&D

Federally funded R&D centers (FFRDCs) and intramural R&D performers are the two major entities conducting research within the U.S. federal government. FFRDCs are independent organizations sponsored by and managed by federal agencies or managed by external institutions such as universities, nonprofits, or industrial firms. By contrast, intramural R&D is conducted by employees of federal agencies like the Department of Defense (DOD), National Institutes of Health (NIH), and Department of Energy (DOE).

..... • Researchers at FFRDCs perform research under strict guidelines, often involving tasks with national security implications. Handling this research through FFRDCs is crucial for the U.S. to keep pace with international competition. Businesses frequently collaborate with FFRDCs, leading to shared-use federal laboratory spaces. Intramural R&D performers, on the other hand, conduct research using their own employees and facilities, allowing for direct control over the research process and ensuring the security of sensitive information.

When applied research is needed, the federal government may assign responsibilities to FFRDCs to coordinate with the private sector in a controlled setting. This approach enables the government to benefit from the expertise and resources of the private sector while maintaining oversight and control over the research process. Applied research encompasses studies that attempt to solve more practical problems within a given field.

Most of the research conducted at Illinois' two FFRDCs is classified as basic research, meaning studies are focused on the fundamental problems of nature and chemicals. At Argonne, 44.92% of research is considered applied research according to 2022 data, closer to the national average for FFRDCs of 40.87% relative to a site like Los Alamos National Laboratory in New Mexico, where 91% of research is classified as applied research. Similarly, very little of Fermilab's research is applied, and most falls under the basic research category. The entirety of Fermilab's funding comes from the DOE, whereas Argonne receives funding from a number of federal agencies, including, primarily, the DOE.

Argonne National Laboratory

Located in Lemont, Illinois, Argonne National Laboratory is a FFRDC that conducts a wide range of scientific research in fields such as materials science, chemistry, biology, energy, and environmental science. The center operates several major research facilities, including the Advanced

Photon Source, a potent X-ray light source used for materials research, and the Argonne Leadership Computing Facility, which houses some of the world's most powerful supercomputers. Among its core initiatives, Argonne conducts research on advanced battery technologies, renewable energy systems, and nuclear energy; develops new materials and technologies for use in energy production, storage, and efficiency; and collaborates with industry partners to translate scientific discoveries into real-world applications. Furthermore, the center supports national security through research on nuclear nonproliferation, counterterrorism, and infrastructure security.



Top 20 FFRDCs by R&D Activity



Source: NSF National Center for Science and Engineering Statistics, 2023 FFRDC Research and Development Survey

Argonne ranked 11th among FFRDCs for R&D expenditures in FY2022, just as it did in FY2018, at \$963.0M. Between 2013 and 2022, the year-to-year average growth in funding to the Argonne team amounted to 3.47%, with funding speeding up slightly during the pandemic. The lab was one of [five FFRDCs nationwide to have R&D performance increase](#) by more than \$100M between 2021 and 2022.²⁰

Fermilab

Located in Batavia, Illinois, the Fermi National Accelerator Laboratory (Fermilab) specializes in high-energy particle physics research. It operates several particle accelerators, including the Main Injector, which is used for neutrino experiments and the production of muons for the Muon g-2 experiment. Fermilab also conducts research on the fundamental properties of matter and energy, including studies of the Higgs boson, neutrinos, dark matter, and dark energy, while developing and building advanced particle accelerators and detectors to support further scientific research. Fermilab works with scientists from around the world on experiments such as [NOvA](#), [DUNE](#), and [CMS](#). Many of these scientists also have experience working at the Large Hadron Collider (LHC) in Europe as part of CERN's Compact Muon Solenoid experiment (CMS), for which Fermilab coordinates U.S. involvement.

Fermilab ranked 17th in FY2022 in R&D performance by FFRDCs, as it did in FY2018, at \$330.3M. Fermilab, [as ISTC has reported in the past](#), has seen a downturn in R&D performed since achieving record years under the Obama administration (\$420.1M in FY2011), due partially to the creation of the LHC in Europe. Fermilab was the major operator of the Tevatron superconducting particle accelerator, which was the highest-energy particle collider on earth until the LHC initiated operations in 2008. Since the closure of Tevatron during FY2012, there has been a decline in R&D activity at Fermilab, with an average decrease of 1.44% annually since 2013.

While funding at Fermilab has slowed consistently over the last 10 years, the center's research on particle physics and its proximity to both the Chicago Bloch Tech Hub and the Illinois Quantum Proving Grounds make it an excellent candidate for increased federal funding. As another example of sites experiencing a recent resurgence in activity, Los Alamos advanced from 3rd in FY2018 to 1st in FY2022, leaping Sandia National Laboratories and Jet Propulsion Laboratories, partially due to a budget increase for the DOE's National Nuclear Security Administration. Federal priorities tend to shift rapidly, and ideally, Fermilab will continue to grow in its role within quantum physics and materials research.

LOOKING FORWARD

The data in this report has summarized Illinois' R&D activity and highlights the critical strategic initiatives that have supported progress. Identifying and prioritizing achievable economic development goals requires decision-making that is rooted in data. Looking forward, ISTC remains committed to advocating for Illinois' innovation ecosystem through collaborative efforts across private and public sector partners, higher education institutions, FFRDCs, and other stakeholders.

- • Based on data shared in this report, ISTC recommends three critical strategies to pursue in order to promote economic growth in Illinois. The recommendations include:
- **Attract new businesses in emerging sectors** like quantum, semiconductor manufacturing, and electric vehicle production.
 - **Support collaborative research** between academic institutions and businesses headquartered in Illinois.
 - **Invest in computer science research** opportunities at Illinois institutions of higher education.

Approaching these recommendations collaboratively and tactfully can lead to new programs, policies, and other interventions that further support R&D activities.

Attract New Businesses in Emerging Sectors

The innovation ecosystem and the R&D that fuels industry change in Illinois has evolved over the last decade. Illinois has a long history of housing machining and manufacturing businesses; however, in recent years, several major employers in the sector, such as Caterpillar and Boeing, have moved operations out of Illinois. These decisions have been predominantly based on tax incentives, lower cost of living for employees, and access to talent ([Federal Reserve Bank of Dallas](#)).

Compounding this issue, Business R&D data shows that Illinois has experienced a decline in federal R&D investments. Grants and other federal financing supported 5.3% of all Illinois Business R&D projects in 2017, but this figure fell to 0.36% in 2021 as a result of many variables. Between 2017 and 2021, the total amount of funding from the [Department of Defense](#), National Aeronautics and Space Administration, the [National Science Foundation \(NSF\)](#), and the National Geospatial Intelligence Agency declined. Additionally, the relocation of aeronautical leader Boeing as well as the expiration of the NSF's grant to maintain the operation of the Blue Waters supercomputer contributed to the decline in federal investment.

Federal agencies are now experiencing budget cuts for R&D, which will further shift the burden to Illinois businesses to perform and fund in-house R&D efforts. For example, the NSF will receive about [\\$600M less for its Technology, Innovation and Partnership \(TIP\) directorate](#) in 2024 relative to 2023. This program promotes innovation in STEM and other research directives that have supported regional innovation hubs. Additionally, the Small Business Administration's Federal and State Technology (FAST) Partnership program and Regional Innovation Clusters each lost \$1M in appropriations that are intended to give small businesses more R&D resources. The Economic Development Administration also received nearly [\\$30M less in federal appropriations](#) for the upcoming fiscal year, while the [NIST received about \\$100M less in appropriations](#) to the agency's construction budget.

With less funding across these programs, R&D awards will be more competitive and reduced in amount, thereby limiting opportunities to invest in emerging sectors at the rate that is needed to scale and counterbalance other industry changes. Inflation and more macroeconomic factors may cause industry leaders to reconsider R&D investment strategies, potentially relocating projects to states offering more favorable conditions. This shift in federal investments could reshape the R&D landscape, affecting both the scale and geographic distribution of innovation efforts across the country.

In response to these changes, Illinois' decision-makers need to determine effective state and local incentives that support business development in emerging sectors. This approach can reinvigorate Illinois by creating opportunities for place-based innovation hubs with potential to regain jobs lost and diversify the state's portfolio of industries.

Illinois has successfully demonstrated this approach in the electric vehicle sector through initiatives like the [Reimagining Energy and Vehicles \(REV\) in Illinois Act](#). These incentives contributed to the creation of a \$2B battery manufacturing facility by Gotion, an electric vehicle company headquartered in China, which is expected to create 2,600 new jobs in Manteno, Illinois. Additionally, the state government has made strong investments into small businesses in the manufacturing sector through the [Illinois APEX Accelerator](#), which assists minority-owned and small businesses to compete in government contracting at state and federal levels. This encourages innovation in the manufacturing sectors by new small businesses and allows them to leverage more of their resources for R&D.

State lawmakers and other stakeholders should look toward the framework that won over Gotion and its team to attract other emerging sectors. For example, Illinois is well positioned to prioritize semiconductor manufacturing and quantum computing due to an abundance of natural resources and its central geographical position, with a nexus of transportation corridors.

A focus on quantum investments is vitally important as corporate leaders like IBM, Intel, AMD, Google, and Amazon move to actively expand into and drive forward the quantum field. In Illinois, [Quantum Corridor](#) has been established as a notable player by recently becoming a member of the Chicago Quantum Exchange and a critical member of the Bloch Tech Hub. Quantum Corridor's fiber-optic network is capable of [transmitting 600 billion pages of text every second, much faster than traditional information technologies](#). Plans exist to expand the Corridor network into Northwest Indiana; some early lines already connect the [Chicago Prime ORD-01 Data Center](#) to another data center in Hammond, Indiana. A quantum-connected future would catalyze innovations already underway due to the advent of generative artificial intelligence, potentially impacting sectors like manufacturing, materials science, and [nuclear energy](#).

State legislators, who have already shown foresight with initiatives like the Manufacturing Illinois Chips for Real Opportunity Act (MICRO) and investments in the Quantum Campus, must continue to champion policies that create a desirable environment for emerging technology sectors. The Quantum Proving Ground, announced in July 2024, should provide an opportunity for major information technology companies to partner with Illinois' university research leaders for R&D engagements through state and federally funded projects. Through this initiative, [the state of Illinois will co-invest \\$140M](#) with the Defense Advanced Research Projects Agency (DARPA) to validate quantum computing hardware progress and test algorithms. More of these partnerships should be explored to fuel interest in the state's quantum ecosystem.

Support Collaborative Research

University-industry collaboration opportunities are a conduit for both businesses and university faculty to catalyze knowledge creation. In recent years, Illinois' university-industry collaboration numbers have not kept pace with the national average growth rate. Shared grants declined 3.2% year-over-year between 2018 and 2022, and growth in Higher Education R&D in Illinois lags behind the national growth rate. Illinois' businesses are increasingly shouldering a larger share of R&D costs, while universities are also facing mounting pressure to self-fund their own research expenditures.

This trend toward relying on siloed funding sources risks impeding the collaborative ecosystem that is vital for innovation. The resulting silo effect not only hampers knowledge transfer between academia and industry but also disadvantages place-based innovation systems, such as research parks. These collaborative hubs thrive on synergies between diverse stakeholders, and the current trajectory risks eroding their effectiveness as catalysts for breakthrough discoveries and economic growth. To maintain the state's competitive edge in R&D, it is critical that Illinois' economic development leaders address this trend further through policies that promote a collaborative approach to innovation.

The state of Illinois has now had [three years of record budget surpluses](#). This was partially due to a surge in federal support received through the CARES Act and the American Rescue Plan, two federal stimulus bills that provided more than \$350B to state and territorial governments. Much of the amount that the state received remains in the government's accounts. Utilizing just a fraction of these funds to promote research engagements between universities and businesses would lead to more growth opportunities for businesses.

These collaborations are doubly beneficial. They give university faculty opportunities to create knowledge that may lead them to produce their own spin outs or publications. Meanwhile, business leaders in partnership with universities in Illinois gain access to some of the brightest minds in computer science, biomedical engineering, quantum, electrification and battery storage technologies, and other research fields to help them scale new product models or perform means testing. The University of Illinois ranked 5th in Computer Science R&D expenditures in 2022, while the University of Chicago ranked 15th. Northwestern, the University of Chicago, and the University of Illinois Urbana-Champaign (UIUC) each ranked in the top 50 for Higher Education Life Sciences R&D. The Grainger College of Engineering contributed to UIUC being the 12th most active institution in the Higher Education Engineering R&D rankings. Research and licensing opportunities exist in bountiful supply for businesses interested in partnering with Illinois colleges and universities.

Businesses and university partnerships in other states, such as Kansas, New Jersey, Rhode Island, New Mexico, Indiana, and Maryland, which each ranked above Illinois in Higher Education R&D supported by business funding for 2022, have resulted in major federal investments, strong place-based economic development, and job creation. State incentives that are created to promote these partnerships can strengthen place-based cohesion between multiple sectors. [Over the last decade, two studies](#) have examined the impact of innovation voucher programs on fostering relationships between academic researchers and corporate

R&D leaders. Short-term benefits include an increase in new or improved products for voucher recipients compared to control groups (Kleine, Heite, and Huber, 2020). Long-term effects were evident from the Dutch Innovation Vouchers Program, which began in 2004. A survey conducted 12 years after the initial prize found that Dutch recipients were 12% more likely to engage in R&D activities than non-recipients. Additionally, these companies dedicated 12 more hours per week to R&D projects, demonstrating the program's lasting impact on research commitment and innovation (Roelandt and van der Wiel, 2020).

Removing barriers-to-entry for new entrepreneurs, small businesses, and medium-sized enterprises is vital for increasing participation in innovation. In order to access the infrastructure being planned and constructed in Illinois, the primary barrier that must be removed is the high cost and risk of spending on new products or services, especially for small and medium-sized enterprises (SMEs), which are more likely to be hindered by both limited funds and fewer connections. For this reason, ISTC is proud to be partnering with the Illinois Department of Commerce and Economic Opportunity to provide collaboration opportunities to smaller businesses. The [Illinois Innovation Vouchers Program](#), piloted through the state legislature, serves as an example of an approachable intervention that is not only measurable, but is scalable and can be replicated across various goals.

Fostering inclusive, entrepreneurial environments within Illinois' university systems puts the state at a competitive advantage. The Research Park at UIUC in Urbana-Champaign is home to major corporations like Bayer Crop Science, BP, and Deere as well as a nationally recognized technology business incubator, EnterpriseWorks. [Nearly \\$1.4B in venture capital has been raised by the 250 startups](#) that have gone through EnterpriseWorks or that currently reside at the Research Park.

The UIUC team, as well as colleagues at Northwestern and the University of Chicago, continue to complement and leverage the industrial and logistical strengths of Chicago with the talent and research know-how of faculty and students. With more state investments in Monetary Award Program (MAP) grants and infrastructure like the expansion of funding for [wet lab space](#) in 2021, Illinois can experience more growth in both small business creation and relocations. Pursuing a robust commitment to shared-use facilities, where researchers and business leaders can collaborate, experiment, and co-create in Illinois, is key for accelerating innovation and economic growth in Illinois.

In smaller downstate communities, this model of collaboration could become a key part of creating new innovation districts and ecosystems. Continuing to incorporate these efforts across Illinois' major institutions while identifying opportunities to expand into new geographies can create diversification and positively impact the state's innovation economy.

Invest in Computer Science Research Opportunities at Illinois' Institutions of Higher Education

Illinois universities need state and local investments to improve campus facilities and resources, attract talented research faculty, and offer industry-driven opportunities to students. Investing in university research, specifically in computer science, can contribute to increasing overall R&D activity and help meet demand for the knowledge, skills, and technology required within the economy's fastest-emerging sectors.

Between 2018 and 2022, computer science was among the fastest-growing Higher Education R&D fields in the nation, with an average growth rate of 7.65% and an overall investment increase from \$2.4B to \$3.2B. However, in Illinois, the growth rate has averaged 3.7% year-over-year, and Illinois ranked 39th in five-year cumulative average growth for higher education computer science research.

Computer science research at universities in Illinois is supported primarily by the federal government. In 2022, federal funding accounted for 64.9% (\$110.1M) of Illinois' \$169.5M university computer science research expenditures. Over the past five years, federal funding stagnated while institutions took on a heavier burden for computer science research. State and local funding sources have declined annually since 2018, falling from 1.85% of overall investments in 2018 to 1.19% in 2022. This represents a 7.1% yearly decrease in state and local government investments for higher education computer science R&D, totaling a \$689K drop between 2018 and 2022. Although this decline may seem small, it reflects a shifting landscape in research funding sources for computer science at Illinois universities.

Illinois must consider diversifying and increasing investments to improve annual growth rates and better position the state as a leader in computer science. State and local investments can supplement current federal funding while simultaneously strengthening Illinois' resources and competitiveness for future federal opportunities. The return on investment includes a more skilled workforce along with better development of technologies and business models, which ultimately contribute to yielding an economy that is not only stable, but growing.

Illinois' R1 universities have been making important advancements in computer science research. UIUC and UChicago are nationally ranked in the top 20 for Higher Education R&D in computer science. UIUC hosts the [Quantum Information Science and Technology Center \(QUIST\)](#) and the [National Center for Supercomputing Applications \(NCSA\)](#), and the University of Chicago is home to the [Chicago Quantum Exchange \(CQE\)](#). Despite these advancements, Northwestern University was Illinois' only R1 institution to register a funding increase between 2019 and 2022. Northwestern more than tripled its funding from \$3M to \$10.1M during this time, partly due to a [Department of Energy grant](#) for quantum computing research. In order to maintain momentum, additional funding is needed to support these programs and their outcomes.

Universities with high research activity that have not reached R1 status, such as Northern Illinois University, the Southern Illinois University System, and Illinois State University could also benefit from renewed state and local interest. Investments here can then decentralize education, research, and training opportunities available within the state; create more access across all demographics and geographies; and balance economic development throughout the state.

Stakeholders should consider how to capitalize on unique, regional strengths that can support emerging research institutions. For example, Northern Illinois University can better leverage its proximity to the Illinois Research and Development Corridor between Dekalb and Cook County and its existing relationship with the two FFRDCs in the Chicago region. The Southern Illinois University system holds proximity to Scott Air Force Base and major defense contractors in the St. Louis area. Finally, Illinois State University's proximity to financial sector leaders, such as State Farm and Country Financial, positions the university for computer science-related research on data security, privacy, and, in the future, quantum cryptology.

In terms of success stories, North Carolina serves as a useful case study, having increased higher education R&D in computer science between 2018 and 2022 by about 13.9% year-over-year while nearly doubling overall investments. This progress was achieved through the Engineering North Carolina's Future Act. This legislation was signed in 2021 and includes recurring investments in the University of North Carolina Charlotte's College of Computing and Informatics to increase the number of engineering, computer science, and data science professionals in the state. This legislation has already improved recruitment efforts at UNC Charlotte, where significant funds have been used to support computer science research and to attract talented faculty members. UNC Charlotte is now on the verge of becoming an R1 research institution and has segued financial support from the state into industry partnerships.

Illinois has an opportunity to model North Carolina's efforts and other case studies by including similar legislation or interventions in long-term economic development plans. Earlier this year, the ISTC Team supported the Pritzker Administration's development of a new economic development plan to be implemented from 2025-2030. This plan includes many calls to action that align with this report including a goal to continue granting capital to incubators throughout the state promoting innovative new small businesses, allocating Illinois INVENT funding specifically to businesses in emerging sectors outlined by the federal CHIPS + Science Act, expanding shared research by promoting creative policy like the Illinois Innovation Vouchers program, and extending the state's active R&D and Manufacturing Tax Credits. In addition to points outlined in the plan, ISTC also believes that capital investment into new computer and engineering research facilities at state universities is necessary, as the wet lab expansion has shown, new investments can catalyze collaboration opportunities. ISTC encourages partners in the innovation ecosystem to consider how the data within this report can inform decisions on strategic investments, new grant opportunities, and public-private partnerships.

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ILLINOIS SCIENCE & TECHNOLOGY COALITION

The Illinois Science & Technology Coalition (ISTC) is a member-driven nonprofit that measures, connects, and advocates for Illinois' innovation economy. Created by the State of Illinois 30 years ago, we create powerful links between the state's universities, industry, startups, and government to strengthen our economy and talent pipeline through data collection, policy advocacy, and programs.

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