



# Transforming Ideas into Advances:

Best Practices in State and Regional Bioscience  
Economic Development Initiatives

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# INTRODUCTION

**T**he bioscience industry represents the joining together of key characteristics for societal and economic progress. These innovations in biotechnology are addressing a host of global grand challenges related to diagnosing, treating and curing disease; ensuring a safe, affordable and more sustainable food supply; and leveraging biotechnologies and sustainable approaches to develop biobased fuels, chemicals, and other industrial products.

This fifth biennial BIO Economic Development Best Practices Report is a catalog of state and regional economic development initiatives. The best practice examples contained within this report highlight the critical facets that foster high-performing industry and the long-term success it has maintained.

Successful industry development initiatives are built upon the following four key building blocks for company creation and expansion:

- Access to angel and venture capital
- Workforce development initiatives
- Technology Transfer Systems
- State of the Art facilities

The accompanying informational charts and economic development efforts highlight the legislative activities and other economic benefits across the United States.

## National Industry Highlights

The following are highlights and key findings from the 2018 TEconomy/BIO industry assessment.

- The bioscience industry's total economic impact on the U.S. economy, as measured by overall output, totaled \$2 trillion in 2016. This impact is generated by the direct output of the bioscience industry combined with the indirect (supply chain) and induced (employee spending) impacts.
- The U.S. bioscience industry directly employs 1.77 million people in more than 85,000 business establishments.
- Since 2001, U.S. bioscience companies have increased employment by 273,000 jobs, or nearly 19 percent, with net job gains recorded by the industry in all but two of the last 15 years.
- Since 2016, total bioscience industry employment has risen by 4.4 percent, with four of the industry's five major subsectors contributing to the job gains.
- Bioscience industry wages are consistently higher and growing faster, on average, than those for the overall economy, reflecting the skilled, high-quality jobs in demand. The average U.S. bioscience worker earned nearly \$99,000 in 2016, 85 percent greater than the average for the overall private sector.
- The industry's 1.77 million direct employees and its associated economic output support 8 million jobs throughout the entire U.S. economy through both indirect and induced effects.

## The Value of Economic Development Partnerships

Beyond the statistics, the bioscience industry has come to play a central role in the economic development priorities of states, cities and municipalities for several important strategic reasons:

First, the bioscience industry is a vital component of the durable goods manufacturing sector of the U.S. economy in an environment of increasing and sustained international competition. Many states have a strong bioscience-manufacturing presence that produces some of the highest quality products in the marketplace.

Second, the bioscience industry provides high-skill, high-wage jobs that diversify the economy and support the creation of improved standard of living. These jobs help to bring higher state and local tax revenues that ultimately support improvements to education, public safety, infrastructure, and other budget priorities.

Third, the bioscience industry is a major driver of workforce training initiatives. Through college and university technology transfer programs, states are able to develop a workforce with the unique skills and training that are key to attracting and growing bioscience industry clusters.

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The following select state economic development measures continue to represent the substantial level of support so vital for growth of the bioscience industry.

**21** states offer matching grants for Phase I and/or II Small Business Innovation Research (SBIR) grants to accelerate early stage company development. **An increase from 16 states in 2017.**

**27** states offer tax credits to angel investors who invest in technology companies including the biosciences. **An increase from 25 states in 2017.**

**39** states offer sales tax exemptions on equipment for both research and development (R&D) and manufacturing with several exemptions specifically for biomanufacturing. **One additional state has joined the ranks this year – up from 38 states in 2017.**

**22** states invest state dollars in private venture capital firms that fund small and emerging bioscience companies. **An increase from 21 states in 2017.**

**38** states offer R&D tax credits for early stage research that is vital in moving research into commercialization. **The number of states has remained the same since 2017.**

# Defining the **BIOSCIENCES**

**T**he Bioscience industry uses the knowledge of living organisms or other biological systems in the manufacturing of products that address health, agricultural and environmental challenges. This diverse industry spans many markets and includes manufacturing, services, and research activities.

**Whether the industry is called biotech, biosciences, or the life science industry, its diversity in scientific discovery and commercialization is defined by the application of biological knowledge.**

In conjunction with TEconomy Partners - responsible for BIO's Economic Development Report - BIO has identified five major sectors of the biosciences that reflect the size and diversity of this growing technology sector.

- **Agricultural and Industrial Biotechnology:** Industries that utilize advances in biochemistry and biotechnology to create products involved in crop protection, advanced seed, agricultural processing, bio-fuels, biodegradable materials from plant-based feedstock, sustainable industrial oils and lubricants, and enzymes and bio-based catalysts for industrial processes.
- **Pharmaceuticals:** Industries that produce vaccines, biopharmaceuticals, tissue and cell culture media.

- **Research, Testing and Medical Laboratories:** Emerging companies working to develop and commercialize new drug discovery/delivery systems, and gene and cell therapies, as well as more service-oriented firms involved in pre-clinical drug development, clinical trials, and research/laboratory support services. While primarily focused on human health, many companies also focus on research and testing for agriculture and veterinary uses.
- **Biosciences-related Distribution:** Industries that specialize in approaches such as cold storage and highly regulated product monitoring, and new technologies for distribution such as automated pharmaceutical distribution systems. These dedicated bioscience-related distribution industries include three unique subgroups: one associated with medical equipment and device distribution; another with drug distribution; and a third with agricultural-related chemicals and seed distribution. Each of these bioscience-related industries is becoming integral to the primary production of bioscience goods in an age of advanced logistics and the increasingly specialized nature of bioscience product development.
- **Medical Devices:** Industries that produce a variety of biomedical products such as surgical instruments, orthopedic implants, bioimaging equipment, dental instruments and patient care products (such as walkers, wheelchairs and beds).



## MATCHING BIOSCIENCE COMPANY PHASES OF DEVELOPMENT AND STATE POLICY SUPPORT MECHANISMS

Because of the lengthy commercialization timeline to success, the biosciences sector has three distinct phases of company creation and expansion. Over the past fifteen years, BIO, with the assistance of its member companies, has identified key types of legislation that enables emerging, clinical testing, and manufacturing companies in our technology sector. This chart characterizes phases of development and essential legislative support mechanisms.

### Emerging Companies

#### *Early-Stage Development*

It is at this stage that company researchers identify the potential of the lead compound or diagnostics tool and develop protocols to begin verifying the viability of the discovery with early testing on in vitro media. Many of these companies can focus on developing products for markets that would otherwise not be served by larger organizations. Typically, these companies have no products on the market, less than 100 employees, and are funded by Angel and Venture Capital supporters.

#### **Foundational Legislative Enablers:**

- SBIR/STTR Small Business Technology Match Funding
- Angel Investor Tax Credit
- Seed Capital Tax Credit
- Incubator/Accelerator Funding

### Clinical Stage Companies

#### *Mid-Stage/Product Development*

Once the technical viability of a discovery has been established, the target product must be developed. This stage of company development typically requires significant investment in personnel, equipment and facilities. These companies generally have less than 200 employees and have products in Phase I FDA safety trials.

#### *Late-Stage/Regulatory Review and Approval*

Clinical trials are required to show that products are both safe and effective. Clinical research contractors are often retained. In the case of biopharmaceuticals, pilot scale manufacturing facilities must be built, or contract manufacturing capacity must be secured, along with the necessary scientific, engineering, operating, and maintenance personnel. Small quantities of the product must be produced for testing.

#### **Foundational Legislative Enablers:**

- Net Operating Losses (Carry-Over, Transferability)
- Research and Development Tax Credits
- Capital Investment Tax Incentives
- Innovation Investment Tax Incentives

### Manufacturing Companies

#### *Mature/Manufacturing/Marketing and Sales*

In this stage, the company manufactures commercial quantities of its approved product, creates a sales force or licenses product to another company. Sale of manufactured products produces revenues and, hopefully, profits. Traditional sources of financing, such as commercial loans and public stock offerings, may become viable.

#### **Foundational Legislative Enablers:**

- Site and Infrastructure Grant Funds
- Renewable Energy Tax Credits
- Road Access and Rail Access Programs
- Sales and Use Tax Discounts, Exemptions and Refunds
- Utilities Rebates

Source: PMP Public Affairs Consulting 2019

# Strategic Policy INITIATIVES

State governments and regional economic development organizations continue to target the bioscience industry because it is an economic engine that provides high wage, high-skilled jobs across a broad range of occupations.

During the last decade, this understanding of the economic potential of the industry has led to policies and programs that provide supportive tax environments in capital formation, technology transfer, and funding for a workforce to facilitate research, development, and manufacturing.

The charts on the following pages demonstrate the extent to which state governments are targeting and supporting the industry for economic growth and development.

## State Supportive Tax Priorities

- Research and Development Tax Credits
- NOL Carry-forwards
- Tax Credit Transferability
- Sales and Use Tax Exemptions
- Creation of Capital Access Funds
- State Pension Fund Investment
- Capital Gains Tax Reductions
- Investment Tax Credit
- Developing Incubator/ Shared Research & Manufacturing Facilities
- Workforce Development Programs

## Small Business Innovation Research (SBIR) Matching Grants Specific to Biosciences

Twenty-one states match various SBIR phases of development research.

State	SBIR Funding Focus/Bioscience Specific	Legislative Program Title
CO	For SBIR Phase I	
CT	Targeted toward manufacturers	Small Business Innovation and Diversification Program
DE	For SBIR Phase I	Small Business Innovation Research
FL	Requires a university partnership	Florida High Tech Corridor Phase II SBIR/STTR External Investment Program
FL	For SBIR Phase I and II	Florida Research Commercialization Matching Grant Program (currently closed)
HI	For SBIR Phase I	Hawaii Small Business Center
IA	For SBIR Phase I	
IN	For SBIR Phase I	Indiana 21st Century Research and Technology Fund
KS	Not exclusive to SBIR but still of interest	Kansas Bioscience Matching Fund
KY	For SBIR Phase I and II	Kentucky SBIR-STTR Matching Funds Program
MA	For SBIR Phase II	Small Business Matching Grant Program at Mass Life Sciences Center
MI	Only for commercialization purposes; for Phase I and II	Michigan Emerging Technologies Fund
MT	For SBIR Phase I	
NC	For SBIR Phase I	ONE North Carolina Small Business Program
NE	SBIR Phase I and II	SBIR/STTR Phase I and II Matching Programs
OK	For SBIR Phase I	SBIR Phase II Matching Funds Program
PR	For SBIR Phase I	Puerto Rico Science and Technology Research Trust Program
SC	For SBIR Phase I	SC Launch SBIR/STTR Phase I Matching Grant Program
TN	SBIR/STTR Phase I and II	SBIR/STTR Matching Program
VA	SBIR/STTR Phase I and II	Center for Innovative Technologies
WV	SBIR Phase I and II	
WI	For SBIR Phase I and II	

Source: PMP Public Affairs Consulting 2019

*"I believe our state is poised for success, with new jobs on the rise, unemployment rates at historic lows, and the growth of established and emerging sectors from wind energy to biotechnology on the horizon."*

Governor Ned Lamont  
Connecticut, February 11, 2019

## State Tax Credits to Encourage Early-Stage Investment

States also use tax policies to encourage private investment in early-stage companies and/or in funds that make early-stage investments. Twenty-two states offer tax credits to angel investors who invest in technology companies, eight of which are targeted specifically to angel investors who invest in bioscience companies. Eleven states reported providing tax credits to individuals who invest in early-stage venture funds.

State	State Tax Credits Provided to:			
	Angel Investors	Bioscience Specific Angel Investors	Investors in Early-Stage Venture Funds	Investors in Bioscience Early-Stage Venture Funds
AZ	■	■		
CO	■			
CT	■	■		
GA	■			
HI	■			
IN	■			
IA	■		■	
KS	■	■		
KY	■		■	
LA	■			
ME	■		■	
MD	■	■		
MN	■			
MT	■		■	
NJ	■	■	■	■
NM	■	■	■	■
NY	■			
ND	■		■	
NE	■			
OK	■		■	
OR			■	
PR			■	
RI	■			
TN	■			
VA	■	■		
WV			■	
WI	■	■	■	■

Source: PMP Public Affairs Consulting 2019



## State Sales Tax Exemptions to Support the Growth of Bioscience Companies

Thirty-eight states reported exempting sales tax for equipment used in R&D, and thirty-six states reported exempting equipment purchased for biomanufacturing from sales tax. Eleven states have sales tax exemptions specifically targeted to bioscience firms.

State	State Sales Tax Exemptions to Support the Growth of Bioscience Companies	Specifically Targeted to Bioscience	Sales Tax on Equipment Purchased for Biomanufacturing
AZ	■		■
CA	■	■	■
CO	■	■	■
CT	■	■	■
FL	■		■
GA	■		■
HI	■		■
IL	■		■
IN	■		■
IA	■		■
KS	■		■
KY	■		■
LA	■		■
ME	■		■
MD	■		■
MA	■		■
MI	■		■
MN	■		■
MS	■		■
MO	■	■	■
NE	■		■
NV	■		■
NJ	■		■
NM	■	■	■
NY	■		■
NC	■		■
ND	■		■
OH	■		■
PA	■		■
PR	■	■	■
RI	■	■	■
SC	■		■
SD	■		■
TN			■
TX	■		■
UT	■	■	■
VA	■		■
WA	■		■
WI	■	■	■

Source: PMP Public Affairs Consulting 2019

## Funds of Funds to Increase the Availability of Venture Capital

States also use tax credits to increase the availability of venture capital. They can create funds that make investments directly in companies, invest in privately managed funds that agree to invest in state companies; or create a fund that in turn invests in private venture-capital funds, which is referred to as a “fund of funds” if it involves more than one fund. As of 2019, eleven states reported investing in a fund of funds, ten states reported investing state dollars in private venture capital firms and fourteen states reported making direct investments in bioscience companies.

State	Invested in Fund of Funds	Invested in Private VC Firms	Invested in Bioscience Companies	Other
DE	■	■	■	Appropriated funds for contract with private nonprofit to provide funding for companies
IL	■	■	■	
KS			■	
KY	■	■	■	
MA			■	Through Massachusetts Technology Development Corporation
MD		■		
MI	■			
MT	■			
NE			■	Contracts with private nonprofit to provide Angel funding for companies
NJ	■	■	■	
NM	■	■	■	
NC	■	■		
OH			■	
OK	■		■	
OR	■			
PA		■	■	
RI			■	
SD			■	Provides financing for feasibility studies in the form of a forgivable loan
TN		■		
VA			■	
WI	■	■	■	

Source: PMP Public Affairs Consulting 2019



## State R&D Tax Credits

Thirty-eight states reported offering R&D tax credits, an increasing number of which offer a larger credit if the research is conducted by an in-state university. R&D tax credits are refundable in eleven states and transferable in five.

State R&D Tax Credits	R&D Tax Credit	Transferable	Refundable	Comments
AR	■	■	■	
AZ	■		■	Refundable up to 75%
CA	■			
CO	■			
CT	■		■	
DE	■		■	Companies receive the full R&D tax credit for which they qualify by removing the annual expenditure cap of \$5 million for the R&D tax credit.
GA	■			
HI	■		■	
ID	■			
IN	■			
IA	■		■	Refundable tax credit is equal to 6.5% of qualified expenditures and it may be increased for bioscience firms participating in the High Quality Jobs Programs
KS	■			
KY	■			
LA	■		■	
ME	■			
MD	■			
MA	■		■	Refundable if company creates more than 10 jobs and applies to Massachusetts Life Sciences Center (MLSC)
MN	■			
MS	■			R&D Jobs Credit
MT	■			
NE	■	■	■	
NH	■	■		
NJ	■	■		Recent enhancements have modernized the credit to include new eligible research categories, new calculation methods, and larger available credits
NM	■			
NC				Ended in 2016; 15 year carryover still in effect
ND	■			
NY	■		■	
OH	■			
OR	■			
PA	■	■		
PR	■	■		The R & D Credits is 50% (non incremental without a base amount of the qualify eligible expenses.
RI	■			The R&D tax credit has a carry forward of 14 years
SC	■			
TX	■			
UT	■			
VA	■		■	Refundable small companies, nonrefundable larger companies
WV	■		■	Investment Credit
WI	■			

# New Capital Formation INITIATIVES

It is critical to have financing available for each stage of development including early-stage, proof-of-concept and prototype development. However, a state or region must also be able to access national and regional venture capital pools as bioscience firms mature and move closer to the market. In short, leading states and regions address a continuum of capital needs from prospective compound through seed to later stage formal venture financing.

## Examples of Bioscience Economic Development Capital Formation Best Practices, 2017-2018

### CALIFORNIA

Bioscience Los Angeles County (BioLA) was launched in late 2018 with support from Los Angeles County and eleven founding corporate sponsors. Each partner will be contributing \$750,000 over a three-year period. The public-private agency's mission is to strengthen the life sciences ecosystem by convening key players in the industry, accelerating startup activity, stimulating job growth and attracting investment to the area. The collaboration's first measure is the Bioscience Investment Fund, with an initial \$15 million provided by the county for seed investments in startups. The fund ultimately aims to raise \$40-\$60 million.<sup>1</sup>

### INDIANA

BioCrossroads, a public-private partnership supporting Indiana's life sciences industry, announced a \$9 million seed fund in October 2018. The Indiana Seed Fund III is BioCrossroads' third fund since it formed in 2002. The latest fund will be invested in early-stage life science startups, including in health IT and agricultural biosciences.<sup>2</sup>

### MARYLAND

In April 2017, the state-funded Maryland Technology Development Corp. (TEDCO) announced the GAP Investment Fund, which will make \$200,000 to \$500,000 investments in scaling technology startups. The fund was created with an initial \$1 million, with plans to expand the program in the future. The new fund is intended to close the gap between TEDCO's existing seed and venture funding programs.<sup>3</sup>

Another TEDCO fund, the Maryland Venture Fund, closed with \$25 million in November 2017. This fund's investment focus is early-stage healthcare, life sciences and tech companies.<sup>4</sup> The Maryland Venture Fund was founded in 1994 as an early-stage, evergreen venture capital fund, and makes investments in the range of \$500,000 to \$1.5 million.

### MASSACHUSETTS

Through the leadership of Massachusetts Governor Charlie Baker and the Commonwealth's legislature, a bill authorizes the state to borrow and spend up to \$473 million over five years and provide tax credits of up to \$150 million for the life sciences industry in that state.

The bill continues an initiative started under former Gov. Deval Patrick to build up Massachusetts' life sciences industry. Patrick's 10-year, \$1 billion plan started in 2008 and needed reauthorization this year in order to continue.

The Massachusetts Life Sciences Center manages the funds, which go to regional investments to "spur workforce and economic development and enrich learning and experiential opportunities for young people in Massachusetts," according to the governor's office.

The public money will help create infrastructure that can be built upon and used by private industry. The money can be used for workforce training in the life sciences industry. It can also be used to help fund scientific advances in digital health, biopharma, medical devices and engineering.

Included in the bill is \$47 million for UMass Amherst to build and equip a Biotechnology and Precision Manufacturing research and training facility.

The bill also reauthorizes until 2028 a tax credit for life sciences companies that bring jobs to Massachusetts.

1 "County backs new bioscience hub." *Los Angeles Business Journal*. 10 September 2018. <http://labusinessjournal.com/news/2018/sep/07/county-backs-new-bioscience-hub/>

2 "BioCrossroads announces the formation of the \$9 million Indiana Seed Fund III." Press Release. 10 October 2018. <https://www.prnewswire.com/news-releases/biocrossroads-announces-the-formation-of-the-9-million-indiana-seed-fund-iii-invests-in-scioto-biosciences-and-animated-dynamics-300727668.html>

3 "TEDCO launches \$1M fund to help Maryland startups bridge the 'funding gap.'" *Washington Business Journal*. 21 April 2017. <https://www.bizjournals.com/baltimore/news/2017/04/21/tedco-launches-1m-fund-to-help-maryland-startups.html>

4 "The Maryland Venture Fund closed on \$25M to invest in tech companies." *Technically Baltimore*. 14 November 2017. <https://technical.ly/baltimore/2017/11/14/maryland-venture-fund-closed-25m-invest-tech-companies/>

## MINNESOTA

In 2016, the Minnesota legislature provided \$594,000 for the Working Lands Watershed Restoration Program plan and feasibility study. This program lays the groundwork for creating a state-funded biofuels incentive program from perennial feedstock instead of corn.<sup>5</sup>

## NEBRASKA

In 2017, Nebraska created a bioscience-specific program within the Nebraska Business Innovation Act. The bill (LB641) created the Bioscience Innovation Program to provide matching financial assistance to help form small enterprises, create high-wage jobs, develop new technologies, spawn innovation and help grow Nebraska's bioscience industry. The bill's sponsor said there would be no fiscal impact on the state tax-supported general fund.<sup>6</sup>

## NEW MEXICO

The Catalyst Fund, a \$20 million state economic development fund of funds, is providing up to \$3 million to BlueStone Venture Partners to spur the growth of New Mexico-based bioscience startups. BlueStone Venture Partners, a new life science-focused venture capital firm, will match funds provided by the state. The Catalyst Fund was launched in 2017 by New Mexico's State Investment Council to increase seed and early-state investment in tech startups in the state.<sup>7</sup>

## NEW YORK

In 2016, Mayor Bill de Blasio unveiled a \$500 million initiative, LifeSci NYC, to spur company creation and training and jobs placement.

The City has identified three areas to support the development of the current industry: connecting industry to local scientific discoveries, providing new space for companies, and building a diverse talent pool for companies of today and tomorrow.

To further boost this sector, LifeSci NYC will be investing \$100 million into a new Applied Life Sciences campus focused on commercial R&D and include space for companies to grow and exchange ideas. The initiative will also include \$50 million to expand the current network of R&D facilities throughout the city, and programs to develop emerging talent to lead new enterprises being created.<sup>8</sup>

## TEXAS

Since Texas voters overwhelmingly approved a constitutional amendment in 2007 establishing the Cancer Prevention and Research Institute of Texas (CPRIT) and authorizing the state to issue \$3 billion in bonds to fund groundbreaking cancer research and prevention in Texas, the state continues to build innovation in cancer research and product development and enhancing access to cancer prevention services across the state.

Since 2010, CPRIT has committed \$411 million to 34 companies started in Texas or relocated to Texas. In turn, these companies have raised \$1.75 billion in additional investments after their CPRIT awards. As of January 2019, 17 companies had CPRIT projects in Phase 1 or Phase 2 clinical trials. Twenty-two CPRIT companies have connections with Texas institutions, further strengthening the life science infrastructure and ecosystem across the state.

## Federal Supportive Legislation and Industry Growth

*The biotechnology industry is the most research and development intensive and capital-focused industry in the world. The United States currently leads the world in the area of biotechnology because U.S. patent laws and legislation such as the Bayh-Dole Act have provided favorable incentives to mitigate the high risks. The biotechnology industry relies on the protections afforded by patent law and on the opportunity to exclusively license discoveries from academic partners through the mechanisms established in the Bayh-Dole Act. Without these protections and incentives, many life-saving discoveries would not have been realized.*

*Prior to the Bayh-Dole legislation, federally funded research was owned by the government and offered for licensing on a non-exclusive basis or simply dedicated to the public. There was little incentive for businesses to undertake the financial risk to develop a product.*

<sup>5</sup> "With \$500 million, New Jersey wants to invest in your start-up." 1 October 2018. *The New York Times*. <https://www.nytimes.com/2018/10/01/nyregion/new-jersey-venture-capital-murphy.html>

<sup>6</sup> "Bioscience innovation funding support urged." *The Lincoln Journal Star*. March 6, 2017. [http://journalstar.com/legislature/bioscience-innovation-funding-support-urged/article\\_7e93aaf4-182a-50c0-b2dd-cc5c0c1b0570.html](http://journalstar.com/legislature/bioscience-innovation-funding-support-urged/article_7e93aaf4-182a-50c0-b2dd-cc5c0c1b0570.html)

<sup>7</sup> "State funding to spur development of bioscience startups." *AP News*. 17 August 2018. <https://apnews.com/ea06261cbdc64221aaddbd6a4071009e>

<sup>8</sup> "Governor Cuomo announces groundbreaking \$650 million initiative to fuel growth of a world-class life science cluster in New York." Press Release. 12 December 2016. <https://www.governor.ny.gov/news/governor-cuomo-announces-groundbreaking-650-million-initiative-fuel-growth-world-class-life>

# Workforce Development INITIATIVES

**L**ike any knowledge-based industry, bioscience companies need a strong supply of qualified, trained workers. To meet the demands of emerging fields, new curricula and programs are being developed by educational institutions working in close partnership with the bioscience industry.

In addition to having world-class researchers, successful bioscience regions have an adequate supply of management, sales, marketing, and regulatory personnel experienced in the biosciences. Funding bioscience workforce initiatives across the educational spectrum is essential to continue growth of this industry.

## Examples of new workforce development programs

### FLORIDA

The Florida Job Growth Grant Fund was created in 2017 to promote economic opportunity by improving public infrastructure and enhancing workforce training. The program awards money to regional projects rather than to individual companies. The workforce training grants support programs offered at state colleges and technical centers. By December 2018, the state had awarded more than \$151 million to 50 projects.<sup>9</sup>

### INDIANA

In 2017, the state of Indiana created the Workforce Ready Grant program aimed at offering tuition-free training certificates in five high-need areas, including advanced manufacturing and health & life sciences. The program was so popular that the legislature extended eligibility to all high school graduates in 2018.<sup>10</sup>

Indiana also introduced the Employer Training Grant program in 2018. This program reimburses employers who train, hire, and retain new or incumbent workers to fill in-demand positions within specific job fields. The grant reimburses employers up to \$5,000 per employee who are trained, hired, and retained for six months. There is a limit of \$50,000 per participating employer.<sup>11 12</sup>

### MARYLAND

The “More Jobs for Marylanders” Act, enacted in 2017, includes numerous workforce training incentives, including a business tax credit linked to job training, a tax credit for apprenticeships and a student financial aid program for non-credit training. The legislation provides tax incentives for manufacturers to create jobs in economically distressed areas of the state.<sup>13</sup>

### MASSACHUSETTS

In 2018, Holyoke Community College opened the Center for Life Sciences, which features biotechnology classrooms and an ISO certified cleanroom training facility. The \$4.55 million Center, which was partially funded through a \$3.8 million grant from the Massachusetts Life Sciences Center, offers courses in biotechnology, genetics and microbiology.<sup>14</sup>

### NORTH CAROLINA

The North Carolina Pharmaceutical Services Network (PSN), which officially opened in 2018, provides training to benefit pharmaceutical manufacturing companies in eastern North Carolina. Examples include:

- Pitt Community College provides pharmaceutical training in a pilot plant environment with lab scale equipment to teach oral solid dosage theory and manufacturing techniques.
- East Carolina University prepares chemistry, biochemistry and biology students for the workforce, and also offers seminars and short courses to support current industry employees. The program is focused on laboratory-based education and training, including courses in good manufacturing practices (GMP) and good laboratory practices (GLP), and short courses for professional development and analytical development services.
- The program at NC State University compliments the existing Biomanufacturing Training and Education Center (BTEC), which provides hands-on educational opportunities to develop skilled biotech professionals, as well as customized short courses tailored to meet the needs of specific companies.<sup>15</sup>
- Alamance Community College in central North Carolina is launching a new Agricultural Biotechnology degree program this year. The two-year applied science degree program was designed to meet the workforce needs of local and global agricultural biotechnology companies.<sup>16</sup>

<sup>9</sup> “Gov. Scott announces nearly \$9 million in awards for Florida Job Growth Grant Fund projects.” Governor’s office press release. December 28, 2018.

<sup>10</sup> “Higher ed prepares Hoosiers for work.” *Indianapolis Star*. May 21, 2018.

<sup>11</sup> <https://www.nextleveljobs.org/Employer/How-It-Works>

<sup>12</sup> “Holcomb’s 2019 agenda focuses on economy, workforce development, public health.” *Indianapolis Business Journal*. December 6, 2018.

<sup>13</sup> “Maryland legislation encourages manufacturing jobs, training.” SSTI blog post. April 20, 2017.

<sup>14</sup> “Life Sciences Center at Holyoke Community College aims to develop biotech workforce.” *MassLive.com*. August 30, 2018.

<sup>15</sup> “Training program for pharmaceutical manufacturing opens in Greenville.” NC Biotechnology Center website. January 31, 2018.

<sup>16</sup> “ACC launches new Agricultural Biotechnology degree program.” Alamance Community College press release. August 14, 2018.

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*“Supporting innovative and growing companies reinforces Maryland’s standing as a leading biotech cluster and a global hub for the development of cutting-edge treatments, diagnostics, and cures.”*

*Governor Larry Hogan  
Maryland, December 3, 2018*

## PENNSYLVANIA

In 2018, Thomas Jefferson University announced that it would open a 25,000 sq. ft. training center for biological manufacturing. The Jefferson Institute for Bioprocessing is being established in partnership with the National Institute for Bioprocessing Research and Training (NIBRT), which is based in Dublin, Ireland. The Jefferson Institute will house programs to educate and train about 2,500 people, including biopharmaceutical professionals and bioprocessing engineering students.<sup>17</sup>

In 2017, Governor Tom Wolf announced a \$12 million Manufacturing PA initiative that supports manufacturing training programs, leverages the state’s research capacity to support students in engagements with industry and expands the outreach of Pennsylvania’s existing Industrial Resource Centers.<sup>18</sup>

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*“Thanks to our investments in skills training and economic development, our state’s biotechnology industry is strong and getting stronger.”*

*Governor Gina Raimondo  
Rhode Island, July 14, 2017*

## RHODE ISLAND

In 2016, Rhode Island voters approved a \$20 million bond issue to create Innovation Campuses to bring together leading industry, academic, and research partners. In December 2018, state officials announced the first round of Innovation Campus projects. One of the campuses is the Rhode Island Agricultural Innovation & Entrepreneurship Campus, which will include greenhouses as well as an Agriculture Innovation Center which will educate and train students for the cutting-edge agricultural products, processes and jobs of the future. The total project cost of the Rhode Island Agricultural Innovation & Entrepreneurship Campus is expected to be approximately \$115 million with the innovation bond proceeds accounting for \$4 million.<sup>19</sup>

In 2016, Rhode Island launched the Wavemaker Fellowship program in an effort to attract and retain STEM professionals. The program awards state tax credits to workers with higher education loan debt who stay in-state to work in STEM occupations.<sup>20</sup>

## TEXAS

Austin Community College’s Highland campus features a business incubator that includes 415,000 square feet of new learning space — to prepare Texas students for high-demand careers and nurture local business growth including the bioscience industry.

The business incubator, located on the site of a former retail mall, features a nearly 125,000-square-foot digital media center, a 14,000-square foot health sciences/STEM simulation center, and will support enrollment of 5,000 students.<sup>21</sup>

## VIRGINIA

In 2016, state officials announced \$46.7 million in state funding, which was matched by \$21 million in funding from Virginia Tech and the Carilion Clinic to expand health sciences, technology research, and training workers in Roanoke.<sup>22</sup>

In 2018, a Roanoke family announced a \$50 million gift to Virginia Tech to accelerate development of its health sciences and technology programs. The Virginia Tech Carilion Research Institute was renamed the Fralin Biomedical Research Institute at VTC. The \$50 million gift is designated to attract top-ranked scientists and to hasten the pace of the region’s economic growth.<sup>23</sup>

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17 “Jefferson selects site for 25,000-square-foot bioprocessing institute.” *Philadelphia Business Journal*. June 14, 2018.

18 “Governor Wolf launches new Manufacturing PA initiative.” Governor’s office press release. October 17, 2017.

19 “Rhode Island announces first round of Innovation Campus projects.” Rhode Island Commerce Corporation press release. December 18, 2018.

20 “Raimondo administration announces third round of Wavemaker Fellowship to attract and retain STEM talent.” Governor’s office press release. September 6, 2018.

21 <https://www.bizjournals.com/austin/news/2017/09/22/austin-community-colleges-next-big-project-at-old.html>

22 “Gov. McAuliffe signs bond bill, advances Health Sciences and Technology Innovation District in Roanoke.” May 6, 2016. <https://research.vtc.vt.edu/news/2016/may/06/gov-mcauliffe-signs-bond-bill-advances-health-scie/>

23 “Research district transforms Roanoke; \$50 million gift bolsters health campus that was years in the making.” *The Roanoke Times*. December 9, 2018.

# Facilities and INFRASTRUCTURE

Investments in basic and applied research facilities at universities and life sciences-related institutes is an essential step in the innovation process. Because the industrial applications of the industry have dramatically changed in the past ten years, state-of-the-art research demands modern research facilities.

State governments, academic research centers, and private developers are acutely aware of this competitive advantage and have increasingly integrated the physical facilities into the long-term vision and strategy for economic development by providing physical space to leverage public-private partnerships in early stage commercialization efforts.

## ARIZONA

In 2017 the State of Arizona passed legislation that provides state bonds to expand, and maintain university research infrastructure at Arizona public universities. The measure establishes a University Capital Infrastructure Fund with subsets for each university and prescribes a formula to calculate amounts appropriated to each university fund for 2019 and beyond.<sup>24</sup>

## CALIFORNIA

BioLabs, in partnership with the Lundquist Institute (formerly the Los Angeles Biomedical Research Institute or LA Biomed), a nonprofit biomedical research organization, announced that they opened a new Los Angeles innovation center in 2019. The facility will house up to 30 spinoff and outside startup companies, and will include lab and office space, a lecture hall, a data center and a freezer farm for bio-banking.<sup>25</sup> The California Health Facilities Financing Authority issued \$50 million in tax-exempt revenue bonds to raise funding for the \$63 million project, with another \$3 million contributed by Los Angeles County.<sup>26, 27</sup>

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*“Arizona’s bioscience and healthcare industries’ efforts to discover, develop, and deliver the life-saving and life changing innovations makes life better today and for the future generations.”*

*Governor Doug Ducey  
Arizona October 11, 2017*

## FLORIDA

The University of Central Florida Life Science Incubator opened in May 2018. The majority of the \$4 million cost was provided from Florida Hospital with funds it had received from the City of Orlando and the State of Florida to establish its own incubator, including additional funds provided by UCF and Tavistock Group.<sup>28</sup>

In February 2019, the Jupiter Town Council approved a memorandum of understanding with Beacon Pharmaceuticals to develop an accelerator facility with office and lab space for up to 50 life science companies, as well as a CRO focused on “right to try” drugs and a drug cell manufacturing center. Beacon Pharmaceuticals would pay annual rent to the town, and Beacon would be eligible for an award of up to \$600,000 over 10 years dependent on job creation milestones.<sup>29</sup>

## GEORGIA

In June 2018, the National Science Foundation Engineering Research Center for Cell Manufacturing Technologies (CMaT) opened at Georgia Tech’s Marcus Center for Therapeutic Cell Characterization and Manufacturing (MC3M). The new facility operates as MC3M’s translational arm, and provides space for collaboration between engineers, clinicians and industry to develop and validate manufacturing processes for cell therapies. Funding was provided by the NSF, Georgia Tech, the Georgia Research Alliance and The Marcus Foundation.<sup>30</sup>

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24 <http://www.azleg.gov/legtext/53leg/1R/summary/HHB2547>

25 “LA BioMed helps drive LA County’s ranking as national Top-10 biopharma cluster.” Press release. June 7, 2018. [www.prnewswire.com/news-releases/la-biomed-helps-drive-la-countys-ranking-as-national-top-10-biopharma-cluster-300662007.html](http://www.prnewswire.com/news-releases/la-biomed-helps-drive-la-countys-ranking-as-national-top-10-biopharma-cluster-300662007.html)

26 “The Los Angeles Biomedical Research Institute (LA BioMed) and BioLabs launch Los Angeles location.” Press release. Feb. 12, 2019. [www.labiomed.org/news/los-angeles-biomedical-research-institute-la-biomed-and-biolabs-launch-los-angeles-location](http://www.labiomed.org/news/los-angeles-biomedical-research-institute-la-biomed-and-biolabs-launch-los-angeles-location)

27 “LA BioMed closes \$50 million bond sale to fund new biotech research lab.” *Los Angeles Business Journal*. Aug. 28, 2018. [www.labusinessjournal.com/news/2018/aug/28/la-biomed-closes-50-million-bond-sale-fund-new-bio](http://www.labusinessjournal.com/news/2018/aug/28/la-biomed-closes-50-million-bond-sale-fund-new-bio)

28 “UCF launches Orlando’s first life-sciences incubator.” *Orlando Sentinel*. May 12, 2018. [www.orlandosentinel.com/business/os-cfb-ucf-wet-lab-incubator-20180510-story.html](http://www.orlandosentinel.com/business/os-cfb-ucf-wet-lab-incubator-20180510-story.html)

29 “Deal could bring life sciences hub with 200 high-paying jobs to South Florida.” *South Florida Business Journal*. Feb. 6, 2019. [www.bizjournals.com/southflorida/news/2019/02/06/beacon-pharma-deal-could-bring-jobs-to-jupiter.html](http://www.bizjournals.com/southflorida/news/2019/02/06/beacon-pharma-deal-could-bring-jobs-to-jupiter.html)

30 “New cell manufacturing research facility will change approaches to disease therapies.” *Georgia Tech News Center*. June 19, 2018. [www.news.gatech.edu/2018/06/19/new-cell-manufacturing-research-facility-will-change-approaches-disease-therapies](http://www.news.gatech.edu/2018/06/19/new-cell-manufacturing-research-facility-will-change-approaches-disease-therapies)



## MASSACHUSETTS

In March 2018, the Baker administration announced the development of the Berkshire Innovation Center in Pittsfield, Massachusetts. The state is committing \$12.5 million through an allocation to the Massachusetts Life Sciences Center, with additional funding coming from MassDevelopment, the City of Pittsfield and the Pittsfield Economic Development Authority. The \$13.7 million project is intended to support the growth of small to mid-sized life science and advanced manufacturing companies in Western Massachusetts. The center will include training facilities, shared wet lab space and equipment, clean rooms, office and event space.<sup>31</sup>

In October 2018, the Massachusetts Development Finance Agency awarded the Worcester Business Development Corp (WBDC) a \$15 million grant to help fund development of a biomanufacturing campus. The Massachusetts legislature authorized the conveyance of the state land to the WBDC in 2016. WuXi Biologics will anchor the new campus.<sup>32, 33</sup>

## MISSOURI

St. Louis Economic Development Partnership and St. Louis County have developed a master plan to create an agtech innovation district called 39 North. Anchored by the existing Donald Danforth Plant Science Center and Bayer's plant science division, officials intend for the district to attract agricultural talent and startups. In April 2018, local, federal and nonprofit sources contributed \$6.8 million to redevelop an interchange to better connect the district. Officials are now seeking additional tenants and private investment.<sup>34</sup>

## NEW YORK

In 2018, the New York City Economic Development Corp. issued a call for proposals to develop an Applied Life Science Hub. With \$100 million from the city, the agency is seeking a mission-driven organization or joint venture to match its investment and offer a site to create an R&D space for pharma companies and startup biotechs. This initiative is a centerpiece of the \$500 million LifeSci NYC plan announced by New York City mayor Bill de Blasio in 2016.<sup>35</sup>

BioLabs@NYULangone opened in 2017 as a coworking and shared lab space for up to 35 life science startups. The space was funded with \$5 million from the New York City Economic Development Corporation through the LifeSci NYC initiative, \$5 million from the academic medical center NYU Langone, and \$2 million from Empire State Development.<sup>36</sup>

JLABS @ NYC, located in the New York Genome Center, opened in June 2018. The new JLABS location is a collaboration between Johnson & Johnson Innovation, New York State and the New York Genome Center. With space for up to 30 startup companies, the incubator serves emerging life science companies and connects them with J&J Innovation resources, including funding, services, expertise and events.<sup>37</sup> The State of New York provided \$17 million for the project.<sup>38</sup>

## PENNSYLVANIA

The University of Pittsburgh and the University of Pittsburgh Medical Center (UPMC) announced in February 2018 that they are transforming a warehouse into a \$200 million immunotherapy research center. The UPMC Immune Transplant and Therapy Center is intended to serve as the anchor of a new life science-based innovation district to attract R&D companies to Pittsburgh.<sup>39</sup>

## TEXAS

In 2018, the Texas Medical Center and the state of Texas announced plans to create TMC3, a \$250 million translational biomedical research center to foster collaborations between biopharma companies, physicians and researchers. The Texas Medical Center is contributing \$40 million towards the project, with \$36 million being contributed each by four partner academic institutions: Baylor College of Medicine, Texas A&M University Health Science Center, the University of Texas Health Science Center at Houston, and the University of Texas MD Anderson Cancer Center.<sup>40</sup>

31 "Baker-Polito administration announces \$13.7 million project launch of Berkshires Life Sciences innovation hub." Press release. March 7, 2018. [www.mass.gov/news/baker-polito-administration-announces-137-million-project-launch-of-berkshires-life-sciences](http://www.mass.gov/news/baker-polito-administration-announces-137-million-project-launch-of-berkshires-life-sciences)

32 "Legislature fast-tracks legal change to expand biotech park for incoming Calif. company." *Boston Business Journal*. Dec. 28, 2016. [www.bizjournals.com/boston/news/2016/12/28/legislature-fast-tracks-legal-change-to-expand.html](http://www.bizjournals.com/boston/news/2016/12/28/legislature-fast-tracks-legal-change-to-expand.html)

33 "\$15M grant allows hospital demolition to make way for biomanufacturing." *The Telegram & Gazette*. Oct. 3, 2018. [www.telegram.com/news/20181003/15m-grant-allows-hospital-demolition-to-make-way-for-biomanufacturing](http://www.telegram.com/news/20181003/15m-grant-allows-hospital-demolition-to-make-way-for-biomanufacturing)

34 "Finding space inside St. Louis' \$600 million agtech industry." *St. Louis Business Journal*. April 19, 2018. [www.bizjournals.com/stlouis/news/2018/04/19/finding-space-inside-st-louis-600-million-agtech.html](http://www.bizjournals.com/stlouis/news/2018/04/19/finding-space-inside-st-louis-600-million-agtech.html)

35 "NYCEDC begins search for a NY bio campus." *Xconomy*. Jan. 24, 2018. [www.xconomy.com/new-york/2018/01/24/have-100m-looking-for-ideas-nycedc-begins-search-for-a-ny-bio-campus](http://www.xconomy.com/new-york/2018/01/24/have-100m-looking-for-ideas-nycedc-begins-search-for-a-ny-bio-campus)

36 "NYU Langone and BioLabs Launch Center for Biotech Startups in Manhattan." Press release. June 26, 2017. [www.prnewswire.com/news-releases/nyu-langone-and-biolabs-launch-center-for-biotech-startups-in-manhattan-300479648.html](http://www.prnewswire.com/news-releases/nyu-langone-and-biolabs-launch-center-for-biotech-startups-in-manhattan-300479648.html)

37 "Johnson & Johnson Innovation opens JLABS @ NYC in collaboration with New York State and the New York Genome Center." Press Release. June 21, 2018. [www.prnewswire.com/news-releases/johnson-johnson-innovation-opens-jlabs-nyc-in-collaboration-with-new-york-state-and-the-new-york-genome-center-300670313.html](http://www.prnewswire.com/news-releases/johnson-johnson-innovation-opens-jlabs-nyc-in-collaboration-with-new-york-state-and-the-new-york-genome-center-300670313.html)

38 "Johnson & Johnson Innovation, New York State and New York Genome Center collaborate to launch JLABS in New York City." Press release. Jan. 9, 2017. [www.prnewswire.com/news-releases/johnson-johnson-innovation-new-york-state-and-new-york-genome-center-collaborate-to-launch-jlabs-in-new-york-city-300387791.html](http://www.prnewswire.com/news-releases/johnson-johnson-innovation-new-york-state-and-new-york-genome-center-collaborate-to-launch-jlabs-in-new-york-city-300387791.html)

39 "UPMC, Pitt announce new Immune Transplant and Therapy Center in Bloomfield." *Pittsburgh Post-Gazette*. Feb. 13, 2018. [www.post-gazette.com/news/health/2018/02/13/UPMC-Pitt-announce-new-200-million-Immune-Transplant-and-Therapy-Center-in-Bloomfield/stories/201802130030](http://www.post-gazette.com/news/health/2018/02/13/UPMC-Pitt-announce-new-200-million-Immune-Transplant-and-Therapy-Center-in-Bloomfield/stories/201802130030)

40 "With TMC3, Texas Leaders aim to launch Houston as top biotech hub." *Xconomy*. April 24, 2018. [www.xconomy.com/texas/2018/04/24/with-tmc3-texas-leaders-aim-to-launch-houston-as-top-biotech-hub](http://www.xconomy.com/texas/2018/04/24/with-tmc3-texas-leaders-aim-to-launch-houston-as-top-biotech-hub)

# Innovation Partnership MODELS

**S**trong partnerships between industry, academia, and state government are essential for the development of successful bioscience clusters. As states evaluate how to continue encouraging bioscience companies to locate within their borders, they need to review their tax and investment incentives in the area of capital acquisition, workforce training, and physical infrastructure to help companies navigate through all phases of product development and manufacturing.

*Through support for industry-university collaborations, provision of R&D tax credits, business incubator development, venture capital support, and other innovation support mechanisms, states and metro regions are able to enhance their attractiveness for bioscience projects and increase the creation and growth of new bioscience companies.*

## CALIFORNIA

In September 2018, UC San Diego partnered with Deerfield Management to create Poseidon Innovation, a joint venture to fund early-stage drug development out of the university. Deerfield, a New York investment management firm that committed \$65 million to the project, has similar partnerships with Johns Hopkins, Vanderbilt and Northwestern, but this was their first with a public university. The money is specifically intended to bridge the funding gap from academic discovery to beginning clinical trials.<sup>41</sup>

In May 2018, Novo Nordisk announced an expanded collaboration with the University of California San Francisco (UCSF). The increased commitment from Novo Nordisk came after the partners reached an important milestone with the inauguration of a new GMP laboratory at UCSF where employees from the university and Novo Nordisk work together on deriving the cell lines for stem cell-based therapies.<sup>42</sup>

## INDIANA

In July 2017, Eli Lilly and Purdue University announced a five-year research collaboration initially focused on developing predictive models for clinical success and on improving the delivery of injectable pain medicines. This \$52 million agreement is much larger than past Lilly-Purdue projects and is Purdue's largest collaboration with a single company.<sup>43</sup>

## IOWA

In August 2018, the Iowa Economic Development Authority board approved \$4.5 million in funding for the creation of the Iowa Bioscience Development Center. The IBDC will bring together partners from research institutions, global companies, entrepreneurs, investors and government to accelerate bioscience sector growth and development in Iowa. The funding will be distributed over three years.<sup>44</sup>

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*"Iowa is fortunate to have a strong bioscience industry. These business leaders lend their expertise to ensure our state has a focused plan for success. We appreciate their leadership and understand the importance of this report to Iowa's economic future."*

*The bottom line is that biosciences are critical to Iowa's current and future economic success."*

*Governor Kim Reynolds  
Iowa, December 19, 2017*

41 "UC San Diego partners with \$65 million project to speed drug development." *San Diego Union-Tribune*. Sept. 5, 2018. <https://www.sandiegouniontribune.com/business/biotech/sd-me-ucsd-deerfield-poseidon-20180905-story.html>

42 "Novo Nordisk increases commitment to stem cell-based therapies." May 16, 2018. <https://www.novonordisk.com/media/news-details.2193101.html>

43 "Lilly and Purdue University announce strategic research collaboration." July 6, 2017. <https://www.purdue.edu/newsroom/releases/2017/Q3/lilly-and-purdue-university-announce-strategic-research-collaboration.html>

44 "IDEA approves funding for Iowa Bioscience Development Center." *Business Record*. Aug. 20, 2018. <https://businessrecord.com/Content/Default/All-Latest-News/Article/IDEA-approves-funding-for-Iowa-Bioscience-Development-Center/-3/248/83657>

## MICHIGAN

The Michigan's University Research Corridor, comprised of three universities – Michigan State University (MSU), University of Michigan (U-M), and Wayne State University (WSU)- is a key incubator for life science, medical, and health sciences companies in that state - launching more than 35 startups between 2012 and 2018. One important contribution to moving discoveries from the lab to the marketplace has been the Michigan Translational Research and Commercialization (MTRAC) program, a partnership between the Michigan Economic Development Corporation (MEDC) and public universities to identify commercial potential in advanced technologies. U-M, MSU and WSU are all homes to the MTRAC program and . WSU's MTRAC is focused on medical devices, biomaterials and health care information technology. The URC member universities in 2017 captured more than \$1.38 billion in life, medical and health sciences research and development funding from public and private sources.

## NEW JERSEY

In February 2019, the Institute for Life Science Entrepreneurship (ILSE), a non-profit organization at Kean University, joined the CARB-X Global Accelerator Network. CARB-X (Combating Antibiotic Resistant Bacterial Biopharmaceutical Accelerator) is a nonprofit, public-private global partnership. ILSE and CARB-X signed a 3-year agreement under which ILSE will serve as an accelerator, providing drug discovery and diagnostics expertise, business strategy and other support to CARB-X's growing portfolio of innovative antibacterial development projects.<sup>45</sup>

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*“North Carolina’s expertise in the life sciences continues to lead the nation. Pioneering companies keep our state at the forefront of promising new approaches like gene therapy, which opens up new ways for us to tackle tough diseases.”*

*Governor Roy Cooper  
North Carolina, February 18, 2019*

## NEW YORK

In October 2018, AllerGenis LLC entered a partnership with Mount Sinai Health System to develop and commercialize technology for improved food allergy detection and patient management. Through this partnership, Mount Sinai licensed its epitope mapping platform to AllerGenis. The epitope mapping platform is based on immunologic research conducted by Hugh Sampson, MD, Director Emeritus of the Elliot and Roslyn Jaffe Food Allergy Institute at the Icahn School of Medicine at Mount Sinai.<sup>46</sup>

In April 2018, Novo Nordisk extended a partnership with Cornell University to further develop a delivery mechanism for stem cell-based therapies to treat diabetes. The Nanofiber-enabled encapsulation devices (NEEDs) are being developed and optimized by Minglin Ma.<sup>47</sup>

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*“Our administration is committed to supporting public-private partnerships and strategic investments that continue to improve Massachusetts’ position as a global leader in the life sciences.”*

*Governor Charlie Baker  
Massachusetts, March 9, 2018*

## NORTH CAROLINA

In October 2018, Minnetronix Neuro announced that it had co-founded The Neurapheresis Consortium with Duke University. The consortium was created to bring together researchers and clinicians to advance Minnetronix's Neurapheresis Therapy through pre-clinical research and into the clinic to treat patients suffering from diseases involving infectious, inflammatory and neurodegenerative agents in the central nervous system.<sup>48</sup>

In October 2018, Deerfield Management announced a \$65 million partnership with UNC-Chapel Hill to create Pinnacle Hill LLC to support the development of novel therapeutics at the University. The goal of the collaboration is to accelerate the translation of research in UNC-Chapel Hill faculty laboratories into clinical therapeutics. Profits from successful projects, if any, will be shared by Deerfield and UNC-Chapel Hill.<sup>49</sup>

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<sup>45</sup> “Kean Institute joins global fight against antibiotic-resistant superbugs.” Feb. 25, 2019. <https://www.kean.edu/news/kean-institute-joins-global-fight-against-antibiotic-resistant-superbugs>

<sup>46</sup> “Mount Sinai and AllerGenis LLC announce partnership to bring novel, precision diagnostics to food allergy patients.” October 30, 2018. <https://www.mountsinai.org/about/newsroom/2018/mount-sinai-and-allergenics-llc-announce-partnership-to-bring-novel-precision-diagnostics-to-food-allergy-patients>

<sup>47</sup> “Novo Nordisk commits nearly \$7 million for Minglin Ma’s diabetes research. Cornell Chronicle. April 19, 2018. <http://news.cornell.edu/stories/2018/04/novo-nordisk-commits-nearly-7-million-minglin-mas-diabetes-research>

<sup>48</sup> “Minnetronix Neuro launches Global Neurapheresis Consortium.” Oct. 8, 2018. <https://www.businesswire.com/news/home/20181008005074/en/Minnetronix-Neuro-Launches-Global-Neurapheresis%E2%84%A2-Consortium>

<sup>49</sup> “UNC-Chapel Hill and Deerfield Management announce the creation of Pinnacle Hill to accelerate the discovery of new medicines. Oct. 22, 2018. <https://uncnews.unc.edu/2018/10/22/unc-chapel-hill-and-deerfield-management-announce-the-creation-of-pinnacle-hill-to-accelerate-the-discovery-of-new-medicines/>

## PENNSYLVANIA

In January 2018, Johnson & Johnson Innovation LLC and Janssen Pharmaceuticals Inc. (JPI) announced an exclusive research collaboration with the University of Pennsylvania's Gene Therapy Program. The partnership utilizes Adeno-associated virus (AAV)-vectors developed by the University of Pennsylvania and antibodies targeting Alzheimer's disease developed by JPI. JPI will have exclusive global rights to commercialize products developed under this agreement.<sup>50</sup>

In October 2018, Amicus Therapeutics announced a research collaboration with the University of Pennsylvania to develop novel gene therapies. Then, in February 2019, Amicus Therapeutics announced plans to open a Global Research and Gene Therapy Center in Philadelphia. The company said that the proximity to researchers at the University of Pennsylvania was a major draw.<sup>51, 52</sup>

## SOUTH CAROLINA

In February 2019, the Medical University of South Carolina (MUSC) established a partnership with Cumberland Emerging Technologies (CET) to develop new biomedical products. CET will examine the institution's discoveries and work with researchers to push developing products toward commercialization.

CET is a joint initiative between Cumberland Pharmaceuticals Inc., Vanderbilt University, LaunchTN, and China's Gloria Pharmaceuticals.<sup>53</sup>

## TENNESSEE

Vanderbilt University has multiple collaborative research agreements with Boehringer Ingelheim. The most recent was a research collaboration to develop new therapies for psychiatric disorders. The company and the Vanderbilt Center for Neuroscience Drug Discovery (VCNDD) will work together to investigate, develop and commercialize two GPCR targets with a goal to address the unmet medical needs for treatments of symptoms associated with schizophrenia.<sup>54</sup>

## TEXAS

In May 2018, the Jiangsu Industrial Technology Research Institute (JITRI) announced plans to open a China U.S. Biotechnology Innovation Center (CUBIC) in the Texas Medical Center in Houston. JITRI is a Chinese independent nonprofit that already has an innovation center in Denmark called the Innovation House. JITRI said it planned to invest \$3 to \$4 million per year to fund research in the area.<sup>55</sup>

In August 2017, Merck KGaA formed a strategic alliance with Baylor College of Medicine and the Texas Children's Hospital Center for Vaccine Development. The collaboration is focusing on optimizing the vaccine manufacturing process to increase vaccine stability and yield.<sup>56</sup>

## WASHINGTON

In February 2018, the Fred Hutchinson Cancer Research Center, the University of Washington and Takeda Pharmaceutical Company Ltd. announced a research alliance called The Seattle Partnership for Research on Innovative Therapies, or SPRInT. The alliance allows researchers at Fred Hutch and UW to collaborate with Takeda to accelerate drug discovery.<sup>57</sup>

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*"Investments in research and development, technology and life sciences are essential to a thriving 21st century economy in Pennsylvania. I will continue to prioritize these programs along with making investments in critical services that enhance the quality of life for commonwealth residents and attract businesses."*

*Governor Tom Wolf  
Pennsylvania, October 2018*

50 "Johnson & Johnson Innovation champions leading edge science with 14 new collaborations with potential to impact patients' lives." Jan. 5, 2018. <https://www.jnj.com/media-center/press-releases/johnson-johnson-innovation-champions-leading-edge-science-with-15-new-collaborations-with-potential-to-impact-patients-lives>

51 "Amicus Therapeutics enters research and development collaboration with University of Pennsylvania to develop AAV gene therapies." Oct. 8, 2018. <http://ir.amicusrx.com/news-releases/news-release-details/amicus-therapeutics-enters-research-and-development>

52 "Gene therapy innovators Amicus Therapeutics to join University City's surging biotech sector." The Philadelphia Inquirer. Feb. 26, 2019. <https://www.philly.com/news/amicus-gene-therapy-john-crowley-20190226.html>

53 "MUSC builds partnership to develop and release more biomedical technology. The Post and Courier. Feb. 26, 2019. [https://www.postandcourier.com/features/musc-builds-partnership-to-develop-and-release-more-biomedical-technology/article\\_4aa84574-352e-11e9-b546-2b4b7719e761.html](https://www.postandcourier.com/features/musc-builds-partnership-to-develop-and-release-more-biomedical-technology/article_4aa84574-352e-11e9-b546-2b4b7719e761.html)

54 "Vanderbilt, Boehringer Ingelheim announce partnership to develop therapies for psychiatric disorders." Jan. 3, 2019. <https://news.vanderbilt.edu/2019/01/03/vanderbilt-boehringer-ingelheim-announce-partnership-to-develop-therapies-for-psychiatric-disorders/>

55 "Houston, China to partner on biotech innovation. *Houston Chronicle*. May 15, 2018. <https://www.houstonchronicle.com/business/article/Houston-China-to-partner-on-biotech-innovation-12914224.php>

56 "Merck and Baylor College of Medicine advance vaccine development and manufacturing for neglected diseases." Aug. 8, 2017. <https://www.prnewswire.com/in/news-releases/merck-and-baylor-college-of-medicine-advance-vaccine-development-and-manufacturing-for-neglected-diseases-639181773.html>

57 "Fred Hutch, UW Medicine alliance with Takeda to advance promising early-stage research." Feb. 21, 2018. <https://www.fredhutch.org/en/news/releases/2018/02/fred-hutch-uw-medicine-alliance-with-takeda-to-advance-promising-early-stage-research.html>

# State-based Examples of RETURN ON INVESTMENT (ROI)

**S**tate-level public officials continually consider the balance between funding innovative programs and assuring that those funds will provide benefits to the state's taxpayers. The following examples of Return on Investment (ROI) illustrate the positive benefits of the industry in specific states. These examples provide a glimpse into the continued potential of the industry, as it grows in size and diversity, and the commercial applications in health, agriculture, and industrial biotechnology marketplaces.

## Return on Investment Examples 2016 - 2018

### CALIFORNIA<sup>58</sup>

The life sciences industry provides major contributions to California's economy. The California Life Sciences Association (CLSA) reported that California life sciences companies were responsible for \$22.7 billion in exports and paid \$17.3 billion in federal, state and local taxes in 2016. Other measures of the industry's impact include:

Total Estimated Revenue	\$169.0 billion
Total Estimated Life Sciences Employment	298,709
Total Estimated Wages	\$34.0 billion
Average Annual Life Sciences Industry Wage	\$113,674
Total NIH Grants Awarded, FY2017	\$3.8 billion
Total Estimated Venture Capital Investments, 2017	\$6.7 billion
Federal Taxes	\$11.5 billion
Direct State and Local Taxes	\$5.8 billion
Number of Life Sciences Companies	3,249

As of September 21, 2017, California companies had 1,274 medicines in the pipeline to treat cancer, infectious diseases, immune issues, central nervous system disorders and many other conditions. In addition, California companies received approval for 440 medical devices in 2016.<sup>59</sup>

### GEORGIA

The Georgia Research Alliance (GRA) is a nonprofit, public-private partnership that partners with both the University System of Georgia and Georgia's Department of Economic Development.

Since its formation in 1990, the GRA has leveraged \$600 million of state funding into:

- \$3.8 billion of direct federal and private investment in Georgia
- 150+ newly launched companies
- 6,400+ high-skill, high-value jobs<sup>60</sup>

### INDIANA

The Indiana Biosciences Research Institute was launched in 2013 to accelerate collaboration across and among Indiana's academic and commercial research assets. The State of Indiana provided the initial seed money of \$25 million to create the Institute. This initial investment was matched with funding totaling another \$25 million from Eli Lilly & Company, Dow AgroSciences, Roche Diagnostics, Indiana University Health and the Indiana University School of Medicine.

In 2017, the Indiana General Assembly included an additional \$20 million in the state's two-year budget to accelerate build-out and continued growth of the Indiana Biosciences Research Institute (IBRI). With the state's additional investment, the IBRI is on track to deliver an economic impact of roughly \$400 million over the next ten years.<sup>61</sup>

Overall, the life sciences industry brings \$62 billion in annual economic impact to Indiana.<sup>62</sup>

<sup>58</sup> 2018 California Life Sciences Industry Report. <http://info.califesciences.org/2018report>

<sup>59</sup> 2018 California Life Sciences Industry Report. <http://info.califesciences.org/2018report>

<sup>60</sup> Georgia Research Alliance: Growing Georgia's Technology Economy. <http://www.georgia.org/business-resources/georgia-research-alliance/>

<sup>61</sup> "Indiana General Assembly provides additional \$20 million to accelerate growth of Indiana Biosciences Research Institute." April 24, 2017. <http://www.indianabiosciences.org/news/?newsname=general-assembly-funds-ibri>

<sup>62</sup> Indiana Biosciences Research Institute: 2016 Annual Report. <http://www.indianabiosciences.org/UserFiles/File/IBRI%20Report%202016.pdf>

## MARYLAND

TEDCO was created by the Maryland State Legislature in 1998 to facilitate the transfer and commercialization of technology from Maryland's research universities and federal labs into the marketplace and to assist in the creation and growth of technology-based businesses. TEDCO operates the Maryland Venture Fund, the Maryland Stem Cell Research Fund, and other funds and programs to help growing companies succeed.

The Maryland Stem Cell Research Fund (MSCRF) promotes state-funded stem cell research and cures through grants and loans to public and private entities located throughout Maryland. While the ultimate goal is to develop new medical strategies that utilize human stem cells for prevention, diagnosis, and treatment of human diseases and conditions, the program also provides economic impact for the state.

The MSCRF has created nearly 1,400 jobs and has supported more than \$286 million in statewide economic activity over its ten-year lifespan. For each \$1 invested through grant funding, \$2 in economic value for the state is created.<sup>63</sup>

## MASSACHUSETTS

The Massachusetts Life Sciences Center (MLSC) was created in 2008 to implement a \$1 billion investment in life sciences.

The Massachusetts Life Sciences Center offers up to \$25 million in tax incentives each year to companies engaged in life sciences research and development, commercialization and manufacturing in Massachusetts. The primary goal of the program is to incentivize life sciences companies to create new long-term jobs in Massachusetts. Companies receiving incentives must commit to the creation of a specific number of net new jobs during a specified calendar year and also to the retention of those jobs for a five-year period.

Through June 2016, the MLSC had made 122 Tax Incentive Awards for a total of \$113.9 million. At the end of FY2016, the Tax Incentive Program had resulted in combined net new hire commitments or actual new hires of 5,408 jobs among active and completed awards.<sup>64</sup>

## NORTH CAROLINA

North Carolina's life science industry has significant impacts in driving the state's economy:

- The total economic impact of the state's life science industry exceeded \$86 billion in 2016, rising an impressive 34 percent during the current economic expansion.
- The life science industry generated nearly \$2.2 billion in state and local government tax revenues in 2016, up more than 13 percent from \$1.9 billion in 2010.<sup>65</sup>

Targeted, early-stage loans to life science companies help create and support scientific and business activities in these companies, which has a long-term impact on the state's economy. From the first loans awarded in 1989 through June 2017, the North Carolina Biotechnology Center has invested \$37.9 million in 201 different companies.

Those 201 companies subsequently raised an additional \$3.9 billion in venture capital, private capital, federal grants, licensing and other collaborations, and money raised in public offerings. For every \$1 dollar loaned, North Carolina Biotechnology Center loan recipients raised an average of \$103 dollars after the initial investment.

## TENNESSEE

Bioworks of Memphis, Tennessee is part of a citywide effort to foster economic growth by building on Memphis' strengths and bioscience potential in the medical, agricultural and logistics fields, and is funded through philanthropic contributions, corporate support, and state and federal grants.

Metrics to date include more than \$50 million invested capital in start-ups: 60 companies and 800 jobs created, 1,717 workers trained and 1,087 workers receiving degrees or certifications.<sup>66</sup>

63 "Impact Study: Maryland Stem Cell Research Fund Awards \$140 Million in Support of Research Projects, Generates 1,400 Maryland Jobs. December 19, 2017. <http://tedco.md/press/impact-study-maryland-stem-cell-research-fund-awards-140-million-in-support-of-research-projects-generates-1400-maryland-jobs/>

64 Massachusetts Life Sciences Center Annual Report, Fiscal Year 2016. <http://www.masslifesciences.com/wp-content/uploads/2016-Annual-Report-FINAL.pdf>

65 2016 Evidence and Opportunity: Impact of Life Sciences in North Carolina. <https://www.ncbiotech.org/sites/default/files/inline-files/NCBiotech-FullReport-final-lores%20%281%29.pdf>

66 [www.memphisbioworks.org/2018](http://www.memphisbioworks.org/2018)



*“Our highly trained workforce, top-tier research institutions and 11 medical universities strengthen Texas’ status as a global biotech and life sciences leader”*

*Governor Greg Abbott  
Texas, February 2018*

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*“Thanks to our investments in healthcare, we’re turning New Hampshire into a hub for biotechnology.”*

*Governor Chris Sununu  
New Hampshire, March 2019*

# GLOSSARY

## of Economic Development Tax Support Terms for the Biosciences Sector

**Angel Investor:** An investor who provides financial backing for small startups or entrepreneurs. Angel investors typically invest their own funds, as opposed to venture capitalists who manage pooled money in a professionally managed fund. The capital provided by an angel investor can be a one-time injection of seed money or ongoing support.

**Bioscience Research:** The basic, applied, or translational research that leads to the development of therapeutics, diagnostics, or devices to improve human health or agriculture.

**Business Incubation:** A business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services.

**Business Retention:** The activity that an economic or workforce development agency undertakes in order to reduce the loss of private sector businesses.

**Drug Development Costs:** The total cost of developing a new drug, including studies conducted after regulatory approval. According to a 2012 analysis by the Tufts Center for the Study of Drug Development, the average cost is \$1.2 billion.

**Economic Development:** A process that influences the growth and restructuring of an economy to enhance the economic well-being of a community. Economic development encompasses job creation, increases in community wealth and the improvement of quality of life.

**FDA Review:** The regulatory process by which the U.S. Food and Drug Administration reviews a sponsor company's data from clinical studies to determine if the new product is safe and effective for its intended use.

**Fund of Funds:** An investment strategy of holding a portfolio of other investment funds rather than investing directly in stocks, bonds or other securities. This type of investing is often referred to as multi-manager investment.

**Human Capital:** A measure of the economic value of an employee's skill set, including education, experience, abilities, and productivity.

**Incentives:** Benefits or rewards offered to motivate action. Incentives are often as part of an economic development strategy, including tax abatements and credits, low interest loans, infrastructure improvements, job training and land grants.

**Initial Public Offering (IPO):** The first sale of stock by a company to the public.

**Public-Private Partnership:** A venture which is funded and operated through a partnership between a government entity and one or more private sector companies, usually to finance, build or manage a project for the public good.

**Research and Development (R&D):** Innovative activities undertaken by corporations or governments in developing new services or products, or improving existing services or products.

**Seed Capital:** The funding required to get a new business started. The capital is almost always supplied by an entrepreneur and his/her family, friends and relatives, and it is used to help attract other investments.

**Tax Credit:** The amount of money that can be offset against a tax liability. Tax credits are often used as an incentive to attract new companies and retain existing companies in the state.



*“We are committed to supporting the public-private partnerships and strategic investments that have made Massachusetts a global leader in the life sciences, research, development and medical advancements.”*

*Governor Charlie Baker  
Massachusetts, June 19, 2017*

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**Tax Exemption:** The amount of money that can be subtracted from the assessed market rate. Tax exemptions are often granted to individuals, institutions and types of property.

**Tax Incentives:** The use of various tax relief measures such as tax exemptions, tax credits or tax abatements to recruit and attract businesses to a community or help local businesses expand.

**Technology Incubator:** Often designed for public and private R&D facilities, high-tech companies and science-based companies, a technology incubator is an entity that helps companies by providing necessary resources and support including infrastructure, technology development, research assistance, and assistance in securing funding.

**Technology Transfer:** The process of transferring scientific findings from one organization to another for the purpose of furthering development and commercialization.

**Venture Capital:** Money provided by investors to startup firms and small businesses that have long-term growth potential. Venture capital is an important source of equity for start-up companies.

**Workforce Development:** An economic development approach focused on enhancing the training, skills and performance of the employees.



# CONCLUSION

America's bioscience industry is in every state in the country and continues to actively engage in building bioscience industry infrastructure. As noted in the previous pages, state sponsored programs to encourage investment and help bioscience companies leverage existing resources has been shown to be instrumental in helping these innovative companies and enhance the overall economic prosperity and economic diversity of communities where the bioscience industry is located.

This best practices guide provides examples of state efforts to invest in the fundamental components of early stage research and efforts to encourage outside capital investment. Moreover, it demonstrates the importance of developing a skilled workforce to help create, grow, and retain bioscience companies. Hopefully this report will encourage enhanced state and regional government leadership best practice examples as they explore measures that include the bioscience industry as a key component of their economic development initiatives.



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