BioCrossroads and the Indiana Life Sciences Ecosystem:

Tracking Two Decades of Progress and Charting a Path for Sustained Success

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TECONOMY PARTNERS LLC

For more information on this report please contact its authors with TEConomy Partners:

Simon Tripp, Martin Grueber, Ryan Helwig, and Jonathan Dworin

1.800.TEC.1296 | info@teconomypartners.com | www.teconomypartners.com

Letter from the President

Indiana has a more than 100-year legacy of starting and growing strong life sciences companies, including Eli Lilly and Company, Zimmer Biomet, Roche Diagnostics and Cook Medical – all of which started with one person's vision and humble roots and grew into companies with customers all over the globe, but continue to have an entrepreneurial spirit today. The state's life sciences community also includes a significant number of spin-out and start-up companies, many of which are contract research and manufacturing organizations who are doing specific skilled work for the larger organizations and delivering products like the COVID-19 vaccines, orthopedic products and cancer treatments to reduce the burden of sickness and disease.

In addition, we are home to the Indiana University School of Medicine (the largest in the country), Purdue University and the University of Notre Dame, all of which have impressive research credentials, and have generated their own spin-out companies and educated a large portion of our healthcare and life sciences workforce.

Back in the early 2000's no one had a doubt that Indiana had some valuable life sciences assets, but there was a threat to industry growth, and even maintaining what was here. Most of the companies and universities were working in silos, doing ground-breaking research and making medical innovations on their own, but not focused on how to do more collectively to advance one of Indiana's greatest assets - the life sciences sector – and ensure that it stayed strong and built national prominence.

The industry needed a connection point to build a coalition to bring new ideas to life and to grow the existing community.

In February 2002, Sidney Taurel, then-CEO of Eli Lilly and Company, along with colleague Dr. John Lechleiter, soon to become Lilly's President (and eventually Taurel's successor), invited the heads of Indiana's research universities, medical school and hospitals, leaders of Indiana's life sciences companies, and other experts in science and technology to a historic breakfast meeting.

In the meantime, a study from the Battelle Technology Partnership Practice, now TEConomy, the authors of this report, identified, quantified and analyzed growth engines for the Central Indiana region. Not surprisingly, the Battelle consultants quickly focused on Indiana's considerable promise as an emerging life sciences hub.

The Battelle study demonstrated many factors in Indiana's favor: a broad life sciences presence from Bloomington to West Lafayette; higher average earnings among workers in life sciences; an impressive level of university-funded research and patent filings; and headquarters operations of several major research and development companies like Eli Lilly and Company, Roche Diagnostics, Cook Medical, and Dow AgroSciences, now Corteva Agriscience. It also revealed that there was activity outside of Central Indiana, such as Warsaw's orthopedics hotbed.

But Battelle's report pointed to some missing pieces as well. Indiana had no real infrastructure that bred either collaboration or proliferation. If a research scientist at a major Indiana university discovered the next big blockbuster drug opportunity or a game-changing medical device, that discovery was going to need to be rapidly commercialized and heavily funded to realize its potential. And that funding wasn't going to happen in venture capital-starved Indiana. Clearly, the region (and the state, which was recognized soon after) needed investment dollars and a stronger partnership among industry, universities and government to unify its development strategy.

Using the Battelle report as a launching pad, in February 2002, a coalition of organizations and business leaders established the Central Indiana Life Sciences Initiative (CILSI), which would eventually become BioCrossroads. The goal of the coalition—initially

managed by its “parent” the Central Indiana Corporate Partnership, and including the office of Indianapolis Mayor Bart Peterson, Indiana University, Purdue University, Eli Lilly, and the Indiana Health Industry Forum -- was to generate more investment dollars and create a true collaborative network. That network could then foster the development of a broad range of companies which could support life sciences work inside and outside the state.

Fast forward twenty years -- BioCrossroads has seized the opportunity to do more with the State’s life sciences corporate and academic assets and bolster tremendous growth to the sector by building unique collaborations, marketing its strengths, igniting a capital market, and developing a one-of-a-kind institute to accelerate research and commercialization. The result is a vibrant and uniquely collaborative life sciences state-wide community that has increased its economic impact to the state by nearly $50 billion in the last 18 years ($32 billion in 2002 and $79 billion in 2021). The magic combination of Indiana’s depth and breadth of life sciences resources together with BioCrossroads’ ability to harness those assets into actionable outcomes like the organization of venture funds; the creation of IndyHub, Indiana Health Information Exchange, AgriNovus Indiana, Orthoworx, Indiana Biosciences Research Institute, and the 16 Tech Innovation District; and the generation of other unique private-public partnerships has secured a strategy for Indiana’s economic future as well as for the health of its citizens and the rest of the world.

We are beyond grateful for the many people and philanthropic organizations who have built, nurtured and energized BioCrossroads, especially Lilly Endowment Inc. and the Richard M. Fairbanks Foundation through generous grants to the CICP Foundation, Inc. on behalf of BioCrossroads, and our early founders and leaders such as Anne Shane, David Goodrich, Chuck Schalliol, Claire Roberts, David Johnson, and Dr. Gus Watanabe, our first chair of the board.

While it is important to look back and celebrate the accomplishments of our industry and our organization over the last twenty years, it is even more critical that we look toward the future, that we ensure continued investment and focus on this sector and that we turn our attention to the next generation of talent, innovation and collaboration. We know there will be challenges and opportunities, but as long as we continue to work collectively, we can definitely stay on the path to continued success.

Sincerely,

Patricia A. Martin
President and CEO, BioCrossroads
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1210 Waterway Boulevard, Suite 5000
Indianapolis, IN 46202

By:

TEConomy Partners, LLC
Simon Tripp, Principal and Senior Director
Marty Grueber, Principal and Research Director
Ryan Helwig, Principal and Project Director
Jonathan Dworin, Project Manager

BioCrossroads
Patricia Martin, President and CEO
Nora Doherty, Executive Vice President
Lori LeRoy, Executive Vice President
Darshan Shah, Senior Vice President
Brian Stemme, Senior Vice President

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Lilly Endowment Inc.
Richard M. Fairbanks Foundation

BioCrossroads®

PROLOGUE: Staking Our Claim on a Promising Landscape

The 21st Century is truly the "century of technology"—actually, many kinds of technologies converging, disrupting and advancing progress in many forms, places (including virtual places) and applications. But the technology that ushered in this era of relentless change was all about biology. News of the stunningly successful mapping of the human genome—unlocking the keys to the unique building blocks that make up every person—arrived on June 27, 2000, through banner headlines like those in the New York Times that day: "Genetic Code of Human Life is Cracked by Scientists." Life was about to change—hopefully for the better, possibly for the longer, and potentially for everyone then alive. University and industry research budgets swelled and expanded research teams scrambled. Scores of revolutionary new medicines seemed suddenly within reach.

The competition among countries, states and regions to become the new biotech leaders for this new biotech century was about to take off.

As the pages that follow make wonderfully clear, Indiana in general—and Central Indiana in particular, with its rich legacy of therapeutic, diagnostic and medical device companies; impressive corporate strengths in all fields of human health, animal health and plant sciences; premier healthcare providers; and world-class research universities—was well positioned from the start to emerge as a winner in the global drive for biotech leadership. But would we rise to the challenge?

We did. Starting in the late spring of 2001, following the announcement of some of the largest philanthropic grants ever made by the Lilly Endowment Inc. to the IU School of Medicine for the pursuit of genomic research talent and excellence, a group of community leaders and volunteers began to meet behind the scenes to consider how to capitalize on our strengths. Initially, there were just five of us: David Goodrich, the first President of the Central Indiana Corporate Partnership; Wade Lange, the President of the Indiana Health Industry Forum; Melina Kennedy, Deputy Mayor for Economic Development for the City of Indianapolis; longtime community leader Anne Shane; and me, as a far more recent community volunteer tasked with thinking through our particular challenges with venture capital formation because of my background as a finance lawyer.

The ideas were big, but the levels of energy and engagement we found—right from the start—were even bigger. Corporate leaders (starting with John Lechleiter at Eli Lilly and Company), university presidents (starting with Myles Brand at Indiana University), public officials (especially Indianapolis Mayor Bart Peterson) and philanthropic executives (particularly Clay Robbins at the Lilly Endowment Inc.) willingly came together to offer their time, their investments and additional members of their own talented leadership teams to help figure out what a "life sciences initiative" for Indiana should be about. We were able to pull together, as a first step, a $73 million venture capital fund-of-funds—comprised completely of local corporate, university, and public pension fund investors—on the promise of advancing a kind of life sciences innovation on this landscape that, as yet, no one had ever seen in Indiana. Ultimately, that promise was realized and investors were rewarded with strong returns and the exciting development of new start-up companies here, really for the first time. But many already-busy people and institutions had to believe, had to care, and had to work hard and work smart to make an ambitious idea like this Indiana Future Fund into a transformative reality.

And that became the model for BioCrossroads going forward. Figure out first what our strengths are—and then, what's missing that companies and communities and universities could work on together by leveraging those assets to provide. Be sure you

have done the research, have the data, and know what you are talking about. Get the right stakeholders together to devise a plan. Bring a talented, expert and fully engaged professional team to the table.

And then—get it done.

As you will see in detail in the story that follows, that formula for BioCrossroads has resulted in the creation of four more venture capital funds, whole new enterprises including the Indiana Health Information Exchange, IndyHub, the I-STEM Resource Network, the Datalys Center for Sports Injury Research, OrthoWorx, AgriNovus Indiana, the Indiana Biosciences Research Institute, AnalytiXIN, and the major placemaking development that has become the 50-acre 16 Tech Innovation District near downtown Indianapolis. BioCrossroads has also emerged as a respected statewide and national thought leader, publishing more than 20 expert studies over the years on various components of the investments, talent, specialty areas and supporting research institutions that drive Indiana's life sciences sector, and their appropriate placement in a larger, national and global context.

It's an impressive story, one that has engaged the talents and contributions of many wonderful leaders. It is also emblematic of what we can do, in Indiana, to get important things done when we truly believe in the mission—and also believe in ourselves to deliver it.

BioCrossroads has now been productively committed to driving Indiana's life sciences sector for over 20 years. It has a storied history of success building on success, as you will see here. But it also has a great future ahead, as research continues to show that indeed, Indiana' s premier and most promising advanced industry asset remains the one we began with two decades ago: life sciences.

The competition has never been stronger, but our momentum has never been greater. We need to get on with the next big chapters ahead. And if the past is any guide, we most definitely will.

David L. Johnson
President and CEO
Central Indiana Corporate Partnership, Inc.
Co-Founder and Past President and CEO BioCrossroads (2005-2018)

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Executive Summary

In 2001, civic leaders from across Central Indiana placed a bet that the life sciences – the study of living things – held potential to support their broader economic development ambitions. Indiana has long been buoyed by assets such as tier-one research universities (Indiana, Purdue, and Notre Dame), and a robust private sector, led by Eli Lilly and Company and other major corporate players including Roche Diagnostics, Cook Medical, Elevance Health (formerly Anthem), and others. Although Indiana was the historic home to the unique pieces that comprise a robust life sciences industry, little had been done to connect these assets into a broader ecosystem poised for growth in the new millennium.

Although these assets are undoubtedly critical, the "X factor" behind the success of Indiana's life sciences sector is the role of the state's catalyst: BioCrossroads. The evolution of this sector is the result of an intentional vision, purposeful follow-through, and ongoing collaboration among dynamic and like-minded actors. According to the organization, "BioCrossroads was designed to fill the gap between legacy life sciences, businesses and academic institutions, and the rising demand in the 21st century for far greater levels of innovative activity and entrepreneurial growth."[1]

Today, BioCrossroads is a resourceful organization seeking to continually lead and facilitate collective responses as its environment changes and the landscape of life sciences progresses. This high-performing organization offers flexibility for solving problems by drawing on best practices while innovating programs to meet novel challenges. As opportunities arise, BioCrossroads is focused on learning from its experiences, keeping an open-mind, and preparing for the future. In this spirit, the following report seeks to accomplish four goals:

1. **Describe the evolution of Indiana's life sciences ecosystem since 2001 and demonstrate how the region's investment in BioCrossroads has contributed to robust industry development.**
2. **Highlight how life sciences serve as an economic driver for Indiana.**
3. **Detail the key accomplishments of BioCrossroads over the past two decades, with an emphasis on the organization's success in enhancing the ecosystem through collaborative initiatives, capital, talent, and awareness.**
4. **Forecast what the next two decades for BioCrossroads may hold. Indiana must be vigilant in maintaining the competitive edge of its life sciences ecosystem.**

For the past two decades, BioCrossroads has pursued a strategic and data-driven approach to ensure that the life sciences are an essential driver of the Indiana economy. As a deserving area of attention for Indiana in the early 2000s, and especially so today, the life sciences are:

- **A cross-cutting sector of the economy:** Despite the common association of life sciences with test tubes and lab coats, in reality, life sciences represent a broad, cross-cutting industry within the U.S. economy. This cross-cutting nature of the sector is a hallmark of the state, as Indiana is rare among states in that it boasts extremely high levels of employment concentration across multiple life sciences subsectors.

1 Indiana's Life Sciences Landscape: BioCrossroads History to 2017

- **A stable economic driver:** Beyond serving as a fast-growing and cross-cutting industry, life sciences also act as a stable economic driver for Indiana. The life sciences have outperformed Indiana's economy since 2001 and are responsible for an outsized portion of total new jobs in the state over the past two decades.

- **Offering opportunities across skillsets:** A hallmark of Indiana's life sciences sector is its ability to deliver economic opportunity across skillsets, while also reaching into all corners of the state and a wide range of communities. Today, although Indiana's life sciences sector remains heavily oriented around well-educated scientists and medical doctors, it also encompasses production and technician positions considered "middle-skill" occupations. Product and geographic diversity are other hallmarks of Indiana's life sciences sector: metropolitan statistical areas in Indiana are consistently among the largest and most concentrated life sciences hubs in the nation for their respective sizes.

- **Enabling research drivers:** Universities, academic medical centers, industry R&D centers, and other nonprofit or federal research centers play a critical role in developing new treatments, products, and cures at their earliest stages. Over the past two decades, academic research and development in Indiana has nearly tripled. Life sciences R&D at Indiana's colleges and universities has grown from a base of $282 million in 2001, reaching $844 million in 2020. Growth in R&D at Indiana's academic institutions has outpaced the national average over the past two decades and has especially done so in recent years. When looking specifically at funding from the National Institutes of Health (NIH), the primary source of federal funding for life sciences R&D, Indiana also has seen considerable growth.

- **Converging with and complementing other critical industries, such as information technology (IT) and advanced manufacturing:** Over the past two decades, numerous developments in the life sciences have only accelerated the pace at which this sector interfaces with other industries. Today, advanced data analytics are deployed throughout the life sciences, including in scientific discovery, drug discovery, clinical decision-making support, and enabling technologies for the emergence of precision medicine. Indiana's life sciences industry is also closely related to the state's strengths in advanced manufacturing.

Today, the life sciences in Indiana are a resilient and cross-cutting industry that has experienced two decades of strong performance in generating high-paying jobs. Indiana's life sciences industry has average employee wages of $106,000, more than twice the average salary for Indiana jobs ($52,000).[2] While Indiana's success across life sciences metrics is notable, the reality is that these achievements do not happen on their own. Instead, they are supported by a wide range of assets across Indiana's life sciences ecosystem that contribute to this sustained growth and success.

The success of Indiana's life sciences industry is the result of a well-functioning ecosystem that encourages innovation and entrepreneurship. Enabling life sciences as an economic driver for Indiana requires building industry, university, and government partnerships; focusing investments on life sciences research and development; fostering entrepreneurship and new businesses; supporting access to venture capital investment; cultivating talent and human capital; developing technology parks and other specialized facilities; and increasing awareness and consensus. Each of these is a focus of BioCrossroads.

2 TEConomy analysis of Emsi (datarun 2022.2)

Building industry/university/government/philanthropic partnerships: A high-functioning life sciences industry cluster requires strong links between an area's universities and its industry base, governments and public institutions, and an engaged philanthropic base. BioCrossroads excels at viewing partnerships in a holistic and systems-oriented manner, which allows for coordinated and strategic approaches to address common challenges.

Focusing investments on life sciences research and development: Intentional investments focused on advancing the life sciences are an essential component of Indiana's strategy to enable economic growth through the life sciences. Since its inception, BioCrossroads has maintained a focus on the distinct competencies within the life sciences that allow the state to capitalize on its unique competitive advantages. BioCrossroads also plays an influential and intermediatory role in supporting signature R&D projects across Indiana's research institutions and within the life sciences industry.

Supporting access to venture capital investment: Early-stage seed capital and venture capital funds are essential ingredients in companies' inception and growth and later in attracting future rounds of capital needed to bring innovations to market. Ultimately, genuinely novel and innovative companies in the life sciences usually require an influx of capital from a true investment vehicle like venture capital. From 2001 to 2021, the number of venture capital deals and dollars going to Indiana's life sciences companies has grown almost tenfold.

Fostering entrepreneurship and new businesses: For two decades, BioCrossroads has worked to encourage a network of seasoned startup talent and leadership that is required for advancing world-class innovation. BioCrossroads excels at finding, supporting, and rewarding promising companies and connecting them with Indiana's broader life sciences community. As a filter for Indiana's life sciences ecosystem, BioCrossroads plays a pivotal role in screening companies for investment and ensuring they can access additional resources if needed.

Developing technology parks and other specialized facilities: Although talent serves as the primary driver of innovation and entrepreneurship in the life sciences, the role of place-based development such as technology parks and other specialized facilities is also critical. Indiana's life sciences sector is home to a significant number of capital projects help drive this place-based development. BioCrossroads' work with Central Indiana Corporate Partnership (CICP) to facilitate investments in technology parks and specialized facilities can be seen in the recent example of the 16 Tech Innovation District.

Cultivating talent and human capital: Indiana is a hub for academic medicine and health sciences research and associated higher education, with world-class assets such as the IU School of Medicine (the largest in the U.S. as measured by number of students), Purdue, IUPUI, along with numerous other public and private colleges and universities throughout the state and IU Health, a provider of advanced specialty clinical care and general clinical services. Across programs, Indiana educates and graduates thousands of students each academic year in the life sciences.

Increasing awareness and consensus: With leadership from BioCrossroads, Indiana excels at spreading awareness about the strengths, challenges, and opportunities facing the state's life sciences industry. As noted by Brookings in Rethinking Cluster Initiatives, the organization's awareness and education function "remains very important for BioCrossroads. It is seen as both a knowledge resource for the public and non-experts—to galvanize support for investments in the cluster—but also providing research and expertise for executives within the life sciences industry."

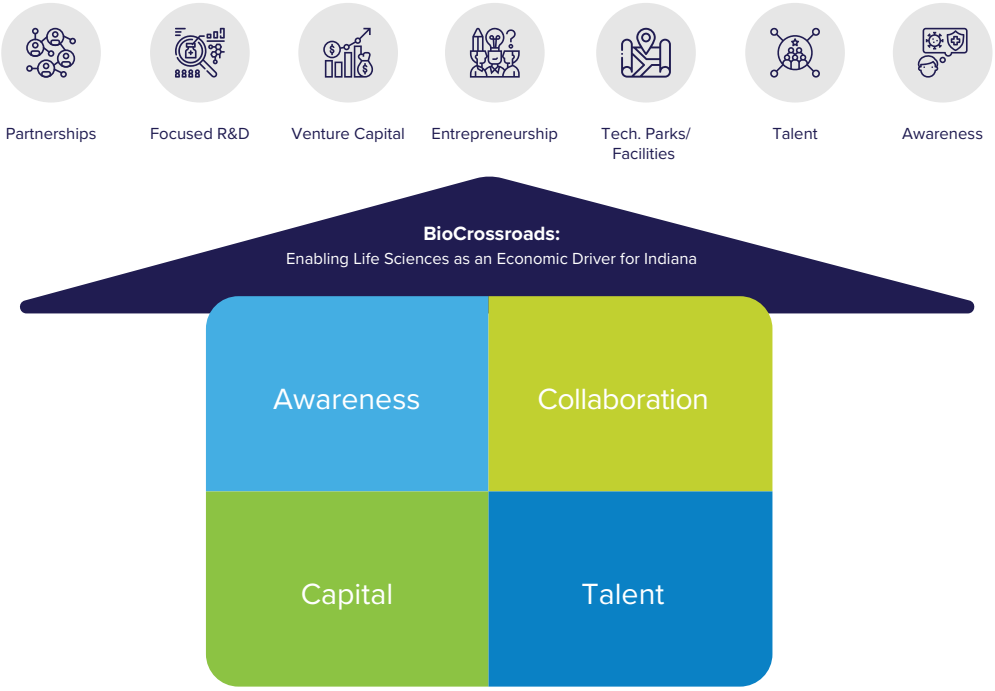
BioCrossroads has played an essential role in supporting Indiana's ongoing growth as a national life sciences hub by encouraging partnerships, guiding focused investments in R&D, supporting access to capital and entrepreneurship, and leading collaborative efforts around networking, technology parks, and talent development. The results are impressive. Over the course of its history, BioCrossroads has:[3]

- Directly **raised $649 million of market capital, philanthropic, and state funding** to identify and pursue promising new Indiana life sciences opportunities.
- Organized **two life sciences venture capital funds**—the Indiana Future Fund ($73 million) and the INext Fund ($58 million).
- Organized and actively **managed three seed funds that have invested in 32 companies**, including previous management of the Indiana Seed Fund I ($6 million) and Indiana Seed Fund II ($8.5 million), and current management of Indiana Seed Fund III ($9 million).
- **Facilitated the formation of ten enterprises** to advance signature Indiana life sciences strengths, including the Indiana Health Information Exchange, the Indiana Biosciences Research Center, the 16 Tech Innovation District, and OrthoWorx.
- Assisted in the attraction of **thousands of jobs** via life sciences companies establishing, expanding, or consolidating operations in Indiana.
- Supported over **500 startup companies** and collaborations by connecting them to industry partners and capabilities, providing basic business planning guidance, and linking them with additional funding sources.

By offering data-driven insight, thought leadership, intentional programming, and meaningful events, BioCrossroads strengthens Indiana's life sciences ecosystem through collaborative initiatives, talent development, investment capital, and value-added networking and awareness campaigns (Figure ES-1). The intentionality of BioCrossroads' activities acts as a forceful economic driver for Indiana, and its work is well-aligned with the actions needed to enhance the ecosystem.

3 https://biocrossroads.com/biocrossroads-celebrates-two-decades-of-advancing-indianas-life-sciences-sector/

Figure ES-1: BioCrossroads Enables Life Sciences as an Economic Driver for Indiana



Source: TEConomy Partners, LLC.

- **Building the Ecosystem Through Collaborative Initiatives:** A key competitive advantage for Indiana's life sciences industry is BioCrossroads' ability to successfully respond to opportunities by building awareness, responding to environmental changes, and maintaining a network focused on problem-solving. Six collaborative initiatives particularly stand out for their ability to cut across the seven areas where life sciences serve as an economic driver: The Indiana Health Information Exchange (IHIE), IndyHub, I-STEM Resource Network, Indiana Biosciences Research Institute, 16 Tech, AnalytiXIN, and the Indiana Economic Development Corporation.

- **Building the Ecosystem Through Capital:** Although entrepreneurs, startups, and small businesses across the nation find themselves frequently seeking new funding sources, the need for capital access is especially acute in Indiana. BioCrossroads' strategy for supporting innovation and entrepreneurship revolves around connecting ideas with capital. BioCrossroads' strategy for encouraging investment capital for Indiana's life sciences companies is best exemplified through six examples: Indiana Future Fund, INext, the Next Level Fund, and three Indiana Seed Funds (ISFI, ISFII, and ISFIII). Across these six funds, BioCrossroads has helped stimulate the growth of more than 40 life sciences companies in Indiana, boosted by $204 million in total investment funds that have gone on to raise an additional $1.9 billion in follow-on capital, a multiplier of approximately 9.3.

- **Building the Ecosystem Through Talent:** Holistic in nature, BioCrossroads' approach to cultivating talent spans the workforce continuum. BioCrossroads builds on traditional approaches to skills development and training by successfully linking a variety of programs to the research institutions and industry partners that drive Indiana's life sciences industry. BioCrossroads' talent strategy is embodied in six main initiatives. For K-12 students, the I-STEM program offered insight into biosciences careers at an early age. University students are exposed to the life sciences industry through programs like AnalytiXIN and Career TraX, while other BioCrossroads programs like IndyHub, 16 Tech, and Ascend Indiana focus on talent attraction and retention efforts for the industry and the state.

- **Building the Ecosystem Through Awareness:** As the key organization representing Indiana's life sciences ecosystem, BioCrossroads frequently serves as a voice of the industry to audiences across the state and the globe. BioCrossroads

works to encourage new business attraction and retention by offering accurate and credible information. BioCrossroads helps to craft the state's messaging around the industry and the needs of this business community. Examples of initiatives led by BioCrossroads to build the life sciences ecosystem through awareness include a branded initiative (BioCrossroads), digital and social media, FrameWORX, the Annual Life Sciences Summit and other networking events, and targeted awareness campaigns.

Over the past two decades, BioCrossroads has provided consistent, dedicated, strategic leadership focused on growing and connecting the state's life sciences industry. From early work in researching key challenges to preliminary efforts at piloting new initiatives to large-scale grants received through partnerships, BioCrossroads' efforts are worthy of widespread recognition. BioCrossroads excels at using networks and data to identify opportunities that maximize the state's assets. In particular, BioCrossroads has success with:

- Identifying potential opportunities, including understanding the initial drivers of these opportunities.
- Building a tangible project, including identification of the people necessary to take action, and the places or hubs where the actions should take place.
- Maturing its projects into transformative sustained efforts, where activities become an integrated and established part of the ecosystem.

Throughout the next decade, it is expected that the life sciences will continue to advance economic development in Indiana. As a state, there is an economic development potential across a variety of opportunity areas and subsectors, most notably diagnostics, vaccines, medical devices and connected medical systems, and small and large molecule pharmaceuticals and biologics, with both human, veterinary, and plant sciences applications. However, it is anticipated that each of these sectors will face critical disruptions due to new technologies and emerging advancements. BioCrossroads plays an essential role in assisting companies through these transitions while also encouraging new developments that capitalize on the market opportunities made available through this disruption.

In the future, there is a distinct value and need for BioCrossroads to assist other organizations in navigating the headwinds and disruptive challenges facing the life sciences ecosystem—including those specific to the life sciences, but also others such as changes due to remote work, advanced analytics (including artificial intelligence and machine learning), automation, robotics, and cybersecurity. Across the life sciences ecosystem that BioCrossroads represents, disruptions may impact a range of organizations including startups facing a constrained funding environment, universities facing declining enrollments, research institutions challenged with attracting and retaining faculty, or industry players competing in an ever-changing and ever-challenging global economy. The challenges are significant, and BioCrossroads will continue to be vital in helping Indiana sustain and grow its life sciences position.

Ultimately, anchoring a life sciences ecosystem in research and development, and intentionally building a holistic and responsive ecosystem to support the growth of commercial life sciences, is working very well for Indiana. As such, the accomplishments of BioCrossroads and the entirety of the Indiana life sciences community are worthy of acclaim. While there is considerable uncertainty in the world today, there remains reason to be optimistic that life sciences will continue to be a core competency and growth driver for Indiana. BioCrossroads is at the center of a successful, collaborative approach, where entities such as industry, university, government, and philanthropy can focus on their strengths while utilizing each other to collectively respond to new challenges in the ecosystem, such as access to investment capital, the need for talent, and the ongoing threats and opportunities of technological disruption. By addressing shared challenges and helping to sustain an ecosystem that can positively respond to promising opportunities, BioCrossroads will continue to serve a critical and central role in Indiana's ongoing economic advancement.

Introduction

In 2001, civic leaders across Central Indiana bet that the life sciences—the study of living things—had the potential to support their broader economic development ambitions. Indiana has long been buoyed by assets such as tier-one research universities (Indiana, Purdue, and Notre Dame) and a robust private sector led by Eli Lilly and Company and other major corporate players, including Roche Diagnostics, Cook Medical, Elevance Health (formerly Anthem). Although Indiana was the historic home to the unique pieces that compose a robust life sciences industry, little had been done to connect these assets into a broader ecosystem poised for growth in the new millennium.

Although these assets are undoubtedly critical, the "X factor" behind the success of Indiana's life sciences sector is the role of the state's catalyst: BioCrossroads. The evolution of Indiana's life sciences sector is the result of an intentional vision, purposeful follow-through, and ongoing collaboration among dynamic and like-minded actors. According to the organization, "BioCrossroads was designed to fill the gap between legacy life sciences businesses and academic institutions and the rising demand in the 21st century for greater levels of innovative activity and entrepreneurial growth."[4]

To support Indiana's life sciences sector, BioCrossroads is invaluable in fostering collaboration, encouraging access to capital, developing and attracting talent, and boosting ecosystem awareness. Today, Indiana consistently ranks among the nation's leading hubs for the life sciences, with:

- **Nearly 2,500 life sciences companies.[5]**
- **Approximately 63,000 employees.[6]**
- **Average employee wages of $106,000, more than twice the average salary for Indiana jobs ($52,000).[7]**
- **Over $12.7 billion in exported products, the highest amount on record, and the third-highest number of exports in the U.S.[8]**
- **Approximately 900 patents were granted, and 61 new products were approved by the U.S. Food and Drug Administration in 2021.[9]**

As Indiana's life sciences sector continues to earn accolades, there is a growing understanding that its successes result from planning and intentionality. According to economic development scholar Bruce Katz, formerly of Brookings Institution and now of the Nowak Metro Finance Lab at Drexel University, Central Indiana is "a community that is combining the entrepreneurial capacity and capital of business, philanthropy and universities, with the legitimacy and broader concerns of local government—a new 21st-century form of networked governance."[10] In particular, Katz applauds BioCrossroads and the Central Indiana Corporate Partnership (CICP) for its relentless focus on strengths in life sciences instead of trying to "become the next Silicon Valley," noting:

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4 Indiana's Life Sciences Landscape: BioCrossroads History to 2017
5 TEConomy analysis of Emsi (datarun 2022.2)
6 TEConomy analysis of Emsi (datarun 2022.2)
7 TEConomy analysis of Emsi (datarun 2022.2)
8 https://www.insideindianabusiness.com/articles/indiana-continues-to-punch-above-its-weight-in-the-life-sciences Indiana companies exported
9 https://www.insideindianabusiness.com/articles/indiana-continues-to-punch-above-its-weight-in-the-life-sciences
10 https://www.thenewlocalism.com/newsletter/funding-networked-governance

> "We were particularly enamored of CICP's BioCrossroads, an effort to steer hundreds of millions of private and civic resources towards recruiting talented researchers, building world-class centers of excellence, investing in STEM education in elementary and secondary schools, giving start-up and scale-up companies access to risk capital and developing quality places."[11]

Since its inception, the principals of TEConomy (originally working at Battelle's Technology Partnership Practice) have worked closely and collaboratively with BioCrossroads. As BioCrossroads enters its third decade of supporting the life sciences industry and ecosystem of Indiana, they have asked TEConomy to assist them in developing a 20-year retrospective that describes their unique role.

The following report describes how Indiana's life sciences ecosystem has grown to become the envy of states and regions across the nation. BioCrossroads is a national leader, playing an influential role in "rethinking" cluster initiatives (as noted in a case study by Brookings Institution) and in improving the competitiveness of existing industries (as noted through its awards with SSTI). BioCrossroads' accolades are worthy of further exploration, and as such, **this report seeks to accomplish four goals:**

1. **Describe the evolution of Indiana's life sciences ecosystem since 2001 and demonstrate how the region's investment in BioCrossroads has contributed to robust industry development.**
2. **Highlight how the life sciences are an economic driver for Indiana.** Notable examples include industry, university, and government partnerships; focused investments in life sciences research; supporting new businesses and entrepreneurship; access to venture capital investment; technology parks and specialized facilities; talent development and attraction; and building awareness.
3. **Details the key accomplishments of BioCrossroads over the past two decades, with an emphasis on the organization's success in enhancing the ecosystem through collaborative initiatives, capital, talent, and awareness.** By researching an issue, building awareness, and engaging in project-based collaborations, BioCrossroads has been able to successfully advance the ecosystem.
4. **Forecast what the next two decades for BioCrossroads may hold.** Not one to rest on its laurels, Indiana must be vigilant in maintaining the competitive edge of its life sciences ecosystem. As the life sciences change, so too must BioCrossroads. Remaining responsive to changes in the environment will be critical for Indiana's long-term economic competitiveness.

As a dynamic organization, the programs and activities of BioCrossroads are constantly changing to match the pace of the complex life sciences ecosystem that it serves. One item that has remained a constant behind BioCrossroads' operations is a data-driven and tactical approach to solving the most pressing issues facing life sciences in the state. As noted by Mary Walshok, Associate Vice Chancellor of Public Programs at the University of California San Diego: "**What I admire about Indiana is that they took stock of what they are good at, and identified their gaps, and then designed significant components of their plan around that. We should all do more of that."**[12]

Since its onset in 2001, a data-driven mentality with a focus on intentional problem solving has been at the core of BioCrossroads, even as programs change. Building on sector-specific roundtable discussions convened by the Central Indiana Corporate Partnership (CICP) in the early 2000s, CICP and the Lilly Endowment decided to retain the Battelle Technology Partnership Practice, an internationally recognized consulting group, to dive deeper.[13] Although there was an inherent desire to identify, quantify and analyze growth engines for the region, there was also a need to highlight the gaps and missing pieces in the life sciences ecosystem.

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11 https://www.thenewlocalism.com/newsletter/funding-networked-governance
12 Katz, B., & Nowak, J. (2017). The new localism: How cities can thrive in the age of populism.
13 The Battelle Technology Partnership Practice transitioned in 2015 outside of Battelle Memorial Institute to become TEConomy Partners, LLC.

Indiana's lack of infrastructure for incubation and collaboration, underperforming commercialization assets, and a lack of venture capital to stimulate the growth of homegrown life sciences companies were revealed by the Battelle report. Indiana had no real structure that bred either collaboration or proliferation of life sciences companies. To realize the benefits of this industry sector, the region needed more than investment dollars—though those were sorely needed. Indiana also needed stronger partnerships among industry, universities, and government, and to unify its development strategy.

Central Indiana had the assets to be a major player in the sizable and growing field but required a "coherent, comprehensive and integrated action agenda" to ensure success. But what does success look like? Amid an era of tightening state budgets and increasing uncertainty due to technological advancements, Battelle argued that the life sciences were a deserving area of focus for Central Indiana that was also true for the entire state, due to them:

- Serving as a cross-cutting sector of the economy.
- Acting as a stable economic driver.
- Offering opportunities across skillsets.
- Enabling research drivers.
- Converging with other critical industries, such as information technology (IT) and advanced manufacturing.

Although the region remained confident in its strategic and data-driven approach, these five reasons to pursue the life sciences as an economic driver remain essential drivers of the Indiana economy today. Originally developed as a study for Central Indiana, the benefits of the life sciences also became increasingly clear, relevant, and important to the entirety of the state.

Serving as a cross-cutting sector of the economy.

Despite the common association of life sciences with test tubes and lab coats, in reality life sciences represent a broad, cross-cutting industry within the U.S. economy. As noted by Battelle in the 2002 report: "The life sciences are a major, cross-cutting sector of the economy, involving a range of manufacturing, service, and research activities. Many industries are involved in the life sciences, ranging from drugs, medical devices, health services, research and testing, and agricultural-related industries to other key supplier and component manufacturing industries."[14]

Two decades later, the cross-cutting nature of Indiana's life sciences economy is a hallmark of the state. Perhaps most indicative of this is that from 2001-2020, employment in Indiana's life sciences sector grew by nearly 25%, compared to just 2% across the state's private sector industries (Table 1). Notably, Indiana has experienced employment growth from 2001 to 2020 across all four subsectors analyzed, including substantial growth across three of these sectors.

Table 1: Life Sciences Employment in Indiana (2001-2020)

Indiana Sector	2020 Location Quotient	2020 Employment	% Growth 2001-20
Total Private Sector	1.0	2,535,558	2.0%
Life Sciences Total	1.5	59,095	25.0%
Bioscience-Related Distribution	1.0	12,514	35.3%
Drugs & Pharmaceuticals	2.8	18,887	1.9%
Medical Devices & Equipment	2.3	18,732	45.8%
Research, Testing, & Medical Laboratories	0.6	8,962	35.1%

Source: TEConomy analysis of Emsi (datarun 2022.2)

Indiana is rare among states in that it boasts an extremely high location quotient (LQ) across multiple life sciences subsectors.[15] In drugs and pharmaceuticals, Indiana's location quotient in 2020 is 2.8, which means that Indiana is nearly three-times (2.8x) as concentrated in drugs and pharmaceuticals as the national average. In medical devices and equipment (2.3), Indiana is specialized at a similarly high level, well more than twice the national average.[16] Although Indiana has lower levels of concentration in biosciences-related distribution (1.0, which is parity with the national normative concentration level) and research, testing, and medical laboratories (0.6), these were among the fastest growing subsectors over the two-decade period.

14 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.

15 LQ is used to determine the concentration of an industry in a particular region when compared to the broader economy. An LQ less than one indicates that the regional employment in a particular industry is lower than the national average, while an LQ greater than one indicates that the regional market has a higher concentration of employment in a particular industry.

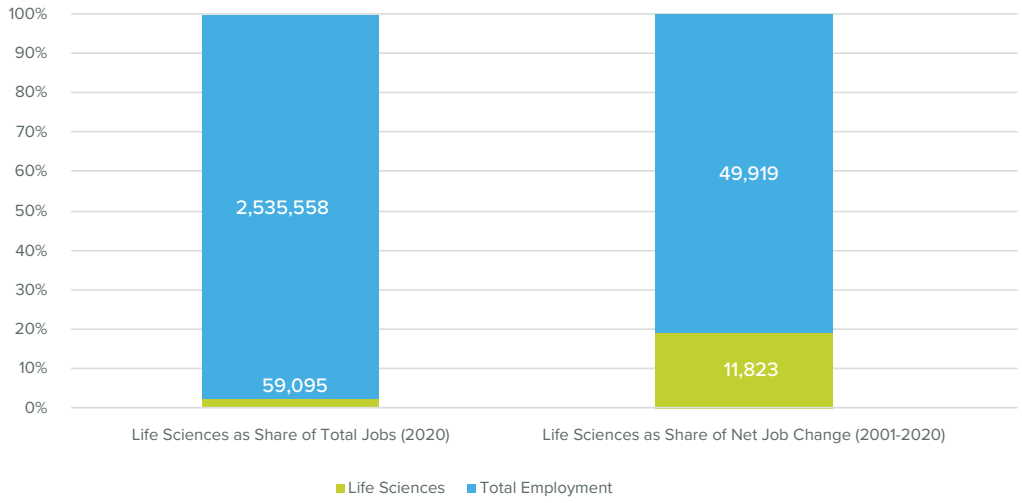
16 Indiana is also highly specialized in the agricultural feedstock and industrial biosciences (2.37), which was not considered for this analysis. This is because agbiosciences is the focus of a separate CICP initiative, AgriNovus Indiana, and does not fall under the remit of BioCrossroads.

A stable economic driver.

Beyond serving as a fast-growing and cross-cutting industry, life sciences also act as a stable economic driver for Indiana. As noted by Battelle in 2002: "The life sciences represents not only a mix of high growth industries that are an important economic driver for communities, but also industries that are more stable over the ups and downs of business cycles."[17] While some industries are inherently cyclical in nature, the life sciences have the advantage of being able to withstand a large number of the economic shocks that have disrupted Indiana's economy over the past two decades.

The life sciences have outperformed Indiana's economy since 2001 and are responsible for an outsized portion of total new jobs in the state over the past two decades. Although the life sciences represent just 2.3% of the state's total jobs in 2020, they represent 23.7% of the net new jobs from 2001 to 2020 (Figure 1). In other words: there were 49,919 new private-sector jobs created in Indiana from 2001 to 2020, and 11,823 of these jobs were in the life sciences.

Figure 1: Indiana's Life Sciences Industry as Share of Total Jobs (2020) and Net New Jobs (2001-2020)

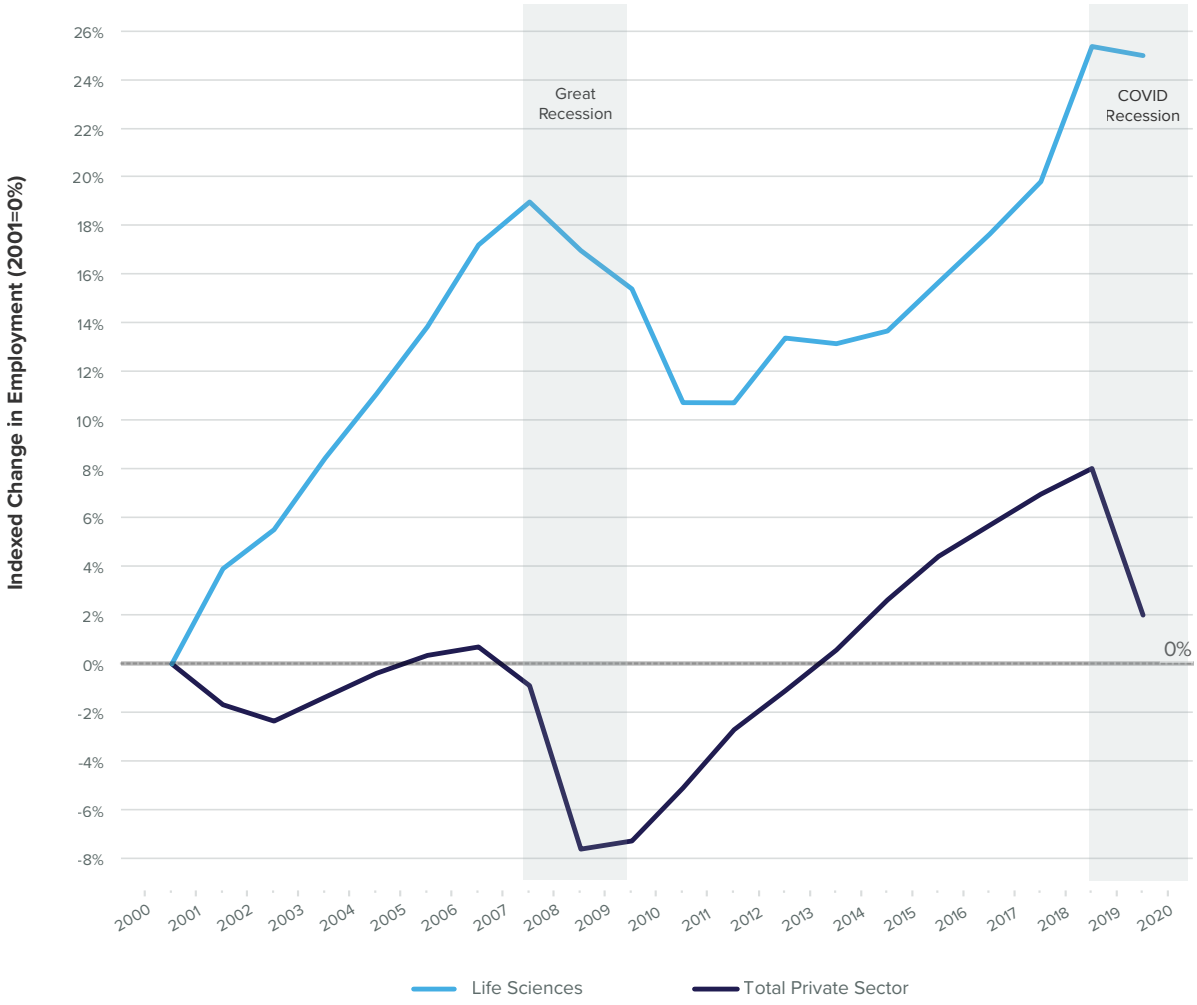


Source: TEConomy analysis of Emsi (datarun 2022.2)

Job growth in Indiana's life sciences sector has been substantially greater than that of the state's private sector (Figure 2). During the Great Recession, job losses in the sector were much less stark than in other private sector industries. The resiliency of the state's life sciences sector is especially evident from its performance during the COVID-19 pandemic: while Indiana's private sector saw five years of job growth erased by the pandemic, Indiana's life sciences economy declined by only a slight margin.

17 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.

Figure 2: Employment Growth in Indiana's Life Sciences and Private Sector Industries (2001-2020)



Source: TEConomy analysis of Emsi (datarun 2022.2)

Offering opportunities across skillsets.

A hallmark of Indiana's life sciences sector is its ability to deliver economic opportunity across skillsets, reaching into all corners of the state and a wide range of communities. As noted in Battelle's 2002 report: "The life sciences offer employment opportunities well beyond well-educated PhDs and medical doctors, with the highest share of employment found in production and technician positions. Nationally, production occupations comprise more than 50% of occupations found in medical devices, more than 40% in the pharmaceutical industry, and more than 30% in agricultural chemicals. Even in hospitals, the largest occupations are found among nurses and healthcare support occupations."[18]

Today, Indiana's life sciences sector remains heavily oriented around not only well-educated scientists and medical doctors, but also many in production and technician positions that are considered "middle-skill" occupations. Life sciences companies rely heavily on a workforce of skilled technicians (both in engineering and scientific domains), production workers with varied skills, transportation and material moving occupations, and others, such as installation, maintenance, and repair (see box for skill classifications). These middle-skill, family-sustaining occupations represent well over one-third of jobs in the life sciences sector (42%), compared to just 32% for all other industries in the state (Figure 3).[19]

TEConomy's Analysis of Skills Required for Entry Level Positions:

High-Skilled Occupations: Generally requiring bachelor's and higher degrees (and work experience such as residencies).

Middle-Skilled Occupations: Requiring moderate education, experience, and/or training beyond high school but less than a bachelor's degree; includes:

- High school diploma plus moderate to long-term on-the-job training
- High school diploma plus apprenticeship
- Postsecondary non-degree award
- Some college, no degree
- Associate's degree

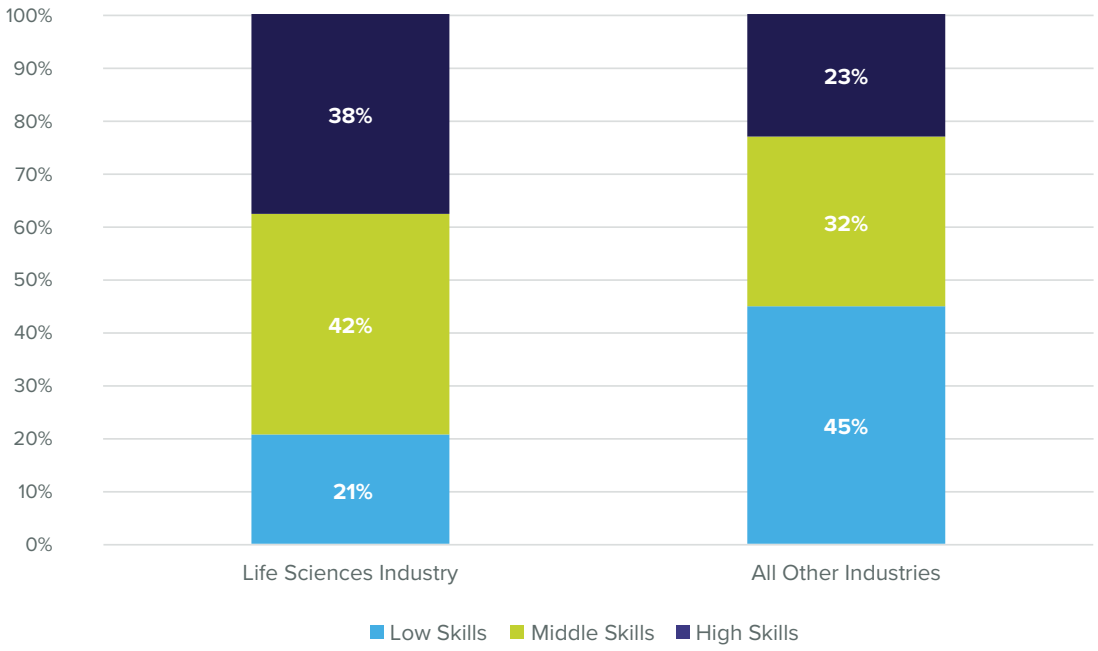
Low-Skilled Occupations: Generally requires less than a high school diploma or a diploma and only short-term training; includes:

- Less than a high school diploma
- High school diploma + short-term on-the-job training

18 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.

19 https://www.csbioinstitutes.org/_files/ugd/dd6885_748b39d8cdb14de490a1380fa342f777.pdf

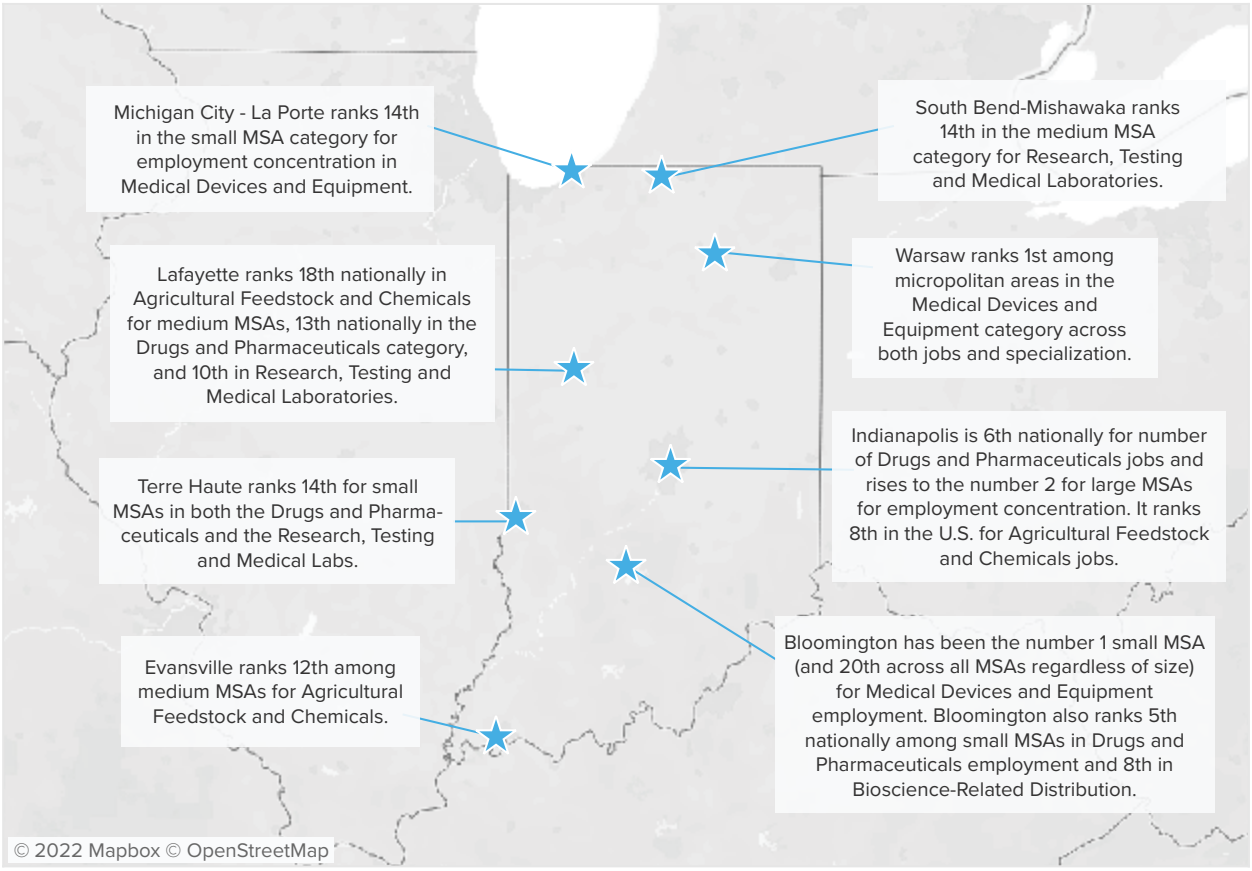
Figure 3: Skills Composition of Entry-Level Occupation Requirements for Life Sciences and Other Industries in Indiana (2020)



Source: TEConomy Partners analysis of Emsi 2021.2 data set

Product and geographic diversity are other hallmarks of Indiana's life sciences sector. Metropolitan statistical areas in Indiana are consistently among the largest and most concentrated life sciences hubs in the nation for their respective sizes (Figure 4).[20] Among large metropolitan areas, Indianapolis consistently ranks in the top 10 across three life sciences sectors, a feat that is also shared by Lafayette among mid-sized metropolitan statistical areas (MSAs). Bloomington stands out for ranking in the top 20 nationally in four biosciences categories. At a more local level, Indiana's life sciences sector truly touches all corners of the state, including the many orthopedics headquarters and supplier operations in Warsaw, Hill-Rom in the southeast, and Mead Johnson in the southwest.

Figure 4: Geographic Diversity of Indiana's Biosciences Industry

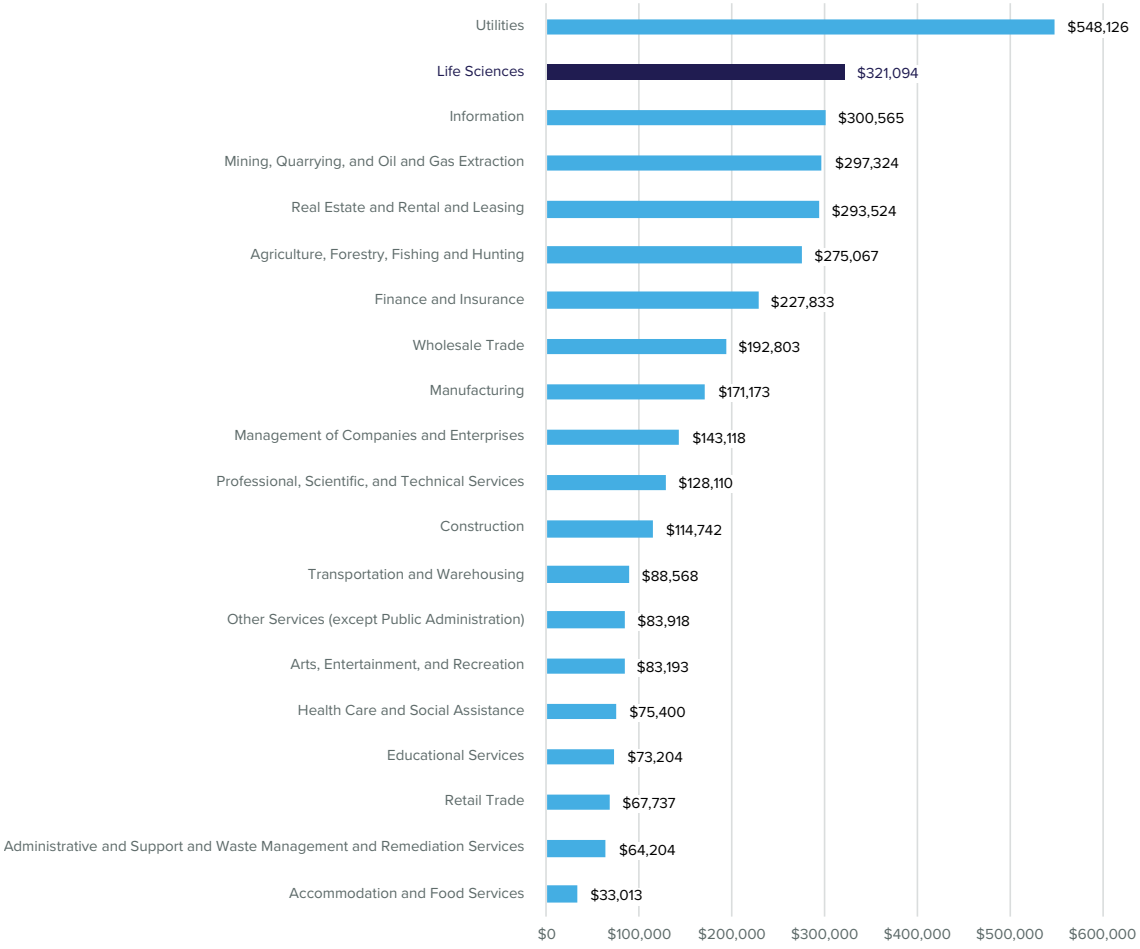


Source: TEConomy Analysis of BIO and BioCrossroads data

In a comparison among Indiana's broad industry sectors in 2020, the life sciences are tremendously productive, ranking second only to utilities in Gross Domestic Product (GDP) per worker. This high level of productivity in the life sciences is due to a wide variety of factors, including the high- and middle-skill jobs (Figure 5), and numerous investments in talent, infrastructure, and facilities to encourage value-added innovation.

20 https://www.bio.org/sites/default/files/2020-06/BIO2020-report.pdf and https://www.prnewswire.com/news-releases/indianas-life-sciences-industry-ranks-among-the-top-10-in-national-report-301073108.html

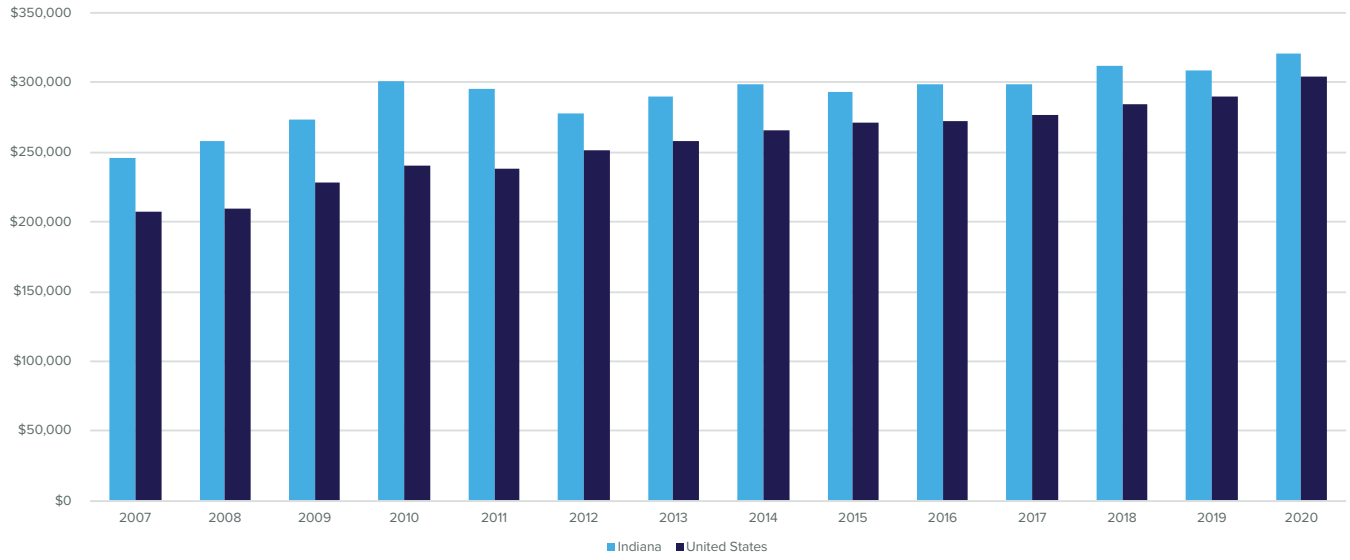
Figure 5: GDP per Employee by Industry Sector in Indiana (2-Digit NAICS) and Life Sciences (2020)



Source: TEConomy analysis of Emsi (datarun 2022.2)

Indiana's life sciences workers were considerably more productive than the national average in 2020 ($321,094 GDP per employee in Indiana, compared to $304,673 for the nation), and each year from 2007-2020) (Figure 6). It is clear that, as a whole, the sector is becoming more productive, largely as a result of advancements in new technologies. And, although it is important that Indiana remains more productive than the nation, Figure 6 does show the productivity advantage for Indiana waning over time. Moving forward, this speaks to the importance of having, among other things, a strong intermediary organization like BioCrossroads paying close attention to the strategic competitiveness of such a signature cluster.

Figure 6: Life Sciences GDP for Indiana and the United States (2007-2020)



Source: TEConomy analysis of Emsi (datarun 2022.2)

Enabling research drivers.

Research drivers such as universities, academic medical centers, industry R&D centers, and other nonprofit or federal research centers play a critical role in developing new treatments, products, and cures at their earliest stages. As noted by Battelle in 2002: "A key for life sciences success is the presence of strong research drivers. Only a few regions of the nation can provide the substantial research depth needed to support the life sciences. Central Indiana, which has its depth in private as well as public research, is one such region."[21]

Over the past two decades, academic research and development in Indiana has nearly tripled. Life sciences R&D at Indiana's colleges and universities has grown from a base of $282 million in 2001, reaching $844 million in 2020 (Figure 7). Academic R&D growth has been particularly rapid in recent years, growing by more than $220 million from 2016 to 2020. Notably, Indiana's academic institutions performed more than $10.8 billion in cumulative R&D over the two decades.

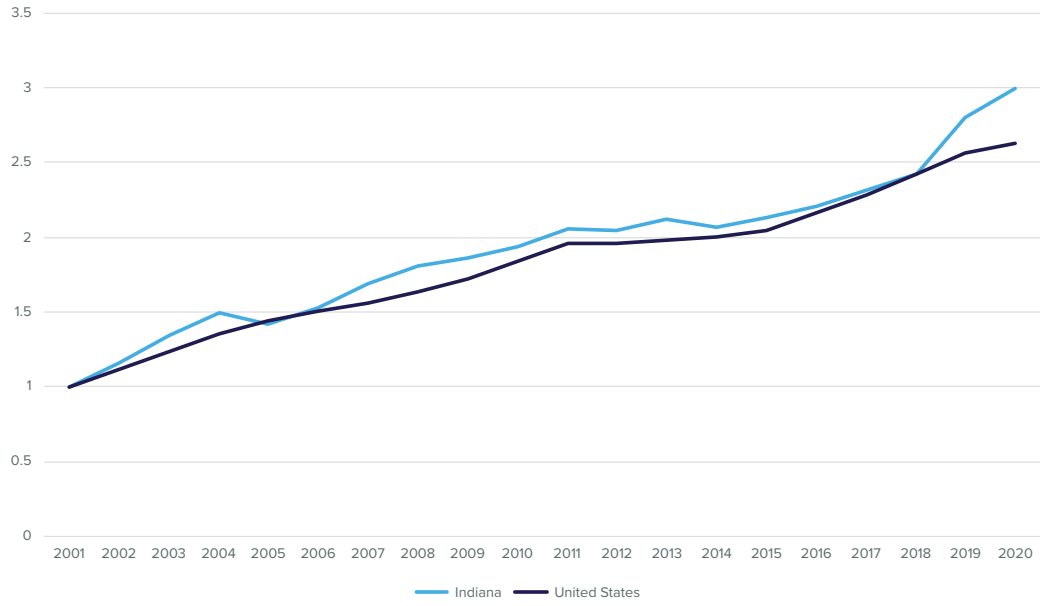
Figure 7: Life Sciences Academic R&D in Indiana ($ Millions)

Source: TEConomy analysis of NSF HERD

Growth in R&D at Indiana's academic institutions has outpaced the national average over the past two decades and has especially done so in recent years (Figure 8). Academic R&D expenditures include all sources of funding (e.g., federal agencies, industry, state, and foundation) for life sciences research at colleges and universities. While Indiana's 2021 academic R&D expenditures in the life sciences were roughly 3x their total in 2001, this same metric was just 2.5x for the nation as a whole. As is evident in Figure 8, Indiana's growth exceeded the nation's throughout the two decade period, but its standout performance in recent years makes a considerable difference in the long-term comparison. Recent initiatives to support life sciences research and development at Indiana's colleges and universities may offer some explanation to this growth over the past few years.

21 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.

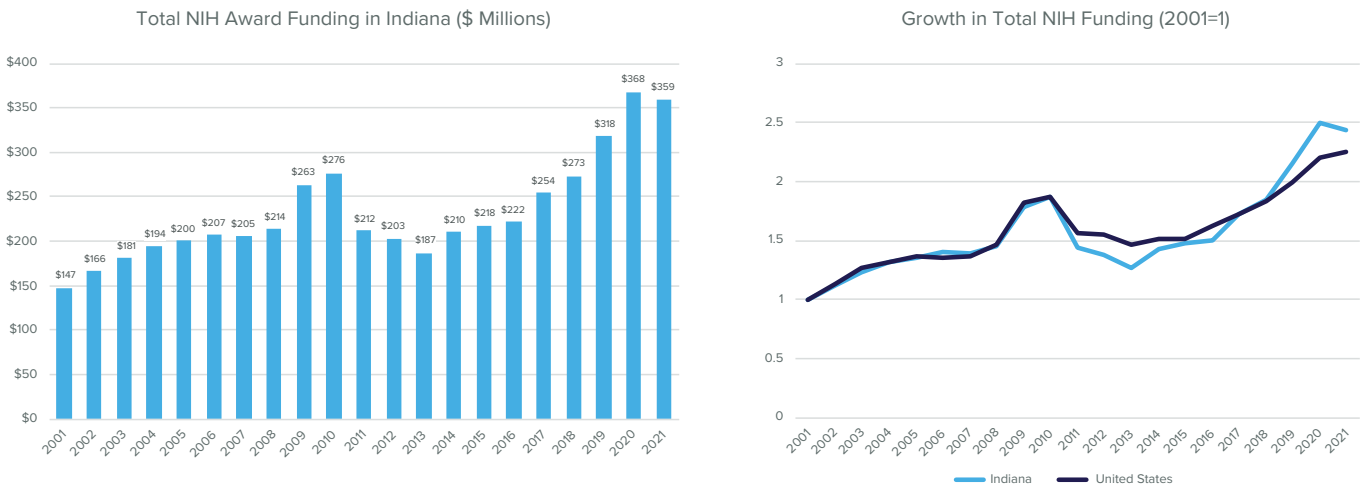
Figure 8: Indexed Life Sciences Academic R&D (2001-2021)



Source: TEConomy analysis of NSF HERD

Indiana has also seen considerable growth in funding from the National Institutes of Health (NIH), the primary source of federal funding for life sciences R&D. An analysis of total NIH Awards finds that the number of awards grew from 538 in 2001 to 788 in 2021, while the funds associated with these awards grew from $147 million to $359 million. Notably, growth in NIH awards in Indiana outpaced the U.S. average since 2001, and especially so over the past five years (Figure 9).

Figure 9: Total NIH Award Funding and Indexed Awards (2001-2021)



Source: TEConomy analysis of NIH Awards

Converging with other critical industries.

In the early 2000s, it was becoming increasingly clear that biology was a technology-oriented industry capable of building on pre-existing strengths in IT and manufacturing. As noted by the Battelle report in 2002, life sciences are becoming "a focal point for the convergence of technologies, with advanced manufacturing essential for development of innovative products such as artificial organs and non-invasive surgery techniques, and information technology critical for mining the wealth of genomic data being generated for drug discovery and diagnosis. These strengths in advanced manufacturing and information technologies are present and growing in Central Indiana, augmenting the region's opportunities in life sciences."[22]

Over the past two decades, numerous developments in the life sciences have only accelerated the pace at which this sector converges with other industries. As Nobel Laureate and former Caltech President David Baltimore remarks, biology today is very much an information science. He notes, "I don't really think our bodies are going to have any secrets left within this century. And so, anything that we can manage to think about will probably have a reality."[23]

Today, advanced data analytics are being deployed throughout the life sciences, including in scientific discovery, drug discovery, clinical decision-making support, and enabling technologies for the emergence of precision medicine. Disruptive technologies in the biological sciences include next-gen sequencing, gene editing, synthetic biology, regenerative medicine and tissue engineering, metabolic engineering, bio-nanotech and nanomedicine, and cyber-biological systems and implantables.[24]

Indiana's life sciences industry is closely related to the state's strengths in advanced manufacturing. Not only is industry employment distributed throughout the state's regions, but research from TEConomy and BioCrossroads finds that three-quarters of life sciences employment in Indiana is within manufacturers, ranging from more than half of employment with manufacturers (54%) in Lafayette to 92% of employment in the Uplands region (Table 2). This manufacturing ubiquity is related to the export-intensive nature of Indiana's life sciences sector: Indiana has $12.7 billion in exported products in 2021, the highest amount on record, and the third highest amount of exports in the U.S.[25]

Table 2: Industry Employment and Share of Life Sciences Jobs at Manufacturers (2020)

Measure	IN[26]	South Bend	Northeast	Lafayette	Indy Metro	Uplands	Evansville
Industry Employment	55,802	1,911	11,512	1,910	22,238	8,487	1,671
% of LS Industry Jobs at Mfg.	75%	75%	87%	54%	74%	92%	85%

Source: BioCrossroads Analysis of Regional Profiles

22 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.
23 Kaku, Michio (2011). Physics of the future: how science will shape human destiny and our daily lives by the year 2100
24 https://biocrossroads.com/wp-content/uploads/2020/01/Indiana-AdvancedAnalytics-and-AI-finalJan-2020.pdf
25 https://www.insideindianabusiness.com/articles/indiana-continues-to-punch-above-its-weight-in-the-life-sciences
26 Includes industry employment in rural or non-metropolitan Indiana (8,073 employees)

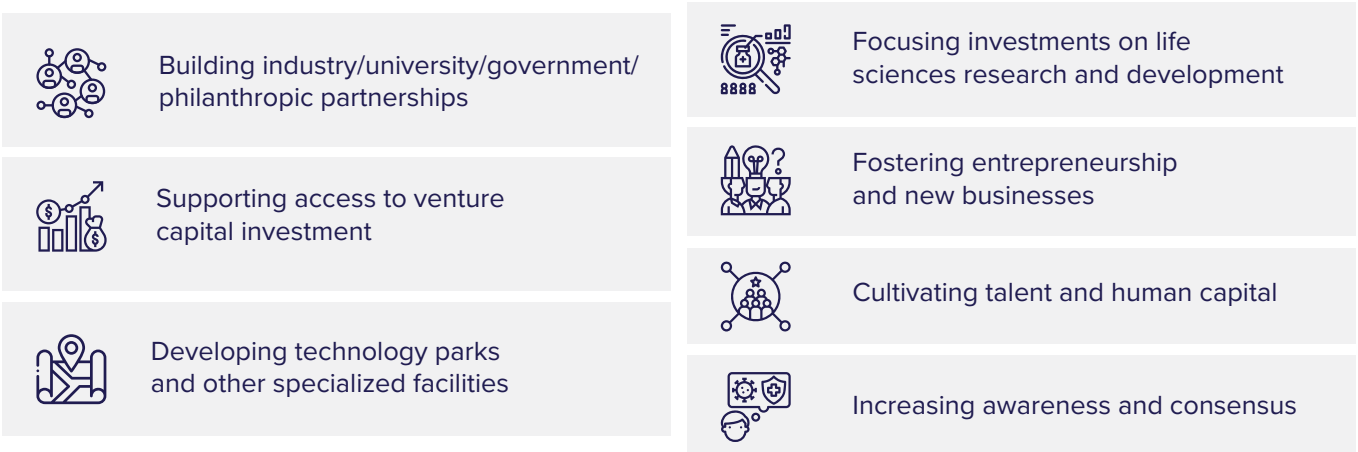
BioCrossroads: Enabling Life Sciences as an Economic Driver for Indiana

An organization such as BioCrossroads takes time to develop and represents a unique asset for Indiana. This section describes BioCrossroads' role in developing key collaborations within the life sciences ecosystem, and how this ecosystem has grown over time. At the core of BioCrossroads is an active/engaged network activated to respond to needs, threats, and opportunities.

Today, the life sciences in Indiana are a resilient and cross-cutting industry that has experienced two decades of strong performance in generating high-paying jobs. However, these achievements do not happen on their own. Instead, a wide range of assets across Indiana's life sciences ecosystem contribute to this sustained growth and success.

The success of Indiana's life sciences industry is the result of a well-functioning ecosystem that encourages innovation and entrepreneurship (Figure 10). Enabling life sciences as an economic driver for Indiana requires building industry, university, and government partnerships; focusing investments on life sciences research and development; fostering entrepreneurship and new businesses; supporting access to venture capital investment; cultivating talent and human capital; developing technology parks and other specialized facilities; and increasing awareness and consensus. **These ecosystem assets directly respond to the challenges identified in the 2002 BioCrossroads Report.**[27]

Figure 10: Enabling Ecosystem Assets to Encourage Life Sciences as an Economic Driver for Indiana



Source: TEConomy Partners and BioCrossroads

As a backbone organization, BioCrossroads works to ensure that each element of Indiana's life sciences ecosystem performs at a high-level, and not solely in a vacuum. The following section highlights how BioCrossroads helps to enable life sciences as an economic driver for Indiana by linking assets together. Through a series of intentional, strategic, and effective responses to shifts in the ecosystem, BioCrossroads serves as an effective steward to lead a coordinated effort on behalf of the broader community.

27 Battelle Memorial Institute Technology Partnership Practice (2002). Life Sciences: A 21st Century Economic Driver for Central Indiana. Prepared for Central Indiana Life Sciences Initiative.

Building industry/university/government/philanthropic partnerships.

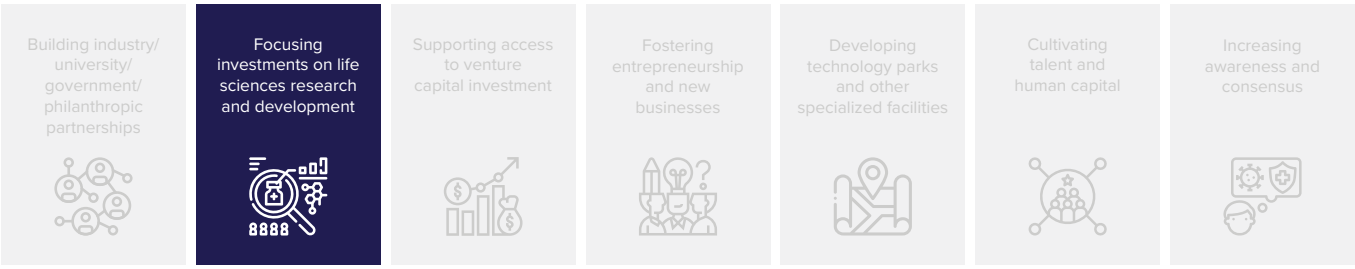
A high-functioning life sciences industry cluster requires strong links between an area's universities and its industry base, governments and public institutions, and an engaged philanthropic base. In an era of uncertain funding for biosciences innovation, collaboration between these sectors serves as a critical means to improve the productivity of R&D and reduce the costs of translating medical discoveries into new products, treatments, and cures.

BioCrossroads views partnerships in a holistic and systems-oriented manner, which allows for coordinated and strategic approaches to addressing common challenges. Innovation in the life sciences requires a holistic view of partnerships, given that universities and industry encompass distinct and unique stages of development across basic, translational, new product development, clinical testing, commercialization, new venture and product development, and overall industry cluster growth. An organization that pays attention to the entire ecosystem is uniquely important.

Among philanthropic partners, the support of the Lilly Endowment Inc. stands out for sustained, strategic, and steadfast investment in the life sciences and as an asset for community and economic development. According to research from Brookings Institution scholars, the Lilly Endowment's contributions—in partnership with considerable private-sector support—have been vital to the success of CICP and BioCrossroads, noting:

> *"It is hard to understate the importance of the Lilly Endowment, as the philanthropy has provided the seed funding necessary to get CICP and most of its initiatives off the ground. The critical role of philanthropies should not mask that a majority of resources come from the business community.* ***This is because CICP constructs strategies a) to appeal to bottom-line interests such as research, technology commercialization, and talent development; b) in ways that yield collaboration within industries, rather than competition; and c) at the front end, in conjunction with the very same businesses and higher education institutions from which it needs to establish buy-in to implement."***[28]

28 https://www.brookings.edu/research/rethinking-cluster-initiatives/



Focusing investments on life sciences research and development.

Intentional investments focused on advancing the life sciences are an essential component of Indiana's strategy to enable economic development through the life sciences. Beyond the academic research capabilities noted previously, Indiana is also home to significant R&D operations for many of the world's largest firms, such as Catalent Biologics, Cook Medical, Corteva Agriscience, Elanco Animal Health, Elevance Health (Anthem), Eli Lilly and Company, LabCorp Drug Development, Zimmer-Biomet, the North American headquarters for Roche Diagnostics, and many other companies. **According to TEConomy and BioCrossroads' research, "Indiana's public life sciences companies have a market cap of $422.5B as of December 31, 2021 up 42% from the prior year. Four companies raised $508M in capital through public offerings in 2021."[29]**

Since its inception, BioCrossroads has maintained a focus on not only the life sciences but also on distinct components within this industry that allow for the state to capitalize on its unique competitive advantages. BioCrossroads' early work with university and industry partnerships that resulted in the Indiana Center for Applied Protein Sciences (INCAPS) (2003) and the Fairbanks Institute for Healthy Communities (FIHC) (2006) provided early learning and experience that enabled a more ambitious collaborative effort with the formation of the Indiana Biosciences Research Institute (2012).

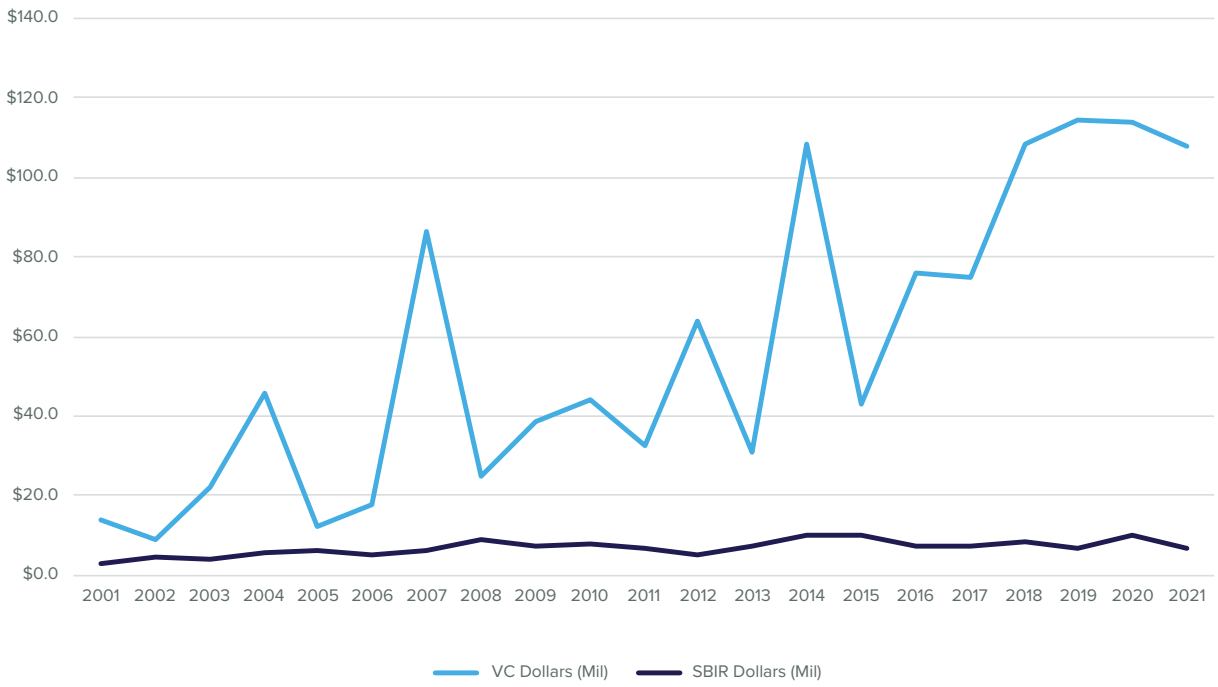
The intentionality of Indiana's focused investments in life sciences R&D is of particular importance for the state. BioCrossroads also plays an influential and intermediatory role in supporting signature R&D projects across Indiana's research institutions and with the life sciences industry. For example, in recent years BioCrossroads has worked with CICP to develop AnalytiXIN, an intentional and place-focused collaboration dedicated to connecting university assets and talent with industry in the areas of data sciences, including digital, AI, and advanced analytic capabilities.

29 https://biocrossroads.com/wp-content/uploads/2021/08/TEConomy-BioCrossroads-Essential-fullreport-Final-August-2021.pdf

Supporting access to venture capital investment.

Early-stage seed capital and venture capital funds are essential ingredients in helping companies get started, grow, and attract future rounds of additional capital needed to bring innovation in the life sciences to market. While grants such as SBIR/STTR awards are important for encouraging ideation in early stages, these funds are relatively small (Figure 11). From 2001 to 2021, Indiana averaged 20 SBIR/STTR awards per year, for an average total of $6.8 million.

Figure 11: Venture Capital and SBIR/STTR Dollars for Indiana Life Sciences Companies (2001-2021)

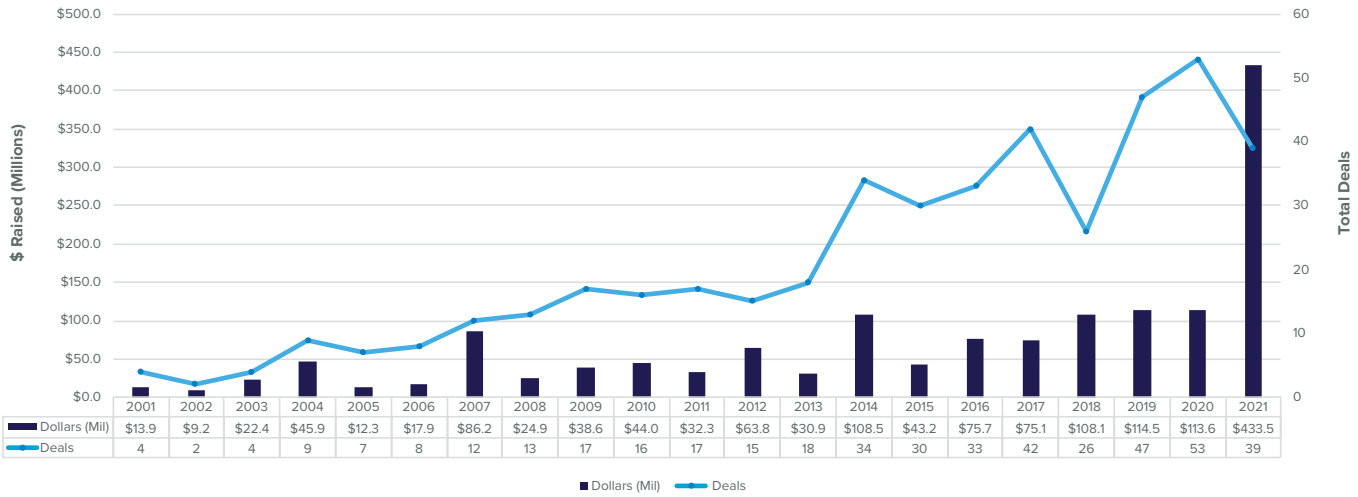


Source: TEConomy analysis of Pitchbook and SBA data

Ultimately, truly novel and innovative companies in the life sciences commonly require an influx of capital from a true investment vehicle like venture capital: a sophisticated venture fund seeking investment-ready, promising technologies and treatments, with competent leadership teams. While Indiana has struggled to access non-dilutive grants to support its young companies (ranking in the bottom half among U.S. states), it has had much more success with attracting venture capital to the life sciences.

From 2001 to 2021, the number of venture capital deals and dollars going to Indiana's life sciences companies has grown almost tenfold (Figure 12). In 2001, there were just four VC deals for a total of $14 million. However, in 2021, Indiana had 39 venture capital deals totaling $433.5 million. Notably, Indiana's life sciences companies have received well over $100 million in each of the four most recent years where data are available (2018-2021).

Figure 12: Growth in Indiana Life Sciences Venture Capital (2001-2021)[30]



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Dollars (Mil)	$13.9	$9.2	$22.4	$45.9	$12.3	$17.9	$86.2	$24.9	$38.6	$44.0	$32.3	$63.8	$30.9	$108.5	$43.2	$75.7	$75.1	$108.1	$114.5	$113.6	$433.5
Deals	4	2	4	9	7	8	12	13	17	16	17	15	18	34	30	33	42	26	47	53	39

Source: TEConomy analysis of Pitchbook data

As noted by CICP President David Johnson in the BioCrossroads 2020 Capital Strategy Report, the "landscape of opportunity capital for life sciences start-ups today is vastly different from what it was 20 years ago. BioCrossroads has made all the difference."[31] As a successful steward of community-based venture capital strategies, BioCrossroads' success is rooted in a clear purpose and intentional focus, capable sponsors and credible development leaders to build the capital required, and highly capable—and investable—managers. As the report notes:

> *"BioCrossroads continues to play an important role. At the nexus of Indiana's life sciences ecosystem, BioCrossroads is where Indiana's life sciences stakeholders focus on the collective. It has ignited Indiana's life sciences capital strategy beginning with the first Fund of Fund vehicles and serving as a trailblazer in supporting promising companies with seed funding, often as one of the first institutional investors. Not only as an investor, BioCrossroads has amplified and extended the efforts of other catalysts in driving innovation, supporting Elevate's annual Kinetic conference, raising awareness and supporting tech transfer efforts at each of IU, Purdue, and Notre Dame, supporting the AXIS program to provide mentoring from experienced managers to early-stage company CEOs, and many more activities in addition to making direct investments."*

30 2021 data includes Greenlight Guru ($120M) and Inari ($208M) deals
31 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf

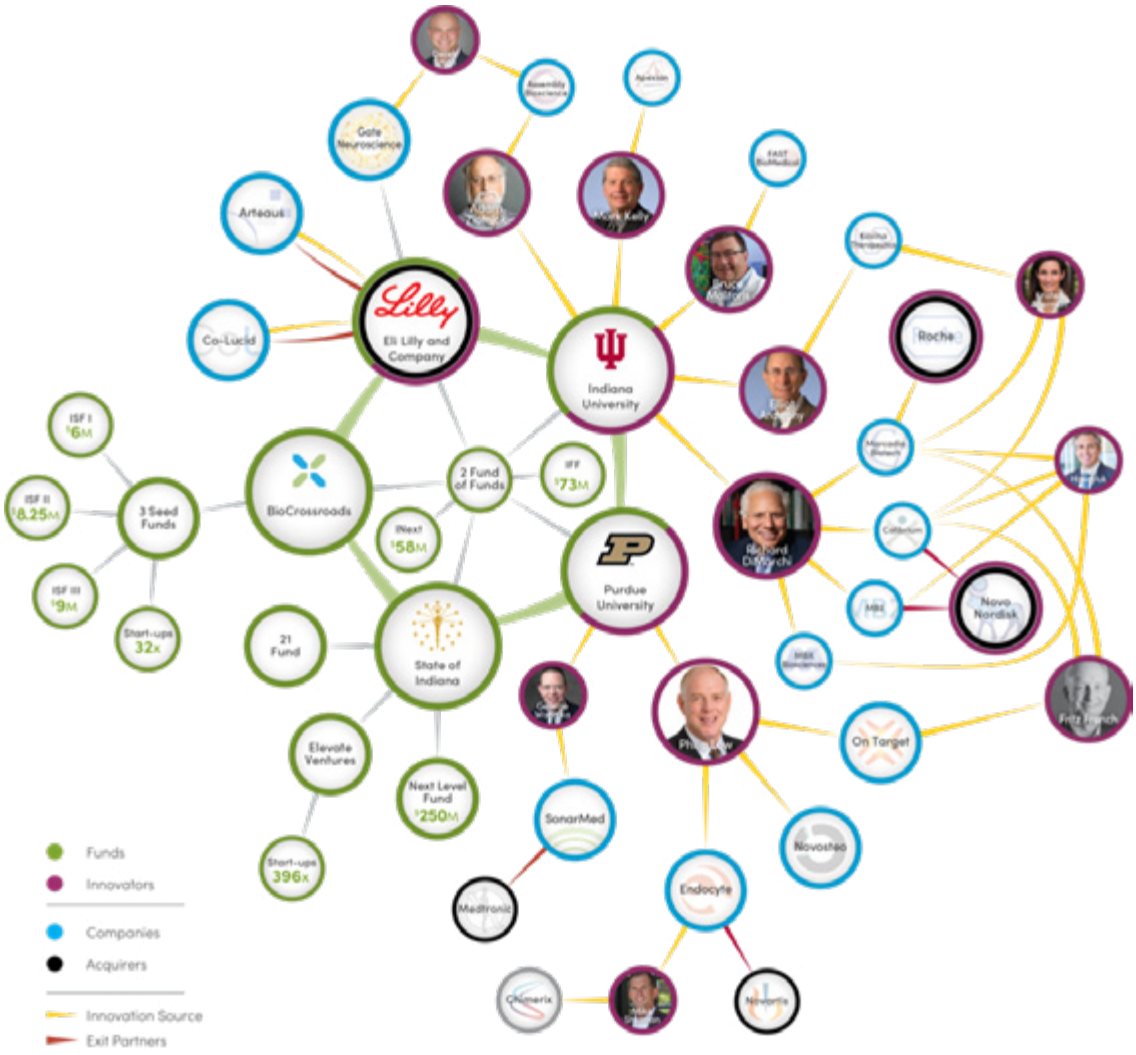
Fostering entrepreneurship and new businesses.

Despite Indiana's strength in research and development, Indiana's status as a hub for life sciences *entrepreneurship* has lagged in comparison to other hubs like Boston, San Francisco, or San Diego. While it is true that venture capital is important for commercializing new technologies in the life sciences, nascent startup companies also require additional support services and assistance. In communities like Indiana, connections to these types of resources may be as difficult to access as capital itself.

For 20 years, BioCrossroads has worked to encourage a network of seasoned startup talent and leadership required for advancing world-class innovation. As a filter for Indiana's life sciences investment, BioCrossroads plays a pivotal role in not only screening companies for investment but also in ensuring that those firms requiring additional assistance can successfully address the necessary gaps in their business prior to receiving new investment.

As noted in an analysis of successful exits among BioCrossroads-affiliated startup companies, numerous people and organizations emerge as key catalysts and sources when looking at sources of innovation, funding, and exit partners (Figure 13). Entities like Indiana University, Purdue University, Eli Lilly and Company, the State of Indiana, and BioCrossroads emerge in Figure 13, alongside the companies (marked with cyan circles), and a highlight indicating receipt of funding from Indiana Future Fund (blue), INext (orange), BioCrossroads' Seed Funds (green), or Elevate Ventures (purple). The source of the innovation is shown through a yellow connecting line and exit partners are linked to target companies using a red connecting line.

Figure 13: Indiana's Life Sciences Catalysts



Source: BioCrossroads

BioCrossroads excels at finding, supporting, and rewarding promising companies and connecting them with the broader life sciences community in Indiana. BioCrossroads maintains a network of resources to provide business planning and early-stage strategic support. For example, AXIS is a new mentoring program focused on developing Indiana's life sciences entrepreneurial talent.[32] Through AXIS, BioCrossroads—with the support of the Innovation Offices of Indiana University, Purdue University, and the University of Notre Dame, together with 16 Tech, and the Indiana Biosciences Research Institute—is creating an inclusive and supportive community of highly experienced mentors and promising entrepreneurs, based on a unique and proven mentoring model from the Massachusetts Institute of Technology's Venture Mentoring Service (MIT VMS).

32 https://biocrossroads.com/axis/

Developing technology parks and other specialized facilities.

Although talent serves as the main driver of innovation and entrepreneurship in the life sciences, the role of place-based development such as technology parks and other specialized facilities are critical to advancing the life sciences. Technology parks help enable the flow of ideas between Indiana's innovation generators in the life sciences—its research universities and industry R&D centers. Meanwhile, shared-use specialized facilities allow Indiana researchers to not only collaborate with one another but also to conduct leading-edge research that would otherwise be cost-prohibitive. As a facilitator of Indiana's life sciences ecosystem, BioCrossroads' support for these place-based developments helps ensure that the state's complex networks of businesses, support assets, and physical assets successfully link together.

Indiana's life sciences sector is home to a significant number of capital projects helping to drive this place-based development. Over the past five years, there has been nearly $2.3 billion in combined capital project spending (an average of $455 million in major capital projects each year for five years), and nearly three million square feet of construction for the 2019-2023 five-year period.[33] This type of capital investment signals growing infrastructure for life sciences development that is available and accessible in Indiana.

33 https://biocrossroads.com/wp-content/uploads/2021/08/TEConomy-BioCrossroads-Essential-fullreport-Final-August-2021.pdf

BioCrossroads' work with CICP to facilitate investments in technology parks and specialized facilities can be seen in the example of the 16 Tech innovation district in Indianapolis. In just a handful of years, the impacts of the innovation district have been pronounced for Indiana, and especially for Indianapolis. As noted by 16 Tech:

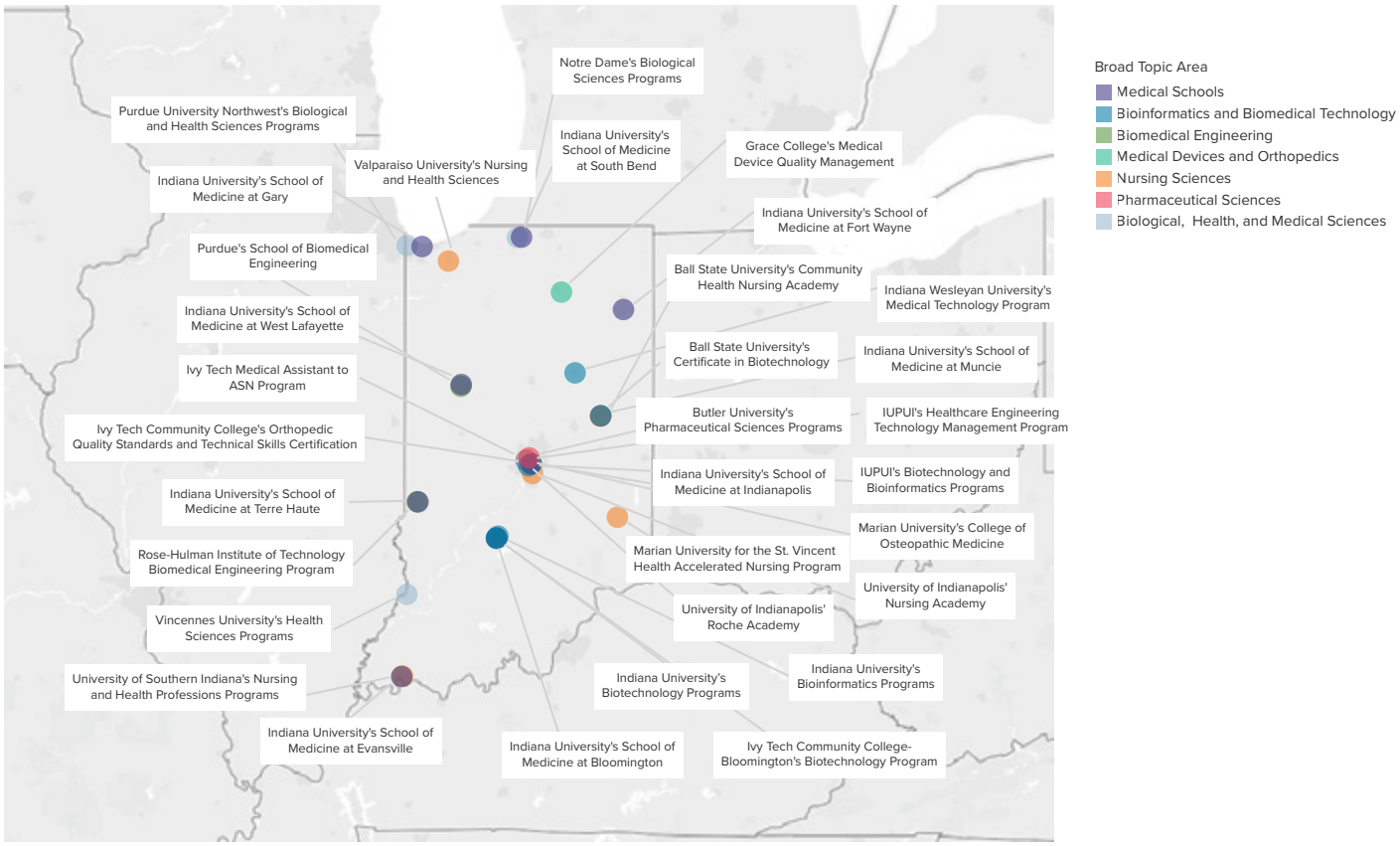
> *"Since 2018, more than $130 million has been invested in buildings and infrastructure in the district. In 2021, the district solidified a fast-growing network of dynamic spaces, tenants, partners, and programs,* ***welcoming more than 50 companies and 500 employees.*** *It is now home to startups, venture studios, key anchor institutions in the life sciences, data analytics and advanced manufacturing sectors, six universities and 21 restaurants and retail establishments. In 2022, 16 Tech celebrated a total of $1.3 million in funding to resident-supported projects in nearby neighborhoods through its Community Investment Fund."*[34]

34 https://16tech.com/krueger-president/

Cultivating talent and human capital.

Indiana is a hub for academic medicine and health sciences research and associated higher education, with world-class assets such as the IU School of Medicine (the largest in the U.S. as measured by number of students), Purdue, and IUPUI. The state is home to numerous other colleges and universities, as well as providers of advanced specialty clinical care and general clinical services. Notable examples of academic programs to encourage Indiana's life sciences industry can be seen in the map in Figure 14.

Figure 14: Examples of Higher Education Programs to Support Indiana's Life Sciences Industry

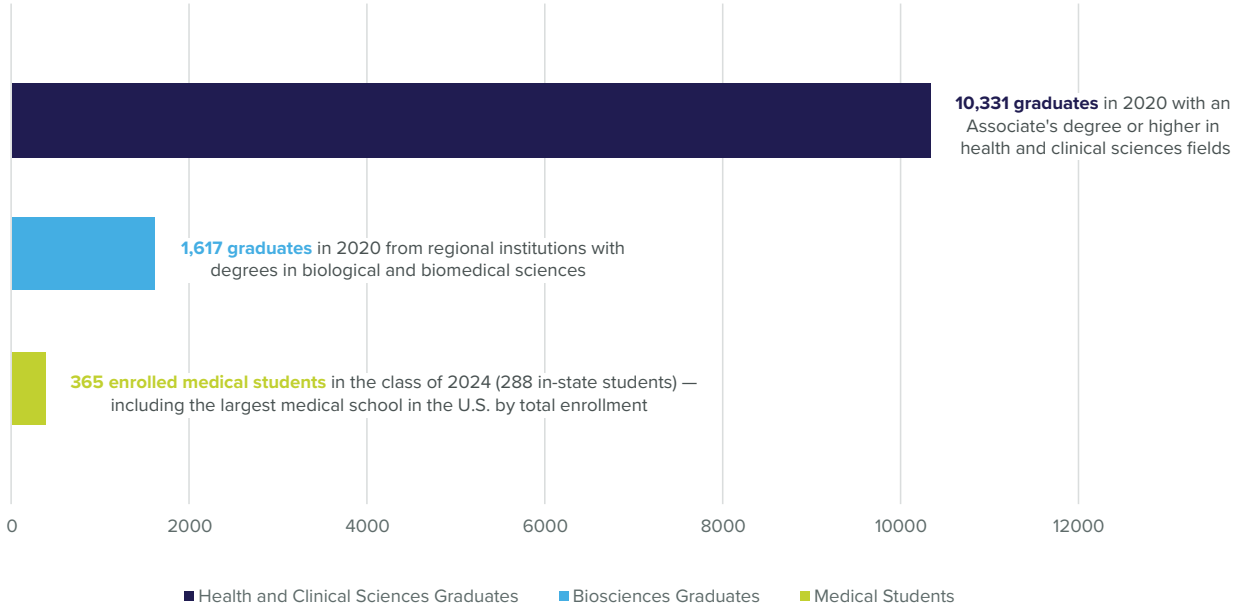


Source: TEConomy Partners and BioCrossroads

Across these programs and others, Indiana educates and graduates thousands of students each academic year in the life sciences, providing them with valuable training, degrees, and certifications that support and strengthen the industry. A snapshot of talent development in Indiana can be found in Figure 15. Indiana's assets in academic and community health serve as both a

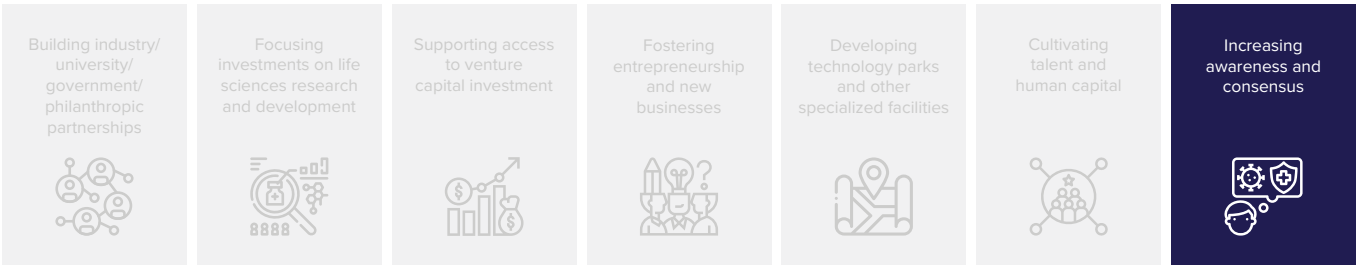
major employer for the state and a provider of high-quality healthcare. Access to quality care plays an important role in human, health, and economic development.

Figure 15: Snapshot of Talent Development in Indiana



Source: BioCrossroads 2020 Report

What makes BioCrossroads' approach to cultivating talent unique is its ability to enhance the traditional approaches to skills development and training—K-12 schools, community colleges, universities, workforce development efforts, etc. In its early days, BioCrossroads established the I-STEM Resource Network with Purdue University as the managing institution to support STEM efforts for K-12 schools, including funding for professional development and classroom resources. Later efforts focused on connecting research institutions and industry partners to drive engagement and develop talent. Today, CICP's talent initiative Ascend Indiana helps Indiana employers find and hire qualified candidates by designing transformative partnerships to create training and educational programs for high-demand workforce needs.



Increasing awareness and consensus.

Although each of the above elements is important to encourage a robust ecosystem for the life sciences sector, it is also vital to reflect on what is needed to support even greater outcomes. There is a risk that progress can stall without the ability to assert and communicate the successes of these ecosystems to wider audiences and without the ability to build consensus around the actions necessary to continue with this momentum.

As noted by Brookings in *Rethinking Cluster Initiatives*, the role of "educating industry leaders, potential investors, and the public through white papers, trend reports, and partnerships with higher education institutions to train Hoosiers in the STEM fields" is very much an essential part of the work of BioCrossroads.[35] Brookings writes that, "While not as flashy, this function remains very important for BioCrossroads. It is seen as both a knowledge resource for the public and non-experts—to galvanize support for investments in the cluster—but also providing research and expertise for executives within the life sciences industry."

With leadership from BioCrossroads, Indiana excels at spreading awareness about the strengths, challenges, and opportunities facing the state's life sciences industry. More so, BioCrossroads works to build consensus around these topics so that the public, private, philanthropic, and educational sectors can collaborate and take necessary shared actions. As is explored in the following sections, BioCrossroads excels at recognizing an issue, studying the topic to identify potential resolutions, and building community consensus about why intentional action is needed.

35 https://www.brookings.edu/wp-content/uploads/2018/07/201807_Brookings-Metro_Rethinking-Clusters-Initiatives_CICP.pdf

BioCrossroads: Building Indiana's Life Sciences Ecosystem

For more than two decades, the evolution of Indiana's life sciences ecosystem has led to an industry that enables growth in Indiana's research drivers, acts as a stable economic force, and offers opportunities across skillsets, sectors, and in-state geographies. BioCrossroads has played an essential role in supporting the life sciences by encouraging partnerships, guiding focused investments in R&D, supporting access to capital and entrepreneurship, and leading collaborative efforts around topics such as networking, technology parks, and talent development.

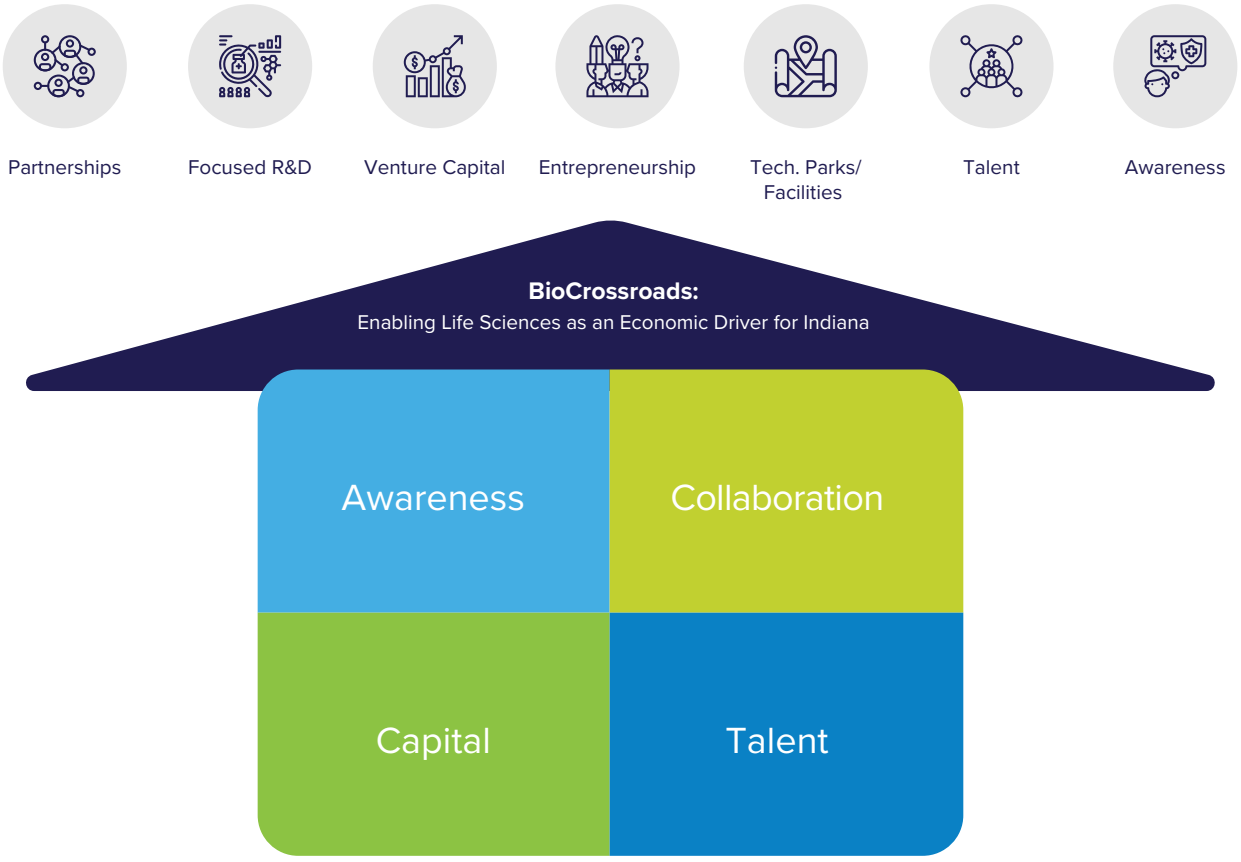
Over the course of its history, BioCrossroads has:[36]

- Directly raised $649 million in market capital, philanthropic, and state funding to identify and pursue promising new Indiana life sciences opportunities.
- Organized two life sciences venture capital funds—the Indiana Future Fund ($73 million) and the INext Fund ($58 million).
- Organized and actively managed three seed funds that have invested in 32 companies, including previous management of the Indiana Seed Fund I ($6 million) and Indiana Seed Fund II ($8.5 million), and current management of Indiana Seed Fund III ($9 million).
- Facilitated the formation of 10 enterprises to advance signature Indiana life sciences strengths, including the Indiana Health Information Exchange, the Indiana Biosciences Research Center, the 16 Tech Innovation District, and OrthoWorx.
- Assisted in the attraction of thousands of jobs via life sciences companies establishing, expanding, or consolidating operations in Indiana.
- Supported over 500 startup companies and collaborations by connecting them with industry partners and capabilities, providing basic business planning guidance, and linking with additional funding sources.

By offering thought leadership, intentional programming, and meaningful events, BioCrossroads helps strengthen Indiana's life sciences ecosystem through collaborative initiatives, talent development, investment capital, and value-added networking and awareness campaigns (Figure 16). The following section serves to highlight the growth of Indiana's life sciences industry, as told through the lens of BioCrossroads' initiatives. As is evident, BioCrossroads' activities act as a forceful economic driver for Indiana and are well-aligned with the actions needed to enhance the ecosystem.

36 https://biocrossroads.com/biocrossroads-celebrates-two-decades-of-advancing-indianas-life-sciences-sector/

Figure 16: BioCrossroads Enables Life Sciences as an Economic Driver for Indiana



Source: TEConomy Partners, LLC.

Building the Ecosystem Through Collaborative Initiatives.

BioCrossroads' Collaboration Strategy

A key competitive advantage for Indiana's life sciences industry is BioCrossroads' ability to successfully respond to opportunities by building awareness, responding to environmental changes, and maintaining a network focused on problem-solving. A typical BioCrossroads response involves three stages:

1. BioCrossroads activates its network by building awareness on an issue of importance to the community, then proactively engages these stakeholders in approaching the challenge.

2. BioCrossroads pursues project-based engagements in collaboration with its network, adjusting programs and activities as needed to ensure that they are working as intended.

3. Over time, many of these activities evolve into signature, transformative efforts.

Once BioCrossroads acts, the activities become a part of the ecosystem and strengthen the ecosystem.

Notable BioCrossroads Collaboration Initiatives

As seen in Figure 17, six collaborative initiatives stand out for their ability to cut-across the seven areas where life sciences act as an economic driver: **1) The Indiana Health Information Exchange (IHIE), 2) IndyHub and I-STEM, 3) Indiana Biosciences Research Institute, 4) 16 Tech, 5) AnalytiXIN, and 6) support for the Indiana Economic Development Corporation.**

Figure 17: BioCrossroads Support for Collaborative Initiatives

Source: TEConomy and BioCrossroads

Incorporated as a nonprofit organization in 2004, the Indiana Health Information Exchange (IHIE) is one of America's largest and most successful health information exchanges, serving as the de facto statewide health data utility for Indiana. BioCrossroads led the capital campaign and worked in partnership with the Regenstrief Institute, Marion County's Health and Hospital Corporation, and other healthcare and community organizations to plan, organize and fund IHIE with a simple goal: *exchanging, employing, and leveraging information to improve health and healthcare in Indiana.* IHIE harnesses the power of data to help Indiana's hospitals, physicians, laboratories, payers, and other health service providers by operating and offering services based on the Indiana Network for Patient Care (INPC). **INPC is the nation's largest interorganizational clinical data repository, with participation from over 120 hospitals, 18,000 practices and 50,000 providers, and it includes data on more than 17 million patients.**

As IHIE has grown over time, the mission of the organization has never wavered: using advanced data sciences and shared clinical information to improve the quality, safety, and efficiency of healthcare, improve overall health of citizens, and create unparalleled research capabilities for health researchers. Today IHIE offers products and services that improve the health of individual patients, give insights into population health (e.g., track patients by measuring progress and analyzing data for a specific segment of the population), and help support public health and Medicaid agencies. During the COVID-19 Pandemic, IHIE has been serving as a single aggregated data source supporting the State's pandemic response, producing vaccination data analysis for local health and community leaders in all 92 Indiana counties to assist with planning and outreach activities that promote increased vaccination rates.[37] Like many BioCrossroads initiatives, IHIE today serves as a best practice to inspire successful models of health information exchanges and health data utilities around the nation.

As IHIE became an established asset within the ecosystem—offering benefits to patients, health systems, and researchers alike—BioCrossroads then turned to an intentional focus on talent development, attraction, and retention.

The origins of IndyHub stem from a series of conversations facilitated by BioCrossroads to discuss the prevailing issue of attracting and retaining young professional talent to the state and region. Formed in 2005 as a free-standing nonprofit with a single staff member and a governing board of directors, IndyHub represents the largest network of 20- and 30-somethings in Central Indiana. IndyHub works to grow, engage, and empower this community and ensure its participants are meaningfully connected to the region and invested in its future. Over time, the talent attraction and retention efforts have grown to include everything from networking events, leadership development programs, volunteer opportunities, book clubs, and access to the arts, among others. So too have the organization's staff, board, and membership-free network of 20- and 30-somethings, which is measured in the thousands.

In 2006, the I-STEM Resource Network was developed to ensure that Indiana's students receive sufficient experience in science, technology, engineering, and mathematics from an early age. As Indiana's life sciences industry increasingly demands specific science-based skills and technical proficiencies, I-STEM was established with a goal of helping students successfully compete for jobs. I-STEM, with much of its program content delivered as the Indiana Science Initiative, was established as a collaboration organized by BioCrossroads, managed by Purdue University, and engaging 16 higher education institutions across Indiana. The Initiative features corporate leadership from Eli Lilly, Cook Medical, Corteva Agriscience, Cummins, and Rolls-Royce. "Lilly Foundation, together with Lilly Endowment, have provided significant and sustained funding for developing this initiative, which is now in the process of being expanded across the state through the more active involvement of leadership from the Indiana General Assembly, as well as Indiana's new Governor and Superintendent of Public Instruction."[38]

Since 2008, BioCrossroads has supported the Indiana University School of Medicine on an NIH-funded Clinical and Translational Sciences (NIH CTSI) Award. IUSM has successfully obtained three major rounds of funding from the NIH CTSI, a grant that also involves Purdue University and the University of Notre Dame. The CTSI represents a leading five-year clinical grant that highlights Indiana's ability to demonstrate broader industry and clinical participation and collaboration in new forms of translational research. BioCrossroads has supported the engagement of Indiana's industry with this important grant including past roles as Chair of the External Advisory Committee.

Among other things, BioCrossroads, in collaboration with the IUSM, has worked to develop and repurpose the former Lilly Phase I Clinic as a CTSI Phase I Cancer Clinic, managed by Covance; and has worked alongside IUSM with Takeda and several other Midwestern CTSI award recipients to develop the multi-industry, multi-university SPARC initiative for the translational study of autoimmune disease.

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37 https://www.ihie.org/ihie-impacts-patient-care/
38 Indiana's Life Sciences Landscape: BioCrossroads History to 2017

Between 2010 and 2013, a series of reports commissioned by BioCrossroads uncovered strengths in the state's life sciences industry that could be enhanced through strategic collaborations. In October 2012, a "call to action" by former Lilly CEO John Lechleiter spurred the formation of the Indiana Biosciences Research Institute (IBRI), the nation's first industry-led research institute in the life sciences. Organized as a separate nonprofit corporation but actively supported by the BioCrossroads team, IBRI is capitalized at over $150 million (principally from generous investments by the the State of Indiana, Indiana University, Lilly Endowment, and Eli Lilly and Company, along with other corporate stakeholders such as Cook Medical, Corteva Agriscience, and Roche Diagnostics).

The IBRI's goal is to create a dynamic and collaborative research environment with industry and academic partners to translate emerging disease understanding into novel therapies that improve patient lives, with a dual focus on attracting world-class talent to work with Indiana's life sciences leaders. Urban scholars Bruce Katz and Jeremy Nowak in *The New Localism* praise this relationship between research and talent, noting: "The IBRI, founded in 2012 as the first industry-led research institute in the United States, best illustrated the links between talent and industry."[39] The IBRI is building new and cutting-edge capabilities to enable its ambitious strategy that will benefit patients and drive economic development of the Midwest biomedical community.

As the IBRI expanded, Indiana's leaders recognized a home was necessary to develop a critical mass around these world-class research assets. As an anchor tenant, the value of an industry-powered research institute in a research park can be immense. Beyond the millions in R&D funds to stimulate the state's economy, the ripple effects from concentrating a research institute among other life sciences assets include benefits related to ideation and research collaboration from specialized facilities, talent attraction and retention, and wealth generation both in the district and in neighboring communities. However, Indiana did not have the sort of naturally occurring technology park or innovation district that could serve as a home for both the IBRI and the broader life sciences community in Indiana.

To provide a home base for Indiana's life sciences ecosystem, the 16 Tech Innovation District was established in 2015 as an intentional effort to attract and retain talent, support entrepreneurship, and engage with the community. Representing 60 acres of prime real estate on the near northwest side of downtown Indianapolis (a location long a priority for public-private development for nearly 20 years), 16 Tech was seeded with land donated by groups including IBRI, IU, IU Health, and Eskenazi Health, forming the core of the 16 Tech Innovation District.

Anchored by the Indiana Biosciences Research Institute and with $75 million in public infrastructure improvements funded by the City of Indianapolis, the innovation district is located near the northwest corner of downtown Indianapolis.[40] Organized by CICP and BioCrossroads in 2016, the project initially relied on substantial and ongoing CICP and BioCrossroads staff support (enabled through the multi-year BioCrossroads grants from both Lilly Endowment and the Richard M. Fairbanks Foundation) before hiring Bob Coy as CEO in 2017.

As more than a traditional research park, 16 Tech is evolving into one of the state's most vibrant live-work-play communities. Nestled inside Indianapolis' historic Riverside neighborhood, at 16 Tech's innovation hub (HqO), there are now a range of activity centers, including flexible and private co-working spaces, a membership-based makerspace (Machyne), and an entrepreneurial-led food hall (AMP). In 2022, Food and Wine magazine included Indianapolis as one of the seven most exciting up-and-coming big American cities for food lovers and included a special mention of the AMP food hall at 16 Tech Innovation District.[41] The AMP features more than 20 spaces for food, drink, retail, and entertainment, with the majority being new concepts led by minority- and women-led businesses.

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39 Katz, B., & Nowak, J. (2017). The new localism: How cities can thrive in the age of populism.
40 https://www.indystar.com/story/news/politics/2015/11/09/city-county-council-oks-75m-indianapolis-tech-park/75475124/
41 https://www.indystar.com/story/entertainment/dining/restaurants/2022/04/13/food-wine-top-cities-indianapolis-restaurants-bars-dining/7305698001/

Notably, issues related to equity and inclusion in the surrounding areas of 16 Tech are core to this development. Since 2020, 16 Tech has awarded a total of $1.3 million in funding to 40 projects through the 16 Tech Community Investment Fund, a community-focused fund launched in 2019 to ensure access and opportunity for neighbors of the 16 Tech Innovation District. This community-based fund is guided by an advisory committee that helps ensure that the residents in the Near West, Near Northwest, and surrounding neighborhoods are included in the development, with a focus on workforce training, business support, education, neighborhood capacity building, and infrastructure and beautification. The fund was seeded with $3 million in public funding through the City of Indianapolis and will be sustained long-term through a per-square-foot assessment paid by tenants in the 16 Tech Innovation District.

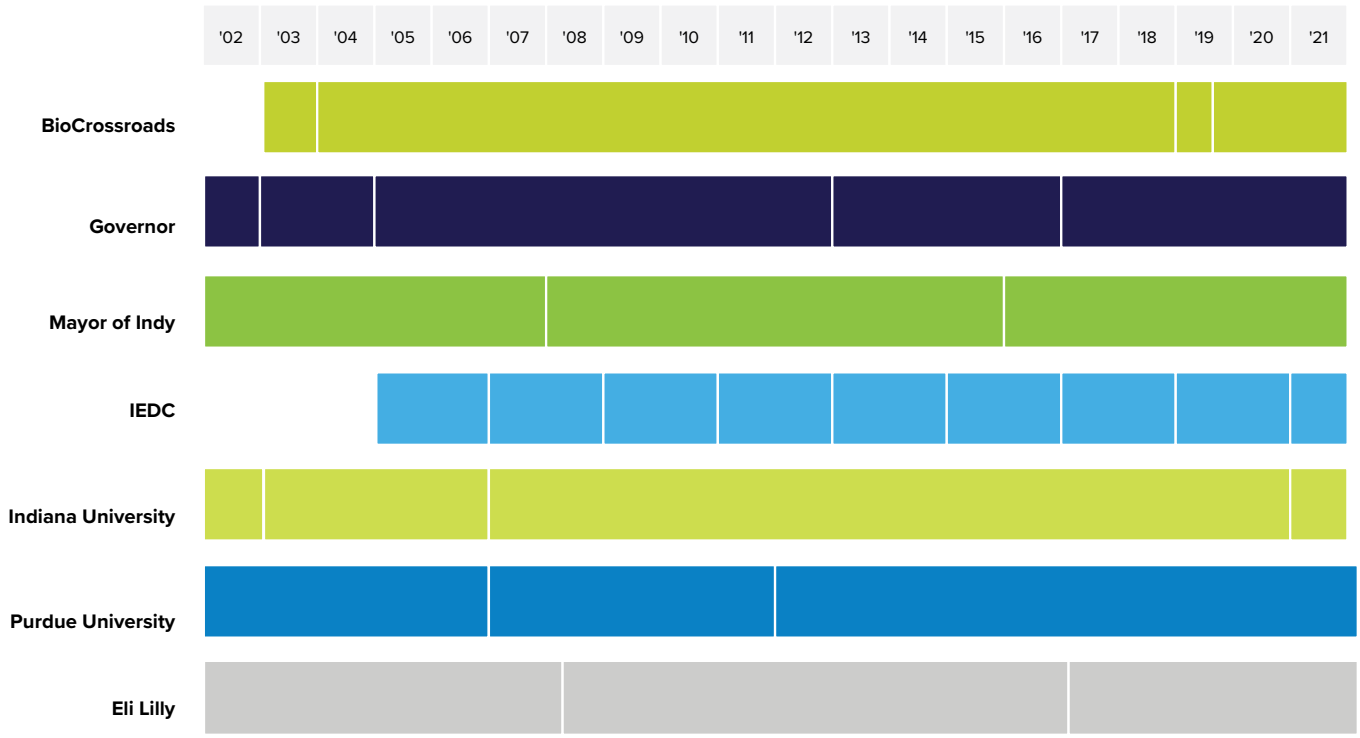
While IBRI catalyzes the development of 16 Tech, more is needed for Indiana to successfully respond to the headwinds changing the life sciences industry. As data analytics becomes more imperative to every element of life sciences, the need for capabilities in data sciences, artificial intelligence, machine learning, and so on are necessary for the Indiana ecosystem. To that end, BioCrossroads has recently helped to build the AnalytiXIN initiative.

Since late 2020, with CICP, BioCrossroads has been spearheading AnalytiXIN as a place-focused collaboration dedicated to connecting university assets and talent with industry in the areas of data sciences, including digital, AI, and advanced analytic capabilities. In 2021, BioCrossroads engaged with all three research universities—Indiana University, Purdue University, and the University of Notre Dame—to bring them together at 16 Tech, where they all now have space at the AnalytiXIN offices. Notably, this location marks Notre Dame's first and only location in Indianapolis. In 2021, grant funds from the AnalytiXIN program led to the recruitment of multiple faculty members at the universities, with additional recruitments completed in 2022. AnalytiXIN also has a presence at the Emerging Manufacturing Collaborative Center (EMC2) in 16 Tech, the State's new smart manufacturing hub designed to encourage greater university-industry collaboration around innovative, production-related technologies.

BioCrossroads has had a long partnership with the Indiana Economic Development Corporation (IEDC), and the IEDC has helped to promote and support the growth of the innovation district. Organized as a public-private partnership governed by a board of directors, the IEDC was officially established in February 2005 to replace the former Department of Commerce and focus efforts on growing and retaining businesses in Indiana and attracting new business to the state. Since then, BioCrossroads and IEDC have partnered frequently on a multitude of efforts related to life sciences business attraction and retention, among other matters important to economic development for Indiana.

The consistency in leadership at BioCrossroads has allowed for BioCrossroads to work on complex, multi-year economic development initiatives. BioCrossroads' long-term, holistic, and strategic approach helps the organization serve as a connector and ensures that projects receive sustained support as others in the ecosystem undergo leadership transitions. As evident in Figure 18, there has been a range of leadership transitions in Indiana's life sciences ecosystem. Leadership plays a critical role in the success of an ecosystem like Indiana's, and the consistency and longevity of leadership at BioCrossroads have been valuable. For example, during David Johnson's term as CEO of BioCrossroads from 2005-2018, his tenure overlapped with four governors, three mayors, seven heads of the IEDC, five university presidents, and three Eli Lilly CEOs.

Figure 18: Leadership Transitions at Key Organizations for Indiana's Life Sciences Industry



Source: TEConomy and BioCrossroads

Building the Ecosystem Through Capital.

BioCrossroads' Capital Strategy

Across the nation, entrepreneurs, startups, and small businesses find themselves frequently seeking new funding sources, but the need for capital access is especially acute in Indiana. Although challenges facing life sciences entrepreneurs are generally more complicated than those in the broader tech sector, insights can be gleaned from Powderkeg's 2018 Indianapolis Tech Census of Indiana entrepreneurs.[42] Their survey finds that:

- 54% of entrepreneurs responding to the study are bootstrapping their companies
- 50% of respondents say it's a struggle to raise capital in Indiana
- 58% of investors who responded have 25% or less of their investment portfolio comprised of Indy tech companies.

BioCrossroads' strategy for supporting innovation and entrepreneurship revolves around connecting ideas with capital. For 20 years, BioCrossroads has maintained an impressive track record of organizing, developing, and managing seed-stage and venture capital funds. With a focus on supporting Indiana's life sciences startups through community-led capital formation, BioCrossroads has completely changed the landscape of investment in Indiana over the past two decades. BioCrossroads' role of direct investment fund management is also unique among CICP entities.

Across six funds, BioCrossroads has stimulated the growth of more than 40 life sciences companies in Indiana, boosted by $204 million in total investment funds that have raised an additional $1.9 billion in follow-on capital, a multiplier of approximately 9.3 times (Table 3).

Table 3: Impacts Associated with Notable VC Funds Featuring BioCrossroads Leadership[43]

Fund	Year	Fund Size	Companies	Additional Funds Raised	Funds Raised (Multiplier)	Notable Company Examples
Indiana Future Fund	2003	$73M	14	$631M	8.7X	• BioStorage • Colucid • Endocyte
INext	2009	$58M	3	105M	1.8X	• Arteaus • Calibrium • OnTarget
Next Level Fund	2017	$50M[44]	2	$435M	8.7X	• MBX • Inari
Indiana Seed Fund I	2005	$6M	12	$95M	15.8X	• SonarMed • FAST
Indiana Seed Fund II	2012	$8M	10	$496M	60X	• Assembly • Apexian
Indiana Seed Fund III	2018	$9M	10	$210M	23X	• Brickell • Sexton
Total		**$204M**	**44[45]**	**$1,889M[46]**	**9.3X**	**$3,577M+ in Exits**

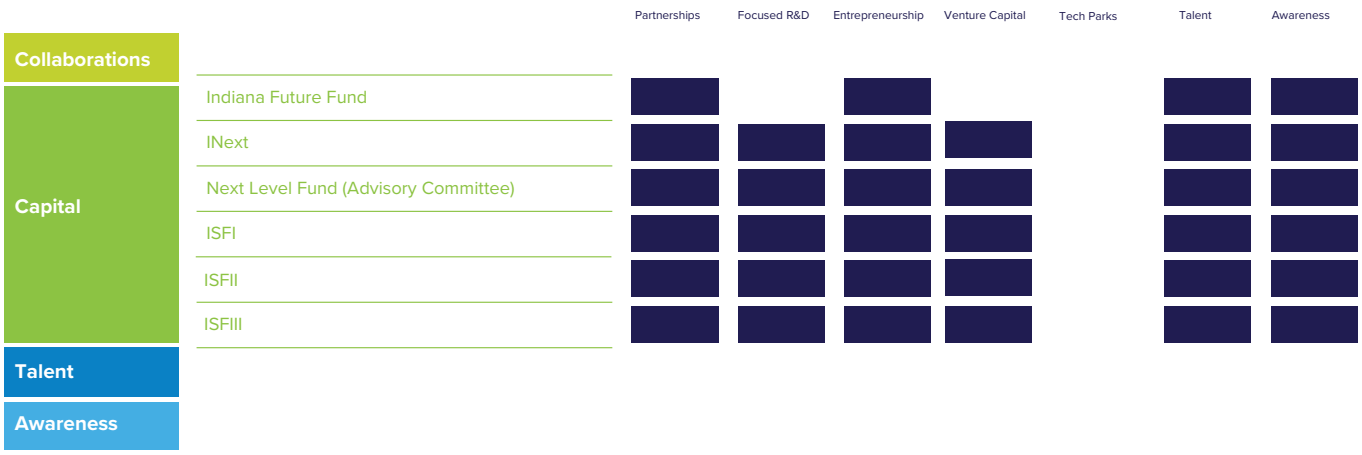
Source: BioCrossroads

42 https://powderkeg.com/wp-content/uploads/2018/02/2018-Indianapolis-Tech-Census.pdf
43 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf
44 The Next Level Fund is a $250 million fund of funds vehicle. Total Funds raised is listed for only those companies relating to life sciences including Inari and MBX. The amount of funds invested by the Next Level Fund in these companies is not disclosed but is believed to be less than $50 million
45 This figure represents unique companies, not the total number of companies invested in each fund (51)
46 Some companies were invested in by more than one fund (e.g., SonarMed, which was invested by IFF and ISFI). Total funds raised controls for duplicate listings and therefore does not sum.

Notable BioCrossroads Capital Initiatives

BioCrossroads' strategy for encouraging investment capital for Indiana's life sciences companies is best evidenced through six examples: Indiana Future Fund, INext, the Next Level Fund, and three Indiana Seed Funds (ISFI, ISFII, and ISFIII). Notably, each of these six funds cuts across six of the seven areas where life sciences act as an economic driver for Indiana (Figure 19).

Figure 19: Notable BioCrossroads Capital Initiatives



Source: BioCrossroads

The Indiana Future Fund (IFF) was BioCrossroads' first capital initiative: an intentional effort to provide nationally managed, locally accessible venture capital for promising Indiana startups while providing strong investment returns to institutional investors. Originally established in 2003 as a venture fund of funds capitalized with $73 million, IFF and BioCrossroads grew together in the organization's early days.

IFF represents a unique collaboration of leading corporate investors, Indiana's research universities and the State's pension funds—with sponsorship and leadership from BioCrossroads and professional management from national investors (Credit Suisse and Carlyle Group subsidiary AlpInvest). Among its accomplishments, the IFF has returned a substantial portion of the committed capital to its investors and enabled successful investments across a range of Indiana-based enterprises, ranging from Endocyte's first VC raise to the successful spin-out of migraine therapy platform CoLucid from Eli Lilly and Company.

> *As noted in the recent report, Supporting Life Sciences: A Look Back at BioCrossroads' Capital Strategy: "Fully invested, a total of 14 Indiana companies were reported as receiving investment by venture funds under the IFF program.[47] These companies raised more than $631 million in aggregate. Pitchbook, a subscription-based service reporting private and public capital market data, lists a distribution and net asset value of $91.31 million for IFF, or 1.25 times return, as of September 30, 2020."[48]*

As a follow-on fund to the IFF, BioCrossroads organized INext in 2009 with a similar management structure and comparable success. With capital invested in five major, national venture-capital funds, this $58 million return-driven venture capital fund featured investors such as Eli Lilly and Company and the Indiana pension funds, the IU Foundation, Purdue Research Foundation, University of Notre Dame, and the Richard M. Fairbanks Foundation.

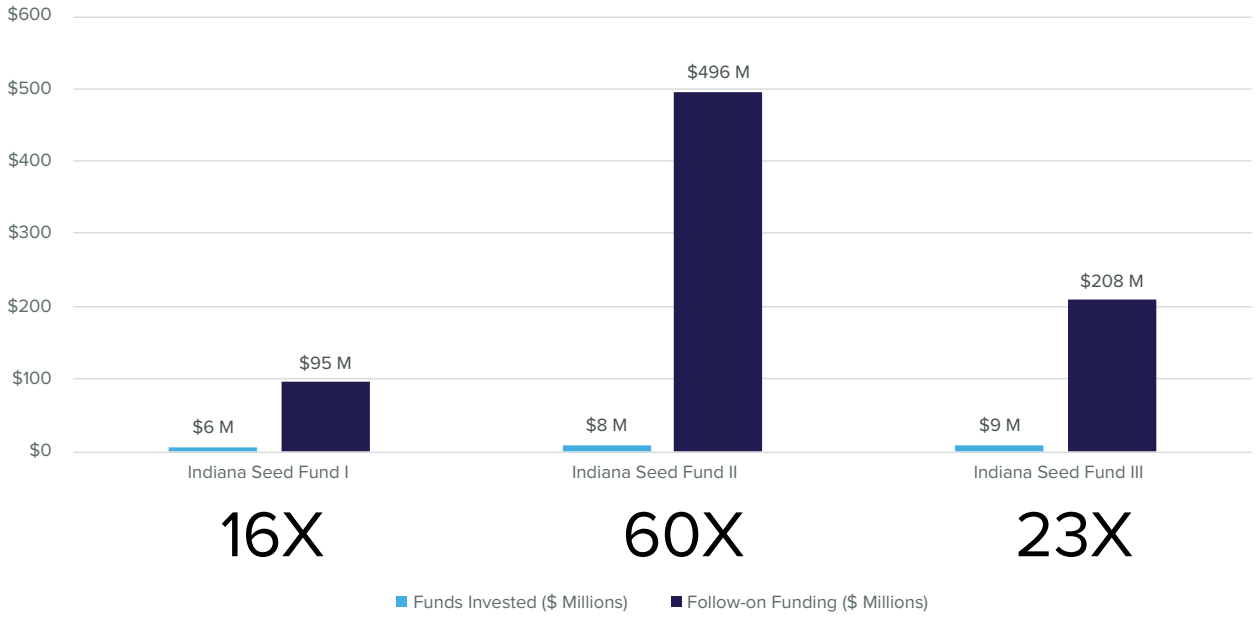
47 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf
48 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf

As noted in BioCrossroads' recent Capital Strategy: "Fully invested, a total of three Indiana companies were reported as receiving investment by venture funds under the INext program.[49] These companies have raised more than $105 million in aggregate to date. Pitchbook, a subscription-based service reporting private and public capital market data, lists a distribution and net asset value of $126.5 million for the Fund, or 2.18 times return, as of September 30, 2020."

BioCrossroads also serves on the advisory committee of the Next Level Fund. Using $250 million from the 2006 lease of the Indiana Toll Road, the Next Level Fund was created in 2017 by Gov. Holcomb and the Indiana General Assembly to make targeted investments in Indiana venture capital funds. Over the past five years, this fund has been investing in innovation and entrepreneurship across Indiana.

A signature effort behind BioCrossroads' capital strategy has been the three Indiana Seed Funds: ISFI (2006), ISFII (2012), and ISFIII (2018). As noted in Table 3 on page 30 and in Figure 20 below, the follow-on funding associated with these funds has been tremendous, ranging from 16X to 60X.

Figure 20: Funds Invested, Follow-on Funding, and Multipliers for Indiana Seed Funds I-III



Source: BioCrossroads Capital Strategy (2021)

An early example of BioCrossroads' ability to coordinate public and private resources to stimulate the state's life sciences ecosystem, ISFI brought together investments from Eli Lilly and the State of Indiana to identify and fund qualified life sciences startups. Structured as a $6 million return-driven seed capital fund, ISFI invested in 12 portfolio companies, nine of which remain active and three of which continue to offer promising exits.[50]

In 2012, BioCrossroads built on the early successes of ISFI to develop Indiana Seed Fund II, an even larger ($8.25 million) source for seed capital funding. Like its predecessor, ISFII featured investments from an even wider range of early investors, including Eli Lilly, Indiana Univeristy, Purdue University, University of Notre Dame, Elevance Health (formerly Anthem), Richard M. Fairbanks Foundation, the Regenstrief Foundation, the Walther Cancer Foundation, and the BC Initiative (the for-profit arm

49 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf
50 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf

of BioCrossroads). With a strong pipeline in place and proven leadership of BioCrossroads' investment team, ISFII has helped accelerate the state's life sciences ecosystem over the past two decades and has invested in 10 companies, including:[51]

- One co-investment with Lilly Ventures
- Two companies with successful exits that have returned early and substantial capital to investors
- One company now traded on NASDAQ at four times its initial valuation and has succeeded in returning all original invested capital to investors

BioCrossroads' most recent and currently active seed fund was launched in 2018, this time with $9 million (ISFIII). With a similar structure and set of funders as its predecessor, ISFIII makes return-driven investments in early-stage life sciences products and platforms with an emphasis on biotechnology, pharmaceutical, medical device, diagnostic, ag-biotech and health information sectors. In 2021, ISFIII completed investments in its 10th portfolio company and achieved its first exit. In just three years, the nearly $210 million in follow-on raises represents 23X the initial investment.[52]

An important part of this fund is its focus on building relationships with "resident" fund managers also investing in the state, such as Indiana's Next Level Fund and Elevate Ventures. A lesson learned and applied from previous programs, this not only leverages *more* of the state's life sciences assets, but also helps to attract additional investor attention for promising startups. Given BioCrossroads' prowess in connecting ideas with capital, this approach to strengthening the entirety of the life sciences ecosystem is a win-win for companies and investors alike.

Key lessons learned from BioCrossroads' approach to capital over the past two decades include responsiveness to market conditions, sophisticated fund and organizational leadership, and expertise in and a focus on the life sciences, not just general technologies. As noted by urban scholars Bruce Katz and Jeremy Novak in the book The New Localism: "The Indianapolis story stands apart in several respects, including the continuity of leadership, the impact of strategic philanthropy, the professional capacity that has been built and nurtured, the culture of collaboration, the level of capital deployed, and the progression of thinking and action."[53] BioCrossroads' approach to building the life sciences ecosystem by stimulating access to capital is, perhaps, the best example of this standout success.

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51 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf
52 https://biocrossroads.com/wp-content/uploads/2021/10/BioCrossroads-Capital-Strategy-Report-final.pdf
53 Katz, B., & Nowak, J. (2017). The new localism: How cities can thrive in the age of populism.

Building the Ecosystem Through Talent.

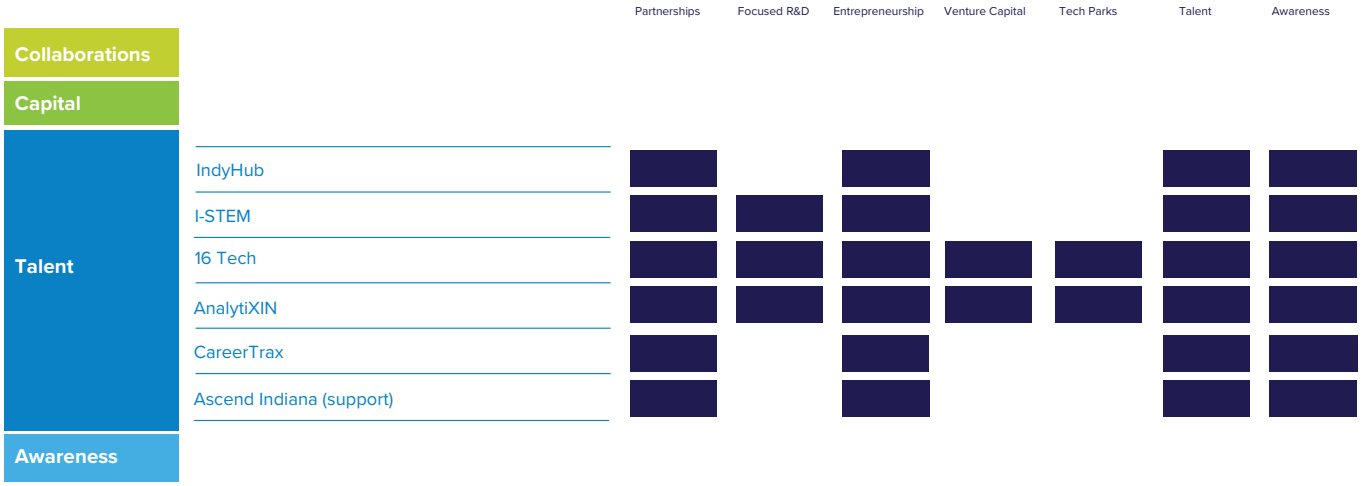
BioCrossroads' Talent Strategy

Holistic in nature, BioCrossroads' approach to cultivating talent looks across the entirety of the workforce continuum. BioCrossroads builds on traditional approaches to skills development and training by successfully linking a variety of programs to the research institutions and industry partners that drive Indiana's life sciences industry. For K-12 students, the I-STEM program offered insight into biosciences careers at an early age. University students are exposed to the life sciences industry through programs like AnalytiXIN and Career TraX, while other programs like IndyHub, 16 Tech, and Ascend Indiana focus on talent attraction and retention efforts for the industry and the state.

Notable BioCrossroads' Talent Initiatives

BioCrossroads' talent initiatives can best be seen through six elements (Figure 21).

Figure 21: Notable BioCrossroads' Talent Initiatives



Source: TEConomy and BioCrossroads

As noted previously, IndyHub represents the largest network of 20- and 30-somethings in Central Indiana. A steward for talent attraction and retention, IndyHub is actively working to grow, engage, and empower this community, and ensure they are meaningfully connected to the region and invested in its future.

One example of IndyHub's efforts to intentionally grow and retain talent in the region is the Corporate Collective Advisory Committee. Through this initiative, members work together with government and civic leaders to explore how the city can better serve young talent and tackle pressing challenges.[54] The Corporate Advisory Committee also provides young professionals with year-round cross-sector opportunities to educate, network, volunteer and develop. The effort is particularly focused on educating employees and employers on issues of talent retention and recruitment, diversity and inclusion, and other broad concerns within the Indianapolis community.

The I-STEM Resource Network was developed in 2006 to provide Indiana's students with experience and proficiency in STEM at a young age. Since the program was piloted in 2010, it included 32 school districts statewide with 152 schools, over 2,400 teachers, and 52,000 students. The program provided science curriculum for grades K-8, with an emphasis on supporting

54 https://indyhub.org/program/corporatecollective/

higher-need districts.[55] I-STEM also held 74 professional development sessions in 2010-2015 that comprised more than 2,400 hours of teacher training.

The 16 Tech physical development is located in a prime location near Downtown Indianapolis that is poised for growth (Figure 22), while the supporting organization 16 Tech Community Corporation plays a critical role in talent attraction and retention. This unique intermediary focuses on four main activities to help groups like BioCrossroads commit fully toward talent development:[56]

1. Placemaking: Oversee the physical development of the district
2. Marketing: Attract companies, teams, and talent
3. Programming and Culture: Curate services and programs to foster innovation and create an inclusive culture
4. Community Initiatives: Engage with and contribute meaningfully to the neighboring communities

Figure 22: Map of 16 Tech Innovation District Immediate and Future Developments

Source: 16 Tech

55 https://www.istemnetwork.org/about-us/what-i-stem-does/
56 https://16tech.com/work/job-board/

Beyond offering an environment conducive to talent attraction and retention, 16 Tech is also intentionally focused on talent development. Operating in the 16 Tech Innovation District since March 2021, the makerspace Machyne works in partnership with Purdue University Extension Marion County (PEMC) to provide workforce and educational training for residents in the neighborhoods near 16 Tech, with a focus on science, technology, engineering, arts, and mathematics (STEAM).[57] Engaging teenaged students in maker curricula, the program is expanding to also include multi-generational programming for adults in the community.

Attracting talent is also a key element of the AnalytiXIN initiative. Through this effort, Indiana's research institutions are attracting and recruiting university researchers and garnering additional support from industry partners. AnalytiXIN targets in-demand fields such as artificial intelligence, machine learning, data analytics, and Internet-of-Things. Through the creation of a life sciences "data lake," AnalytiXIN provides unique opportunities to identify and address unmet needs in the life sciences. By combining clinical, genomic, and non-clinical (i.e., social determinants of health) data under patient consent, AnalytiXIN is creating a Health Data Asset (HDA) that is accessible and usable by commercial and academic researchers to drive research and discovery. Conceptualized by a working collaboration involving BioCrossroads, Eli Lilly and Company, IU Health, and the Indiana Biobank within the IU School of Medicine, along with other partners, this HDA has the potential to not only advance a data and analytics innovation ecosystem in Indiana, but also solve complex health and socio-economic problems in the state and beyond.

BioCrossroads' Career TraX program works to provide awareness of early-in-career life sciences jobs as well as life sciences companies in Indiana. From its decades of experience, BioCrossroads understands the critical need for more people to join the life sciences industry's workforce, particularly early-in-career individuals. Increasing awareness about opportunities in these occupations is one avenue toward broadening participation. With an emphasis on individuals early-in-career, from high school diploma to recent college graduates, BioCrossroads' Career TraX program helps offer exposure to companies, careers, and other young professionals active in Indiana's life sciences industry.

BioCrossroads also works closely with the talent initiative of CICP, Ascend Indiana. The hallmark program of Ascend Indiana is its innovative job-matching platform, The Ascend Network. Covering jobs across the state—including those in the life sciences—this platform helps connect job seekers with promising jobs, while also helping employers in Indiana find and hire the qualified candidates they need to grow and scale.

57 https://16tech.com/machyneandpurdue/

Building the Ecosystem Through Awareness.

BioCrossroads' Awareness Strategy

As the key organization representing Indiana's life sciences ecosystem, BioCrossroads frequently serves as a voice of the industry to audiences across the state and around the globe. BioCrossroads works to encourage new business attraction and retention by offering accurate and credible information. BioCrossroads helps to craft the State's messaging around the industry and reach the needs of this business community. BioCrossroads works across a variety of communication mechanisms, from written reports to in-person gatherings, to utilizing social media and other tools to spread awareness about the ecosystem. Spreading awareness, in turn, helps to encourage even more development leveraging the strong activities occurring within the state, and in the life sciences especially.

Notable BioCrossroads' Awareness Initiatives

Examples of initiatives led by BioCrossroads to build the life sciences ecosystem through awareness include a branded initiative (BioCrossroads), digital and social media, FrameWORX, the Annual Indiana Life Sciences Summit and other networking events, and targeted marketing campaigns (Figure 23).

Figure 23: Notable BioCrossroads' Awareness Initiatives

Source: TEConomy and BioCrossroads

As a branded initiative that serves as the face of Indiana's life sciences industry, BioCrossroads is, in and of itself, an effort to build awareness. Since its inception, BioCrossroads has served as a front door for both stakeholders within the ecosystem and outsiders interested in learning more. As a highly efficient, dynamic, and reputable organization, the "brand" of BioCrossroads is now synonymous with the sophistication of Indiana's life sciences industry. BioCrossroads is considered a best-practice in cluster-based economic development, and its ability to market the industry and the region together as one is synonymous with this success.

BioCrossroads also maintains a strong web presence, offering access to news and resources through its website and through digital and social media. The BioCrossroads social media sharing guide features curated trending life sciences topics that are easily converted into shareable social media posts.[58] BioCrossroads also helps boost engagement through hashtags

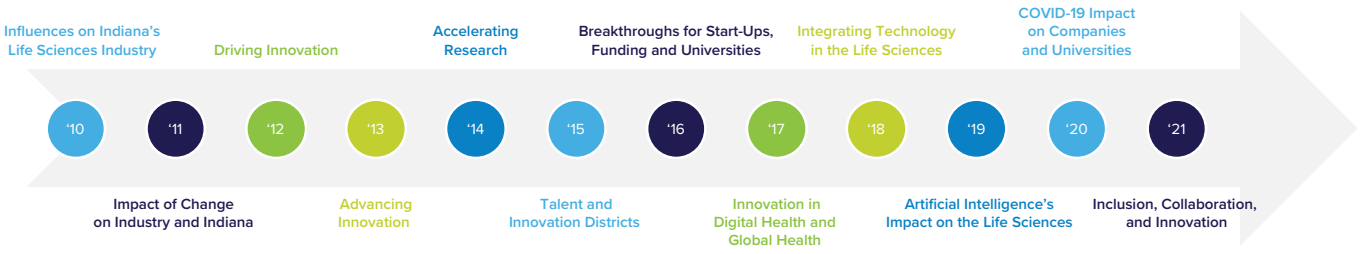
58 https://biocrossroads.com/sharing-guide/

related to the ecosystem and specific topics, events, or discussions (e.g., #inlifesciences, #lifesciences, #biocrossroads, #datascience).

As a further example, the Indiana Life Sciences Database is an extensive source for critical data, metrics, and indicators for Indiana's life sciences sector (pharma, device, diagnostic, labs, related enterprises). Made possible through a grant by Lilly Endowment and developed by BioCrossroads in collaboration with the Indiana Business Research Center at IU's Kelley School of Business, the database has become the accepted and widely cited authority for quantifying Indiana's life sciences assets.

The Indiana Life Sciences Summit—the BioCrossroads' and broader industry's premier annual event—drives conversations and provides content on important and timely topics with national thought leaders as well as speakers from Indiana's life sciences community. The Summit serves as the ideal avenue for bringing together the BioCrossroads' network, featuring leadership from industry, venture capital, startups, academia, and elsewhere. The event also showcases Indiana's strengths and opportunities in key sectors and highlights the important work of BioCrossroads' key collaborative efforts such as IBRI, 16 Tech, and the venture funds. From 2004 to 2009, the Summit was hosted by Burrill and did not have a specific theme. Over the past decade, the Summit has focused on a new topic annually, featuring a broad scope of matters pertaining to the life sciences (Figure 24).

Figure 24: Examples of Themes of BioCrossroads' Annual Life Sciences Summit (2010-2021)



Source: TEConomy Partners and BioCrossroads

To further educate and build awareness for key issues in the BioCrossroads network, FrameWORX is an educational series focused on relevant Indiana Life Sciences topics and issues. In its earliest iteration in 2011, FrameWORX brought together a range of perspectives on increasing connectivity in the life sciences industry across Indiana and through national and global collaboration.[59] Since then, examples of FrameWORX topics include the impacts of COVID-19 on point-of-care diagnostics, the importance of Indiana CTSI, and using post-baccalaureate education as a competitive advantage in the life sciences industry, among others.

Beyond these formal events, BioCrossroads also supports a range of networking events that are important to the industry. In recent years, notable examples include Med Tech Engagement (2018), AI and DA focused Industry and University Engagement (2019), AnalytiXIN (2020, 2021), and Micro Clusters (2021) events. BioCrossroads also supported a range of networking events during its first decade of operations, including:

- Communication, Collaboration, Capital and Talent (2002)
- Sports, Cancer, Proteomics, Neuro, CV, Ag, Evidence-Based Med (2003)
- Biosensors Conference (2003)
- Bioimaging Center (2004)
- Indiana Translational Research Acceleration Collaboration (ITRAC) (2006)
- BioCrossroads LINX (2010)
- ExHIbiT (2010)
- CTSI Phase I Clinic (2011)

Through its publications, BioCrossroads has earned a reputation for the breadth, depth, foresight, and action-oriented nature of its research. From 2002 to 2021, BioCrossroads has released 32 reports—an average of one report every 7.5 months (Figure 25). Whether it is annual reports, articles, or other internally produced research, BioCrossroads has helped Indiana stay

59 https://biocrossroads.com/frameworx-summary-indianas-life-sciences-innovation-engine-full-steam-ahead/

ahead of the game by researching key trends and technologies and then sharing their findings with their network. This constant flow of research also ensures that the organization is accountable to its membership and other key stakeholders in the life sciences ecosystem.

Figure 25: BioCrossroads' Produced Reports from 2002-2021

Source: TEConomy and BioCrossroads

BioCrossroads' Book of Data and Organizations is a valuable resource with information on the tremendous data and technology resources available across Indiana's industry, government, health systems, academia, and digital health startups. The fifth version of this book, released in 2022, features snapshots of 46 organizations who control data assets (e.g., data sets, data talent, and/or data technology), as well as five cross-organizational initiatives where collaboration is driving impact. As an asset for the life sciences ecosystem, this resource helps by reducing the need to seek health data assets outside of the state, establishing more local partnerships, and attracting new organizations to collaborate with Indiana-based organizations.

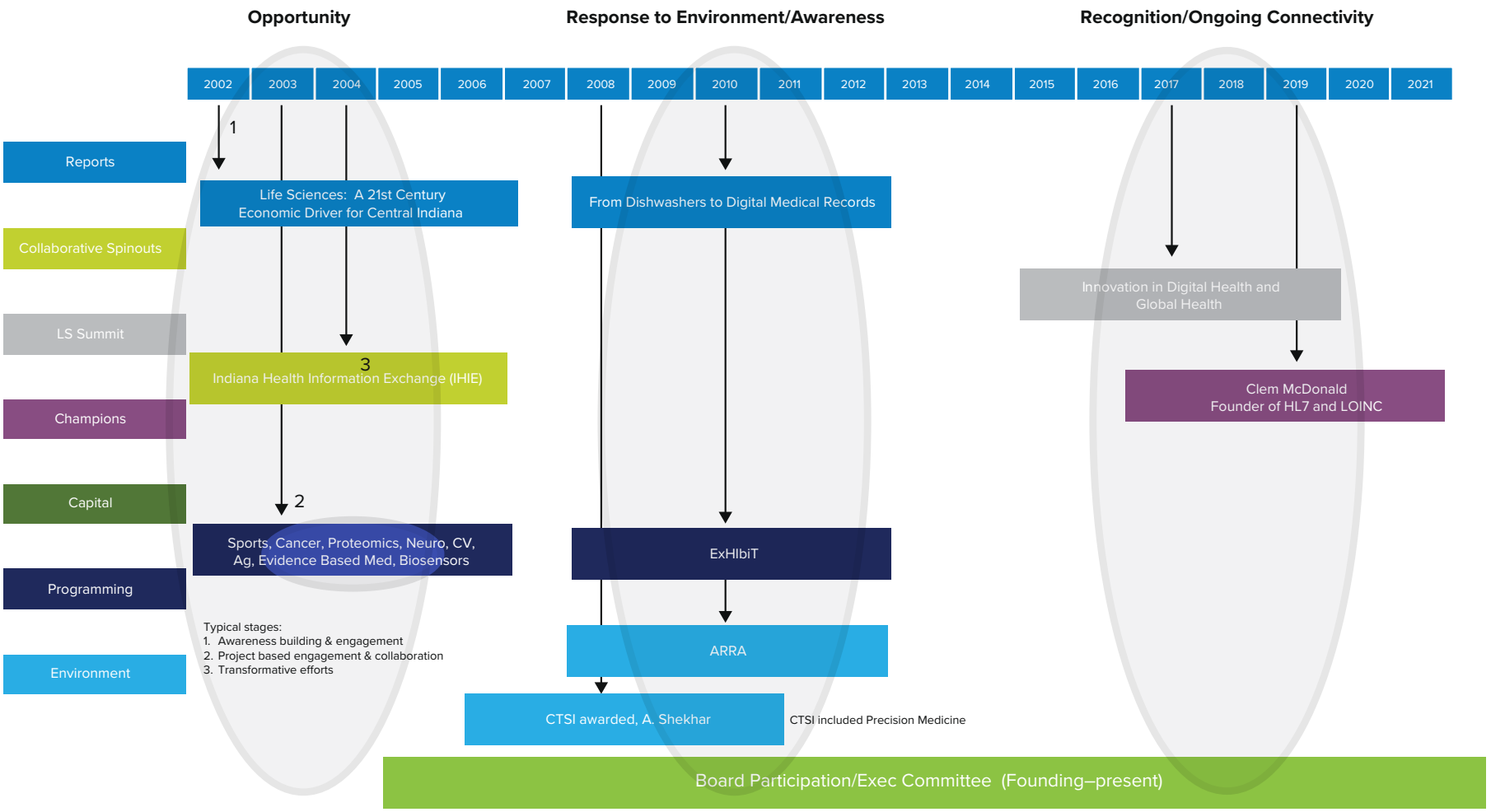
BioCrossroads also serves as a champion for communicating the industry to external audiences through targeted marketed campaigns. BioCrossroads has been designated by the Indiana's life sciences ecosystem to spearhead new initiatives and implement a longer-term vision for the state. BioCrossroads also works in conjunction with IEDC and other economic development partners to help market the state to prospective businesses in the life sciences.

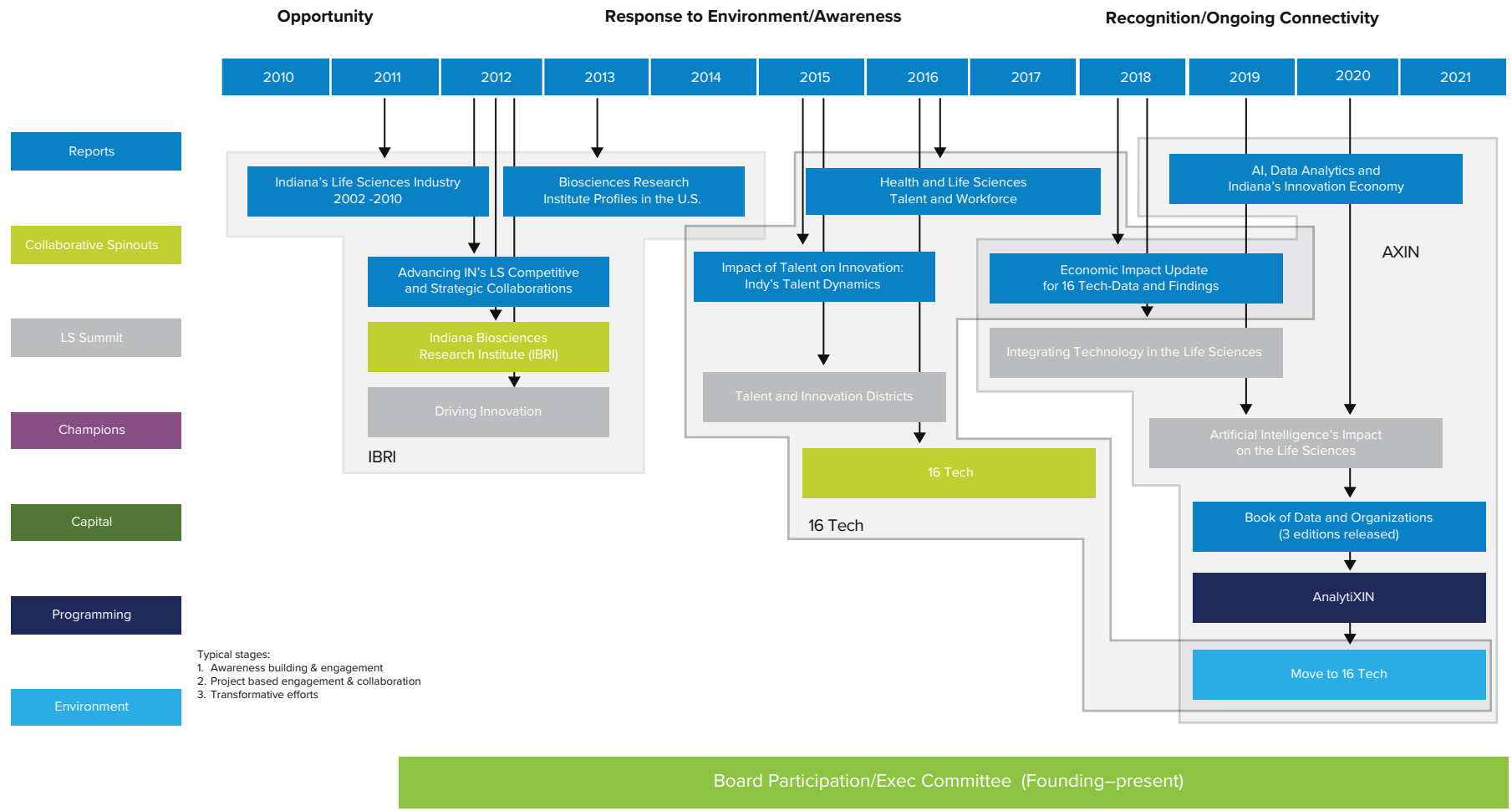
“Connecting the Dots”—BioCrossroads’ Symbiotic Collaborative Efforts.

Although all seven areas of the ecosystem are important, a hub is needed to connect the dots across the assets. There is a need for something that works more rapidly than research universities, at the speed of private industry. BioCrossroads excels at identifying quickly through research what’s needed to “go big” to make life sciences an economic driver. An ecosystem approach is necessary because each asset involved is unable to act on its own. A partnership intermediary such as BioCrossroads allows for institutions to focus on their strengths while leveraging their partners in areas where they are deficient.

BioCrossroads is worthy of recognition for its persistent efforts to grow and connect the state’s life sciences industry. From early work in researching key challenges to preliminary efforts at piloting new initiatives to large-scale grants received through partnerships, BioCrossroads’ efforts have made an impact. As seen in Figure 23, IHIE stands out as an effort providing evidence of BioCrossroads’ early success at activating its network around a particular engagement and pursuing a project-based collaboration within this network.

Figure 26: Examples of BioCrossroads' Driving Transformative Efforts Through Awareness and Project-Based Engagement





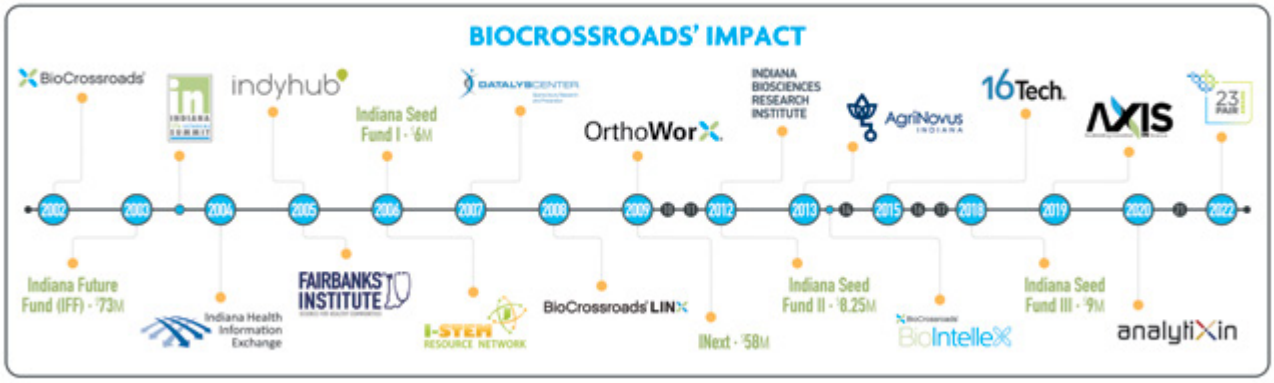
Source: BioCrossroads

Ultimately, BioCrossroads excels at using networks and data to identify opportunities and get the most out of the state's assets. In particular, BioCrossroads has been proficient at:

- Identifying potential opportunities, including understanding the initial drivers of these opportunities.
- Building a tangible project, including identification of the people necessary to take action, and the places or hubs where the actions should take place.
- Maturing its projects into transformative sustained efforts, where activities become an integrated and established part of the ecosystem.

Science and technology move so quickly that it is vital to be responsive to changes in the environment. The life sciences are a living network where data supports action, and the dynamism of the ecosystem continually unveils the next steps for exploration. At the same time, progress can move quite slowly (with it taking considerable time to move from a research innovation to an on-the-market product), so there is a need for continuity and long-term intentionality. As BioCrossroads has responded to these changes in the life sciences ecosystem, the organization has sought to change with its environment. And, while BioCrossroads' activities are oftentimes simple and transactional at first, they become more sophisticated over time as they become more integrated in, and integral to, the complex and highly effective Indiana life sciences ecosystem.

Figure 27: Timeline of Notable BioCrossroads' Impacts



Source: BioCrossroads

The Next Decade and Beyond

As evident from the sections above, BioCrossroads is both a strategic and opportunistic organization that uses its portfolio approach to drive investment in talent and innovation to build a stronger economy. The last several years have been challenging, with new complexities introduced due to COVID-19 (such as the proliferation of remote and hybrid work and the importance of pandemic responsiveness and preparedness), and other headwinds accelerated (such as the increased importance of technical talent, digital tools, and the necessity of diversity, equity, and inclusion in the workplace). As BioCrossroads embarks on its third decade, Indiana is seeing an influx of investment across the life sciences, an optimistic harbinger of things to come. During the first half of 2022, notable examples of investment across Indiana's life sciences ecosystem include:

- Eli Lilly and Company investing more than $2 billion in two new manufacturing sites at Indiana's LEAP Lebanon Innovation and Research District in Boone County.
- More than $2 billion in investment from IU Health to develop a new hospital in downtown Indianapolis, along with expanded collaboration with the IU School of Medicine.
- The establishment of the William D. Young Institute for Advanced Manufacturing of Pharmaceuticals at Purdue University.
- INCOG BioPharma Services investing approximately $60 million to establish its first manufacturing facility and global headquarters in Fishers.

Over the course of the next decade, it is expected that the life sciences will remain a key strategic driver of economic development in Indiana. For the State, there is economic development potential across a variety of opportunity areas and subsectors, most notably: diagnostics, vaccines, medical devices and connected medical systems, and small and large molecule pharmaceuticals and biologics, with both human and veterinary applications. However, it is anticipated that each of these sectors will face critical disruptions as the result of new technologies and advancements (Table 4)—disruptions that pose both challenges and opportunities.[60] BioCrossroads plays an important role in assisting companies through these transitions, while also encouraging new developments that capitalize on the market opportunities made available through this disruption.

60 https://www.cicpindiana.com/wp-content/uploads/2018/11/FINAL-CICP-ClustersandDisruptors-Executive-Summaryfinal.pdf

Table 4: Disruptive Technologies Across Life Sciences Focus Areas

Life Sciences Focus Area	Examples of Current and Pending Disruptive, Major Technology, and Process Changes
Biopharmaceuticals and Diagnostics	• Continuous Manufacturing • Single-Use Systems • High-Volume Cell Processing Advances • Advanced Purification Technologies • Cell Preservation, Distribution and Handling Methods
Medical Devices	• Connected and Networked Devices • Regenerative Medicine

Source: TEConomy Partners and Central Indiana Corporate Partnership

In the future, BioCrossroads' assistance to other organizations as they navigate the headwinds and disruptive challenges facing the life sciences ecosystem will be much needed—including those listed above, but also others such as changes due to remote work, advanced analytics (including artificial intelligence and machine learning), automation, robotics, and cybersecurity. Across the life sciences ecosystem that BioCrossroads seeks to represent, disruptions may impact a range of organizations, whether they are startups facing a constrained funding environment, universities struggling with declining enrollments, research institutions challenged with attracting and retaining faculty, or industry players competing in an ever-changing and ever-challenging global economy and fast-moving technology landscape.

BioCrossroads is a resourceful organization seeking to continually lead and facilitate collective responses as its environment changes and the landscape of life sciences progresses. As opportunities arise, BioCrossroads is focused on keeping an open mind and preparedness agenda. The organization offers flexibility for addressing problems, drawing upon best practices, but also innovating and standing-up its own endeavors. In the world of cluster-based economic development, BioCrossroads is respected among the best-in-class both nationally and globally. BioCrossroads is, in many ways, the best practice.

In the 2011 BioCrossroads 10-Year Retrospective, seven challenges were identified as critical to the longevity of Indiana's ecosystem (Table 5). In many respects, these challenges remain pertinent to the present situation facing the state's life sciences ecosystem. With certain distinctions and modifications, these challenges also remain relevant to BioCrossroads as the organization begins its third decade in operation.

Table 5: Progress on Challenges Identified for 2010's and Areas of Focus for the 2020's

Challenges Identified for 2010's	Areas of Focus for 2020's
Work to anticipate and identify the major changes that await U.S. life sciences industry in the coming decade and look to seize opportunity to guard against losing its base.	Beyond business retention, Indiana should focus on attracting and growing new life sciences businesses/ developments in the face of supply-chain challenges and trends toward onshoring in industries such as pharmaceuticals.
Find additional ways to assist the Warsaw-based orthopedics industry through successful implementation of collaborative approaches and mechanisms.	Work with Orthoworx to retain and strengthen the state's orthopedics industry, with an emphasis on encouraging innovation, entrepreneurship, and new skills development.
Address the imbalance of higher institution degrees vs. high-school-only education in the life sciences workforce.	Provide best-in-class workforce training solutions to ensure that Indiana's life sciences workforce is trained with the skills needed for now and into the future, regardless of degree.
Continue to address ways to fill early-stage capital funding gaps if it wants to further grow its life sciences industries of the future.	Continue to deliver return-driven venture capital funding to promising Indiana startups, while also ensuring that the pipeline of new companies is primed for further investment.
Forge new and stronger strategic partnerships of the Indiana life sciences industry and Indiana medical centers and universities to form comprehensive discovery to product development approaches and mechanisms.	Ensure that Indiana remains on the cutting-edge for new technologies in the biosciences, ranging from (e.g., gene editing, synthetic biology, regenerative medicine, metabolic engineering, bionanotech and nanomedicine, and cyber-biological systems).[61]
Indiana state and local government should continue to manage limited resources wisely. However, the state should also maintain incentives to the private sector that promote growth of its life sciences industry.	Encourage further financial support for workforce, innovation, economic development expenditures across the state to ensure that Indiana is competitive with other states with robust life sciences industries.
Advocate for national policies and investments which both protect Indiana's existing clusters of the life sciences and further its competitiveness in face of increased global competition.	Advocate for national policies that encourage the development of the life sciences industry as an economic driver, as well as those that ensure that Indiana remains hospitable to top-tier talent.

61 https://biocrossroads.com/wp-content/uploads/2020/01/Indiana-AdvancedAnalytics-and-AI-finalJan-2020.pdf

Conclusions

Ultimately, anchoring a life sciences ecosystem in research and development and intentionally building a holistic and responsive ecosystem to support the growth of commercial life sciences is working very well for Indiana. Considerable evidence demonstrates that BioCrossroads collaborates to fill gaps, support talent, strengthen the network, and produce robust outcomes for Indiana's economy.

Three take-aways have emerged from this analysis of BioCrossroads' efforts in leading the Indiana life sciences ecosystem over the past two decades:

1. **This is an important sector for Indiana.** The life sciences are a resilient and cross-cutting industry that have experienced two decades of strong performance in cross-cutting, high-paying jobs.

2. **This is an important state for the life sciences.** Many other states are envious of what's been built in Indiana. This is evident from reports such as Brookings' Rethinking Cluster Initiatives, which places BioCrossroads and its parent organization in elite company as a best-practice case study.

3. **This is an important industry for the world.** Indiana is home to the production of all three COVID-19 vaccines, the invention of insulin, and as a technology hub, is innovating across multiple new medical devices, treatments, vaccines, therapeutics, and more.

Taken together, the accomplishments of BioCrossroads and the entirety of the Indiana life sciences community are worthy of widespread recognition. Although there is considerable uncertainty in the world today, there remains reason for optimism that the next decade will continue to see significant advancement in life sciences and associated economic development. BioCrossroads is at the center of a collaborative approach, whereby entities including industry, university, government, and philanthropy can focus on their respective strengths while collectively responding to new threats and opportunities in the ecosystem, such as investment capital access, the shared need for talent, and the ongoing threats and opportunities inherent in technological disruption. Helping to address shared challenges and realize promising opportunities, BioCrossroads will continue to play a central role in advancing life sciences as a core driver of Indiana's economic growth and as an essential statewide employment engine.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