

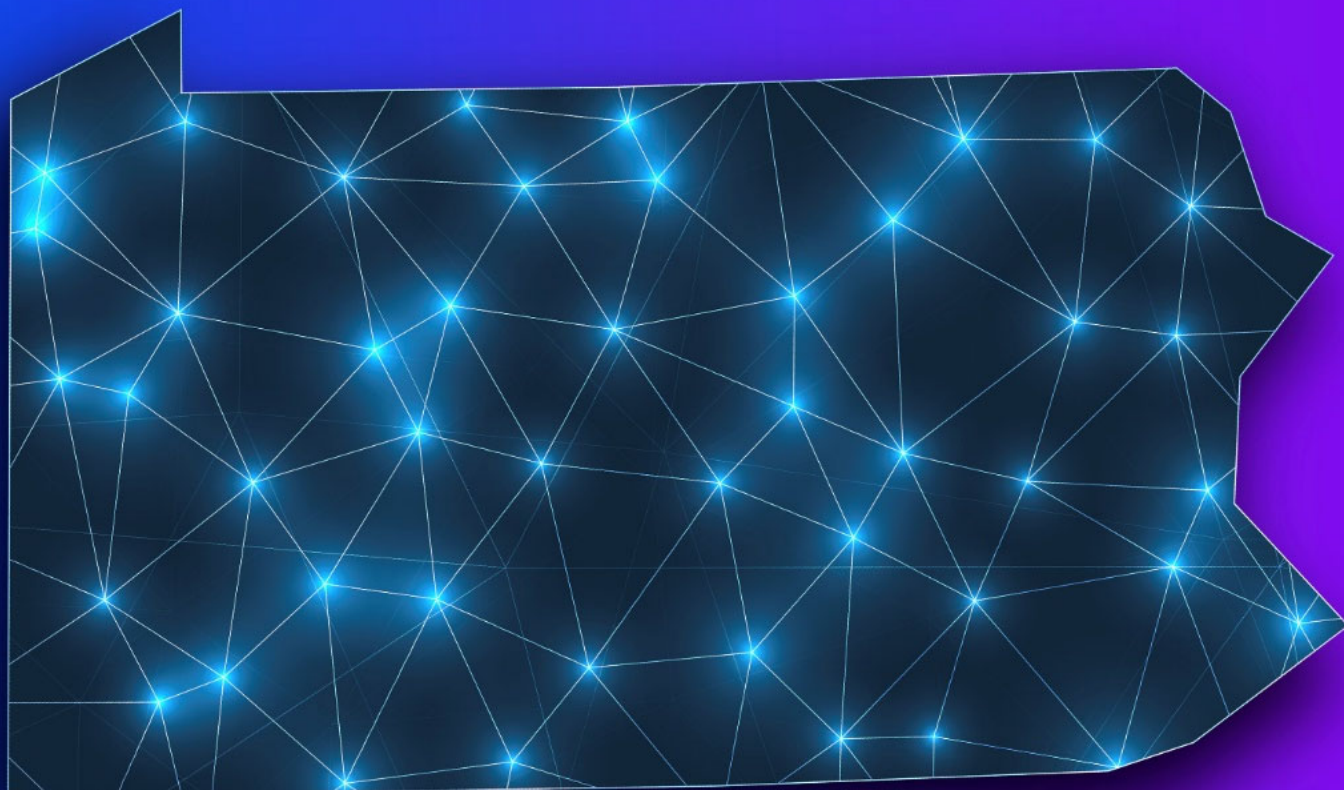


# Pennsylvania Life Sciences Industry

September 2022

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# Prepared for:

## Life Sciences Pennsylvania



Life Sciences Pennsylvania (LSPA) is the statewide trade association for the Commonwealth of Pennsylvania's (Commonwealth) life sciences industry. Founded in 1989, LSPA works to ensure Pennsylvania has a business and public policy climate that makes the Commonwealth of Pennsylvania the most attractive location to open and operate a life sciences company.



LSPA represents biotechnology, medical device, diagnostic, pharmaceutical, research, and investment entities, along with myriad service providers who support the industry. Together, LSPA unifies Pennsylvania's innovators to make the Commonwealth a global life sciences leader.



**Prepared by:**

## KPMG

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KPMG's role is limited to providing the services and deliverables articulated in the scope as defined in our engagement letter with LSPA. KPMG cannot undertake meetings with legislative branch officials or legislative branch employees at any level of government that could be fairly interpreted as public policy advocacy, lobbying, or otherwise be perceived as impairing our objectivity or independence. In no event can KPMG undertake meetings with government officials on behalf of LSPA or otherwise appear in a public or private context that could be fairly interpreted as public policy advocacy, lobbying, or otherwise be perceived as impairing our objectivity or independence. In providing our services in general, KPMG professionals take no view and cannot undertake any role that could be fairly interpreted as public policy advocacy and the firm's work is not intended to be used as such or in that context.

Any advice, recommendation, information, deliverable or other work product provided to LSPA under this contract is for the sole use of LSPA and is not intended to be, and may not be, relied upon by any third party, and all advice, recommendations, information, deliverables, or other work product may be marked to so indicate.

This report is provided as a holistic work to be read and interpreted only in its entirety.

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# Executive summary

The life sciences industry has experienced significant change during the last several years due to the convergence of several trends including rapid technological change, increased research spending, and growing investment in early-stage ventures. These factors combined with changes to life sciences in the wake of the COVID-19 pandemic (pandemic) have led to a noticeable acceleration in industry trends that were underway prior to the pandemic.

Pennsylvania's life sciences ecosystem has made a sizable contribution to the growth and resilience of the Commonwealth's economy during the COVID-19 pandemic. The number of establishments in Pennsylvania doing business in life sciences has increased significantly during the five years ending in 2020: There were 3,009 life sciences establishments<sup>1</sup> in Pennsylvania during 2020<sup>2</sup>, which represents an increase of nearly 17 percent from 2015.

Much as the year 2020 was characterized by the emergence of and response to the pandemic, the year 2021 was transformative for much of Pennsylvania's life sciences industry. Several important indicators of the industry's competitiveness and growth turned higher, including spending on research and development, venture capital investment, and employment at the firms and establishments that form the life sciences ecosystem. Pennsylvania's life sciences industry is leading much of the rest of the U.S. in terms of research and development, as is evident through increased federal research grants, patent applications, new business formation, and entrepreneurship.

The following states identified by LSPA represent Pennsylvania's peer states for the purpose of this study:

- California
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina

This set represents Pennsylvania's peer group because it includes both leading states in the life sciences industry nationally and important regional peer states. Life sciences clusters in these states specialize in research, development, and innovation. These states contain some of the most concentrated centers of life sciences activity.

<sup>1</sup> Establishments are defined as a single physical location at which business is conducted or where services or industrial operations are performed.

<sup>2</sup> The last full year for which data were available at the time of preparation of this report.

A deeper dive into the industry's current state reveals that life sciences hubs within the Commonwealth still face several challenges and bottlenecks, ranging from shortages in wet lab space, difficulties attracting and retaining skilled workers with Good Manufacturing Practice (GMP) experience, and difficulties attracting and retaining executive leadership talent for early-stage ventures.

The purpose of this report is to summarize the contributions of the life sciences industry to the Pennsylvania economy by analyzing industry subsector growth and other indicators of socioeconomic growth. The report also compares Pennsylvania's life sciences industry's growth and development with that of peer states<sup>3</sup>. The data represented in this report are gathered from multiple sources including government agencies, commercial and foundation databases and reports, and industry stakeholder interviews. These data were analyzed and reported by KPMG to measure the contribution of the life sciences industry to the Pennsylvania economy.

Some key findings from this study include the following:

- During the five years between 2015 and 2020, employment in the life sciences industry in Pennsylvania grew by more than 20 percent, which is a higher rate of growth than the U.S. average for the life sciences industry. Notable increases in employment occurred throughout the industry, including growth in the number of businesses with fewer than 100 employees.
- From 2015 through 2020, Pennsylvania's life sciences employment growth rate was highest in the research, testing and medical laboratory subsector, although the drugs and pharmaceuticals, wholesale trade, and medical devices subsectors also saw significant gains.
- Venture capital funding received by Pennsylvania's life sciences industry surged in 2021 after dropping significantly during 2020, the first year of the COVID-19 pandemic.
- In 2021, Pennsylvania received over \$2 billion in funding from the National Institutes of Health (NIH), which was one of the single largest sources of funds received by Pennsylvania's researchers during the year, exceeding the totals for state and local government and institutional sources of funds.
- Pennsylvania is home to two of the top-100 research universities globally in terms of life sciences and medicine research, according to the 2021 Shanghai Index. In addition, Pennsylvania ranked fourth in the U.S. in terms of statewide academic spending on research and development.
- From 2018 to 2021, the number of clinical trials sponsored by companies with facilities and/or headquarters in Pennsylvania increased by approximately 50 percent. In addition, during 2021 there were more than 90 clinical trials underway in Pennsylvania involving Orphan Drugs.<sup>4</sup>
- The life sciences industry directly employed more than 100,000 in Pennsylvania during 2020. When considering the indirect and induced contributions of the industry, the industry is estimated to be responsible for supporting an additional 230,000 jobs.
- Pennsylvania is responsible for a larger share of life sciences graduates when compared to peer states: The Commonwealth ranked third in terms of the number of life sciences degrees awarded among the peer states.

The remainder of this report is broken down into different subject areas detailing the life sciences industry's impact on funding, research, economic contribution, and academia in Pennsylvania. An overview of recent trends evolving within Pennsylvania's life sciences industry is also discussed.

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<sup>3</sup> LSPA identified the peer states of Pennsylvania as California, Massachusetts, Maryland, New Jersey, New York, and North Carolina.

<sup>4</sup> The FDA defines an Orphan Drug as a drug intended to prevent, diagnose, or treat a rare disease or condition.

# Life Sciences industry

As defined in this study, the life sciences industry encompasses not only human health-related services and technology (biotechnology, pharmaceuticals, and medical devices) but also industries related to development and application of science and new technologies to improving human health. Establishments operating in life sciences are engaged in the research and development, manufacturing and commercialization of products and services that advance or improve human health.<sup>5</sup>

There is no official definition of life sciences for purposes of measuring activity or economic contribution at the local, regional, or national levels. This report utilizes industry categories as defined by the North American Industry Classification System (NAICS)<sup>6</sup> that contribute to innovation and the improvement of human health to create a consistent definition of life sciences that reflects the industry's unique contours in Pennsylvania.

Individual NAICS codes that are related to innovation and the improvement of human health are grouped into several broad categories, including drugs and pharmaceuticals; medical devices and equipment; research, testing, and medical laboratories; and wholesale trade. The full list of NAICS codes used in the definition of life sciences for the purpose of this report is in the Methodology Appendix.

Artificial intelligence, machine learning, individualized medicine, health data management, and wearable medical devices are all emerging industry segments within life sciences. This 'digital health' cluster is a rapidly growing subsector of the life sciences industry that utilizes software, personalized health data, and machine learning technologies to improve human health, reduce costs, and/or improve quality of service within healthcare.<sup>7</sup> While this is an increasingly important aspect of the life sciences industry, there are not currently separately identifiable digital health industry codes within the NAICS classification framework. Instead, the digital health industry must be accounted for based upon allocation of existing NAICS industry codes in which digital health activities are currently classified, such as computer software and related industries. Due to insufficient detail available in the NAICS classification system to reliably estimate the portion of these industries that is attributable to digital health, it is excluded from the Pennsylvania life sciences industry definition for the purposes of this report. We note that this approach is generally consistent with industry practice at time of preparation of this report.

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<sup>5</sup>Source: 'What is Biotechnology?', Biotechnology Innovation Organization website, as accessed on March 20, 2022; 'life sciences Ontario Sector Report 2015', 2015, life sciences Ontario, as accessed on March 20, 2022.

<sup>6</sup> NAICS is the standard industrial classification system used by Federal agencies for classifying businesses in the U.S. NAICS was developed by the Office of Management and Budget.

<sup>7</sup> For additional information see the FDA's article "What is Digital Health?", available online at <https://www.fda.gov/medical-devices/digital-health-center-excellence/what-digital-health>.

# Pennsylvania Life Sciences snapshot

Despite challenges posed by the COVID-19 pandemic in 2020 and 2021, Pennsylvania's life sciences industry remains a source of new ideas, products, and steady job growth, as well as a source of growth for the overall state economy through the industry's indirect and induced economic contributions.

All major subsectors of Pennsylvania's life sciences industry (except for wholesale trade) increased their concentration of employment in Pennsylvania compared to the U.S. average during the five years between 2015 and 2020. This is evidence of the industry's relatively greater resilience throughout the pandemic and the return on investment in the life sciences workforce in Pennsylvania.

Pennsylvania's life sciences industry forms a major component of the Commonwealth's industrial structure. This can be seen in the location quotient<sup>8</sup> of 1.22 calculated for 2020, as shown in Table 1. The Commonwealth's location quotient is greater than 1.0, indicating that a greater relative share of total employment is attributable to life sciences than the average for the U.S. as whole. Table 1 also shows that Pennsylvania's drugs and pharmaceuticals sector, with its location quotient of 1.62, has the greatest relative concentration compared to the other industry subsectors.

**Table 1: Life Sciences Location Quotient Analysis**

Industry (Subsector)	2015	2020
Drugs & Pharmaceuticals	1.59	1.62
Medical Devices & Equipment	0.99	1.02
Research, Testing, and Medical Laboratories	1.15	1.34
Wholesale Trade	0.93	0.84
<b>Life Sciences Total</b>	<b>1.14</b>	<b>1.22</b>

*Source: KPMG analysis of Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics.*

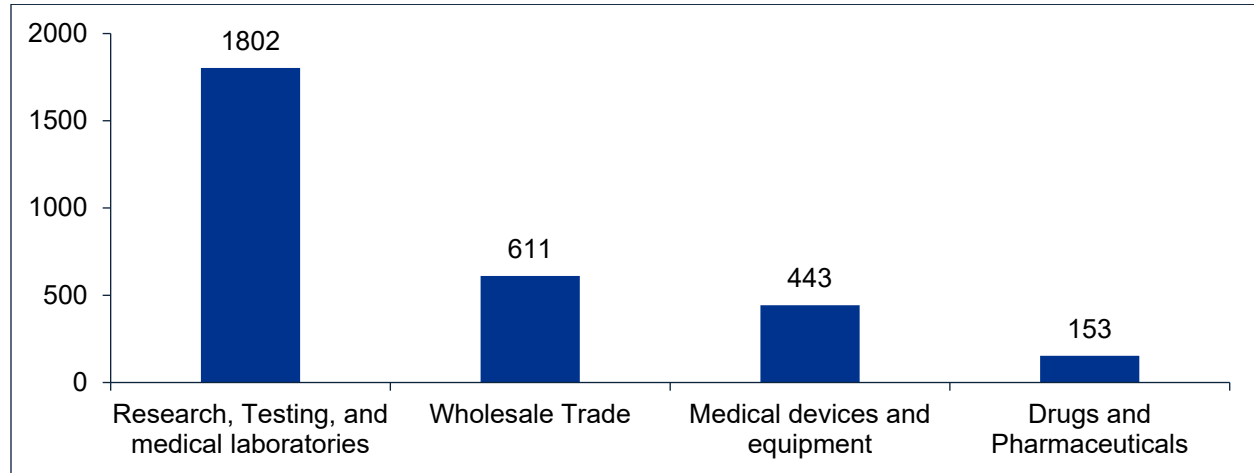
The life sciences industry's foundation rests upon the cornerstone of small businesses, which account for most life sciences establishments and firms within the Commonwealth. Pennsylvania's life sciences industry also depends critically upon the contribution to innovation, research, and education at the world-class research institutions that anchor these clusters within the Commonwealth.

<sup>8</sup> A location quotient is used to measure the relative concentration of an industry in a geographic region, with a larger location quotient indicating a greater relative concentration. If the location quotient value is greater than 1.0, this indicates the geographic region has a larger relative share than the benchmark (United States). The location quotients included in this report are calculated based on employment data from the U.S. Bureau of Labor Statistics.



Figure 1 shows the breakdown of establishments by industry subsector. As of 2020, approximately 1,802 establishments operated in the research, testing, and medical laboratories subsector, making it the single largest industry subsector.

**Figure 1: Life Sciences Establishments in Pennsylvania by Industry Sub-Sector in 2020**

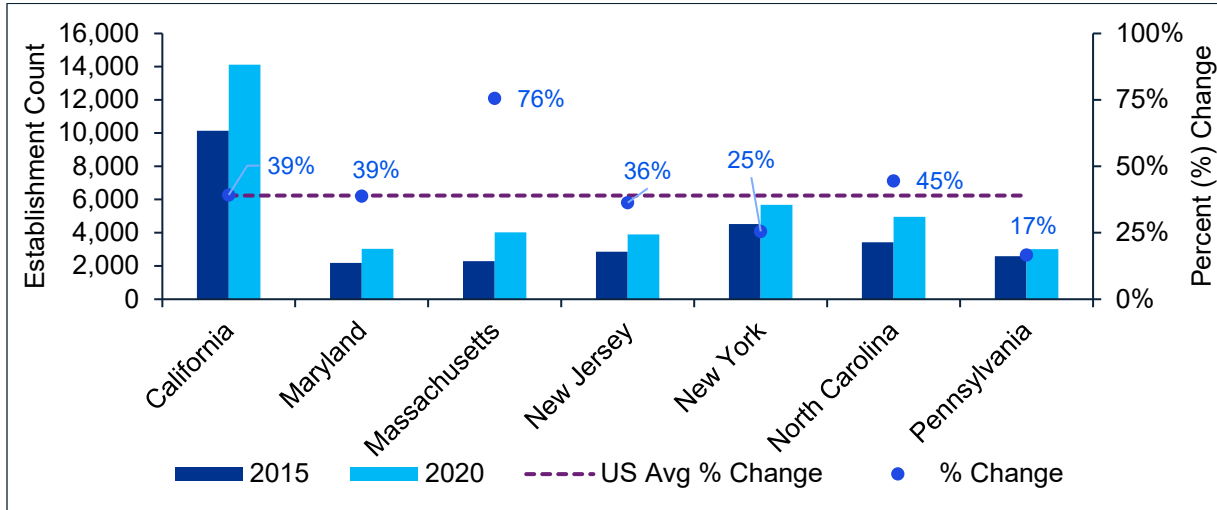


*Source: KPMG analysis of Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics.*

Figure 2 shows total establishments in Pennsylvania relative to the count in peer states. In 2015, there were a total of 2,580 life sciences establishments (or individual locations of business or commercial activity) in Pennsylvania. That number grew by nearly 17 percent to 3,009 in 2020. Figure 2 shows that the rate of growth in Pennsylvania is lower than the U.S. average but is comparable to the rate of change in peer states' life sciences establishments.

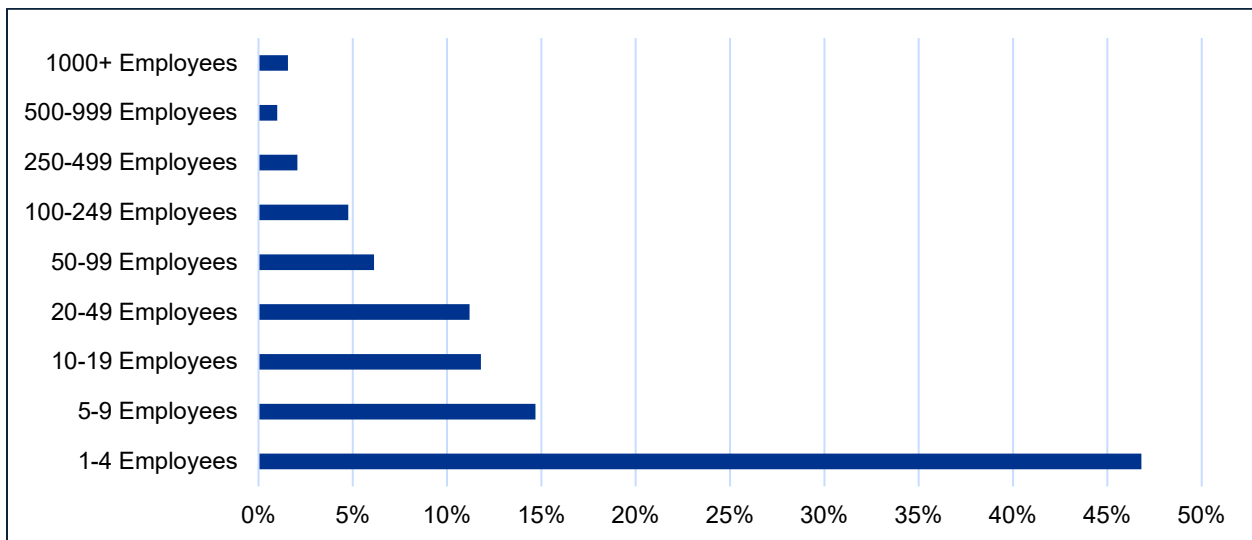
In recent years, growth in life sciences across Pennsylvania has been accompanied by the formation of smaller firms and establishments with less than 100 employees. Figure 3 shows the breakdown based on number of employees. In 2019 alone, more than 60 percent of life sciences establishments had fewer than 10 employees. Establishments with 500 to 999 employees and establishments with over 1,000 employees accounted for lower shares of the industry employment, making up only approximately 1.0 percent and 1.6 percent of the number of establishments in Pennsylvania, respectively.

**Figure 2: Establishment Count and Percent Change in the U.S. and Peer States – Comparing 2015 to 2020**



Source: KPMG analysis of Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics.

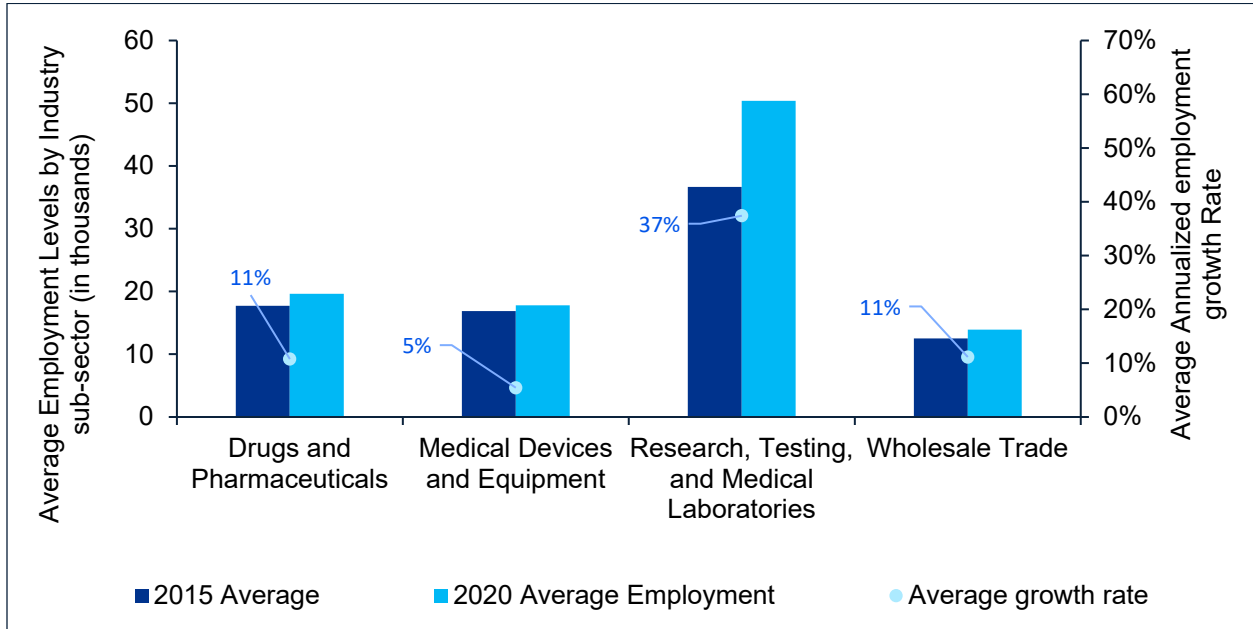
**Figure 3: Life Sciences Establishments in Pennsylvania by Number of Employees in 2019**



Source: U.S. Census Bureau, 2019

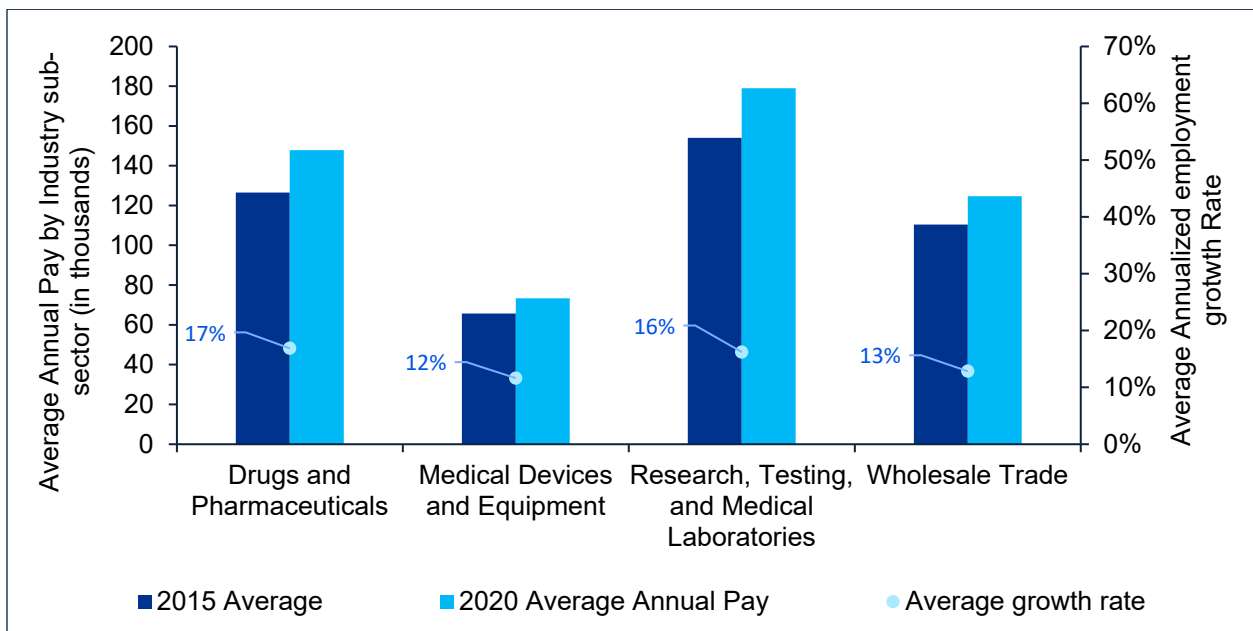
Figure 4 and Figure 5 show that the single largest subsector of the Pennsylvania life sciences industry is the research, testing, and medical laboratories sector, which had an average employment level of 50,389 in 2020 and was the fastest-growing subsector over the prior five-year period. This subsector also saw strong growth in average annual wages, which increased by more than 40 percent to \$178,930 in 2020. Each subsector of the life sciences industry had average annualized pay growth ranging from 13 percent to 17 percent.

**Figure 4: Average Employment Level and Average Annualized Employment Growth Across Industry from 2015 to 2020**



Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics

**Figure 5: Average Annual Pay and Average Annualized Annual Pay Growth Across Industry in Pennsylvania’s Life Sciences from 2015 and 2020**



Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics

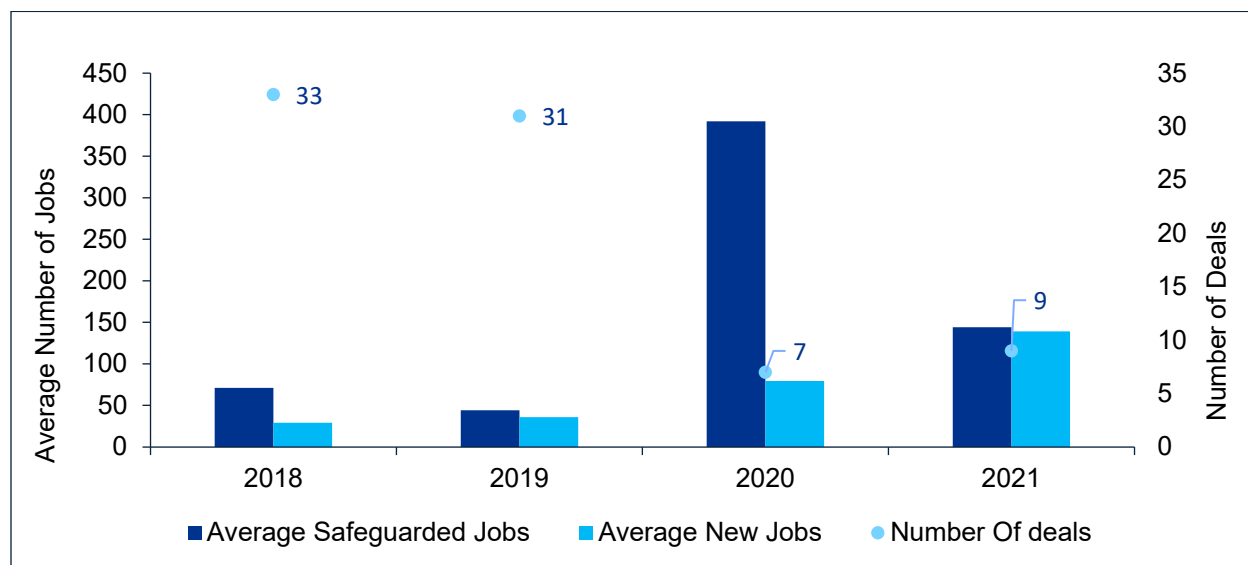
Over the last few years, gains in life sciences employment in Pennsylvania were driven partially by hiring activities of relocating and expanding companies. Wavteq<sup>9</sup>—a Foreign Direct Investment consulting firm—records deals in which companies were offered various incentives in order to expand current

<sup>9</sup> Economic Development Incentives Platform | Incentive. Wavteq.com.

business or start new business operations.<sup>10</sup> These incentivized expansion, retention, or new project deals create both new job opportunities for employees and, when they are made by existing firms, help safeguard existing jobs for current employees.<sup>11</sup>

Figure 6 and Figure 7 visualize the results from the Wavteq data, which measure jobs among life sciences firms that relocated or expanded during the period and benefited from tax incentives. From 2018 to 2021 approximately 3,878 new jobs were created, and 7,755 jobs were safeguarded in the life sciences industry in Pennsylvania.<sup>12</sup> Most of these projects (76 percent) were expansionary and took place in the research and development in biotechnology, pharmaceutical preparations, and medical equipment and supplies manufacturing subsectors.

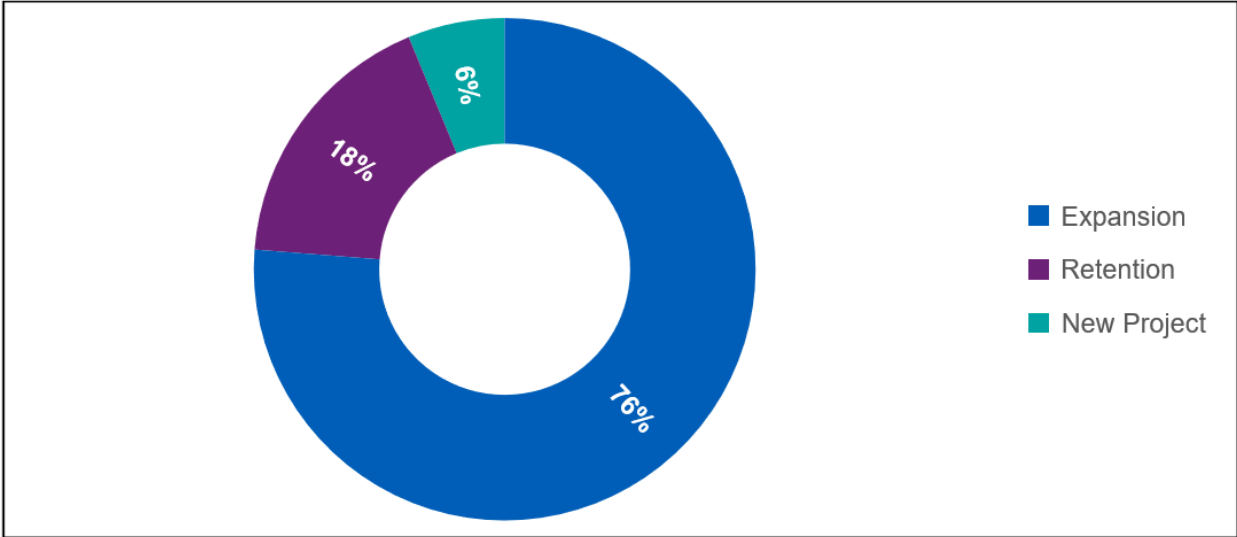
**Figure 6: Average Number of Jobs – New and Safeguarded – and Deals in Pennsylvania from 2018 to 2021**



Source: Wavteq

<sup>10</sup> Different incentives include tax rebates, a grant or subsidy, a loan or credit, and other non-financial incentives such as infrastructure development.  
<sup>11</sup> Expansion is a project that works to expand the reach of the company. Retention is a project seeking to retain employment at the company.  
<sup>12</sup> These job creation figures represent gross counts for the subset of businesses that relocated or expanded during the period of analysis and utilized incentives.

Figure 7: Types of Incentive-Based Deals and Related Projects



Source: Wavteq

# Commonwealth support

The Commonwealth of Pennsylvania offers several incentive programs that are often utilized by companies in the life sciences industry, including Research and Development Tax Credits and Keystone Innovation Zones. In addition, the Commonwealth has specific appropriations in its budget specifically focused on life sciences and other high-tech, industries including the life sciences Greenhouse Incentive and the Ben Franklin Technology Development Authority Fund. The Commonwealth also offers additional support in the form of a dedicated agency focused on supporting companies in the life sciences industry (Department of Community and Economic Development). Table 2 provides additional detail on Pennsylvania incentive programs, recipients, and proposed costs.

California, New York, Massachusetts, and New Jersey are often evaluated in conjunction with Pennsylvania due to their large life sciences industry presence. Each of these states has R&D<sup>13</sup> tax credits that are often utilized by life sciences companies. Massachusetts has a similar approach to Pennsylvania as they both provide strong support in the form of a dedicated agency and a legislative act to appropriate funding support in the form of incentives at the discretion of the governor’s budget. New York, New Jersey, and California utilize a different approach to support companies in this industry. These states have designated incentive programs in the form of grants and tax credits, which may be enhanced for companies in the life sciences industry. While both approaches have their benefits, Pennsylvania’s commitment to the life sciences industry is evident in its focus on continual funding and a variety of incentive programs.

**Table 2: Commonwealth of Pennsylvania Incentive Programs**

Program name	Program description	Estimated beneficiaries	Proposed budget (\$ in millions)
R&D Tax Credit	A statutory credit in the amount of 10.0 percent of increase in qualified research expenditures	1,150 companies annually	\$55.0
Life Sciences Greenhouse Initiative	A special appropriation fund to promote early-stage risk capital and catalyst development and creation of new life sciences-related products and companies	30 life sciences companies	\$3.0
Ben Franklin Technology Development Authority Fund	A special appropriation fund to promote entrepreneurial business environment, advance technology innovation, and create technology ready workforce	Not Available	\$17.0
Keystone Innovation Zones	A statutory tax credit offered to targeted industries (including life sciences) in an amount derived in the zone over the previous two years, subject to limitations	220 life sciences companies, annually	\$15.0
PA First	A discretionary cash grant awarded to promote job creation and capital investment in the Commonwealth	Not Available	\$20.0

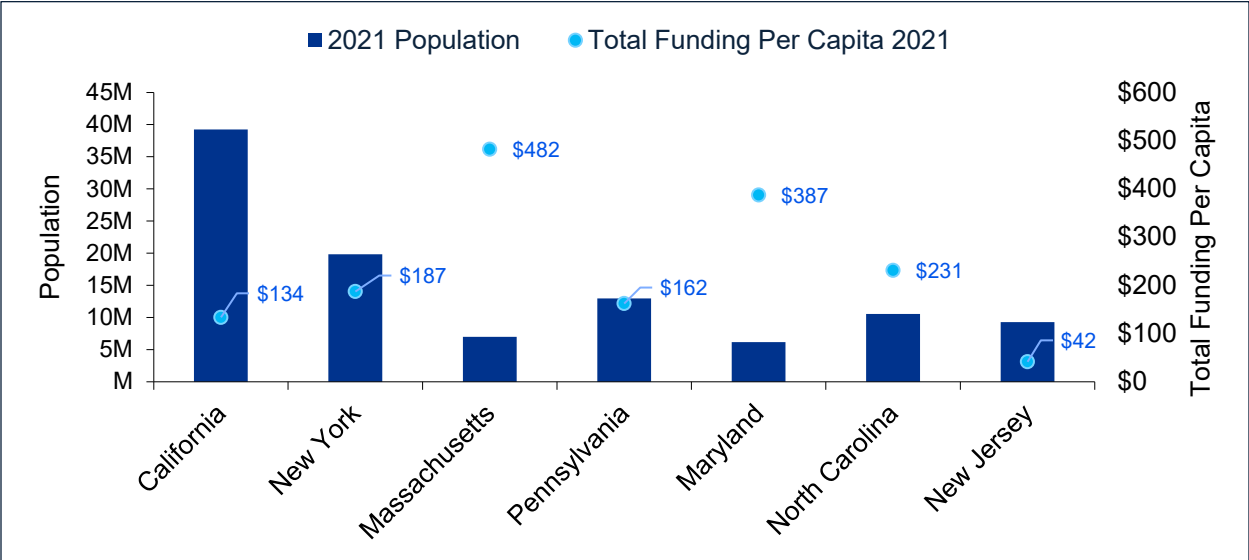
<sup>13</sup> Research and Development

# Research excellence

## Research and development

To offer a normalized perspective of funding between states of different populations, Figure 8 below shows the total National Science Foundation (NSF) and NIH funding per capita based on the 2021 population in each state. Pennsylvania's funding per capita hovers just behind those of California and New York but above those of North Carolina, New Jersey, and Massachusetts.

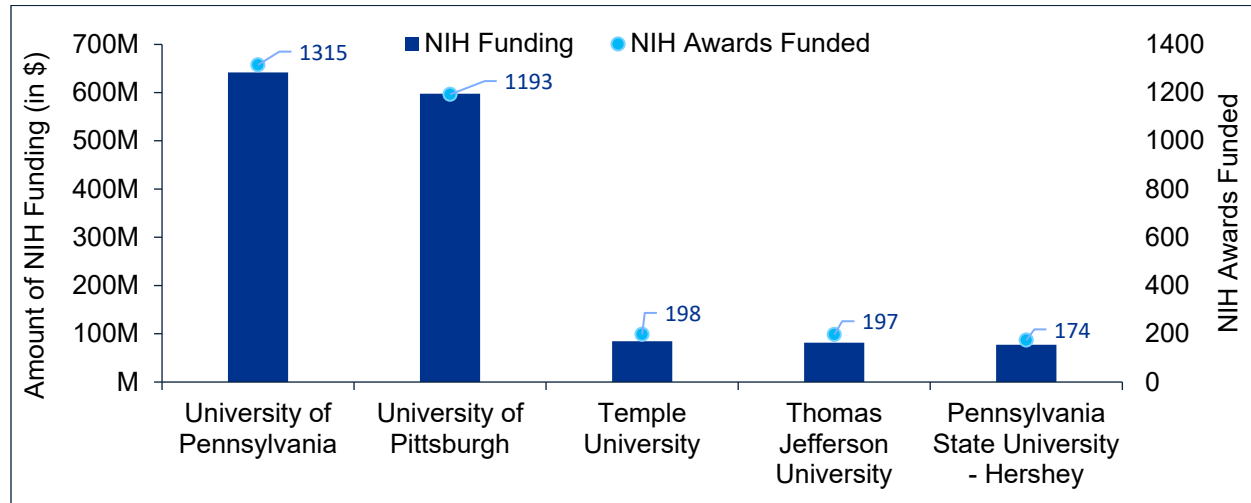
Figure 8: Total NSF and NIH Funding (FY 2021) Per Capita Based on 2021 Population



Source: Funding data from NIH and NSF, population data from the U.S. Census, 2021.

Like other states, much of Pennsylvania’s NIH funding can be attributed to university recipients. In fiscal year 2021, Pennsylvania received over \$2 billion in NIH funding, \$641 million of which was awarded to the University of Pennsylvania in 1,315 awards.

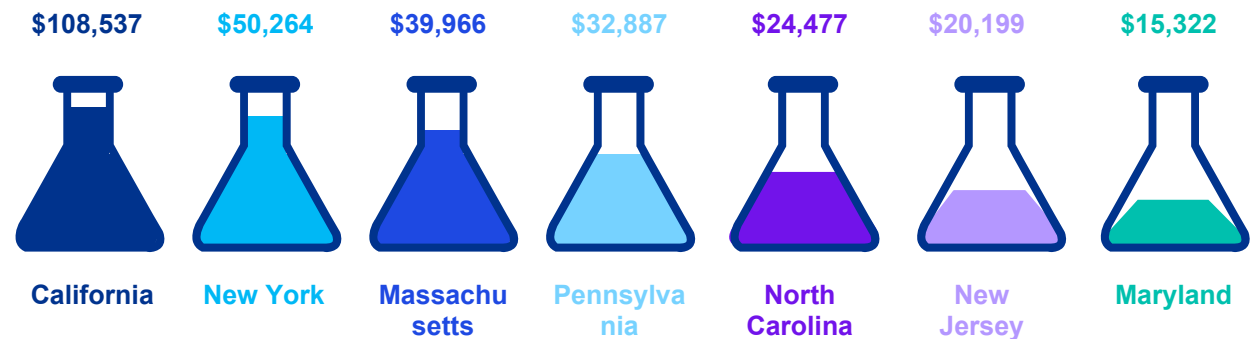
**Figure 9: Top Five Pennsylvania Universities that Received NIH Funding by Amount and Number of Awards in FY 2021**



Source: National Institutes of Health (NIH), FY 2021

In fiscal year 2021, establishments in Pennsylvania received \$32.9 million in funding from the NSF. In addition to being one of the highest NSF funded states, Pennsylvania had an NSF funding rate<sup>14</sup> in FY 2021 that was on par with funding rates of the leading peer states. Figure 10 shows the NSF grants by state and Figure 11 shows the funding rate.

**Figure 10: NSF Research Grants by State in FY 2021 (thousands of dollars)**

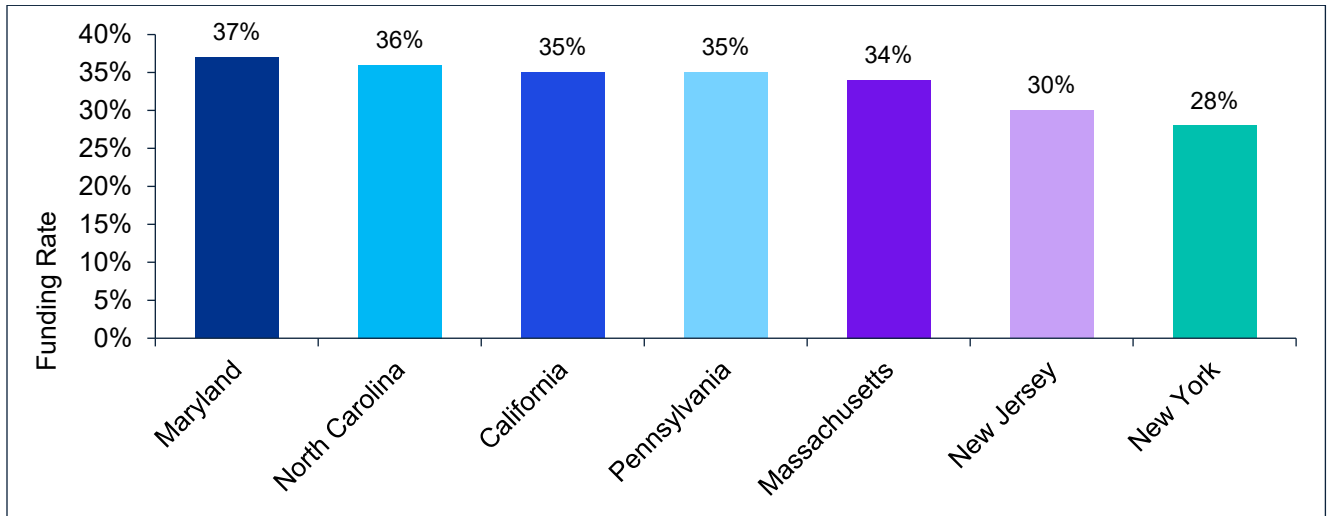


Source: National Science Foundation Awards funded or managed by the Department of Biological Sciences, FY 2021.

<sup>14</sup> The funding rate, sometimes referred to as “success rate,” is calculated by the number of competitive awards made during a year divided by the number of total proposals competitively reviewed.



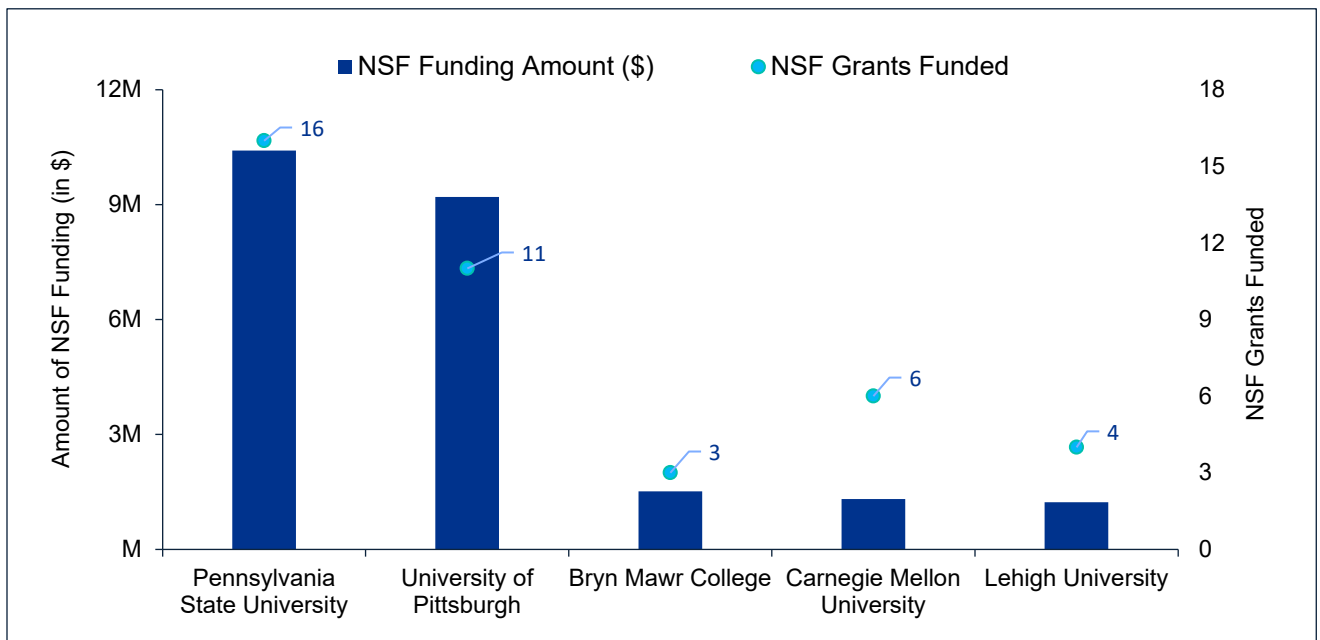
**Figure 11: NSF Research Grants Funding Rates by State in FY 2021**



Source: National Science Foundation, Department of Biological Sciences, FY 2021. Note: Peer states selected by LSPA.

Pennsylvania universities received a significant amount in NSF funding. In fiscal year 2021, the total NSF funding attributed to universities sums to \$32.7 million. Figure 12 shows the top five universities that received NSF funding.

**Figure 12: Top Five Pennsylvania Universities that Received NSF Funding by Amount and Number of Grants in FY 2021**

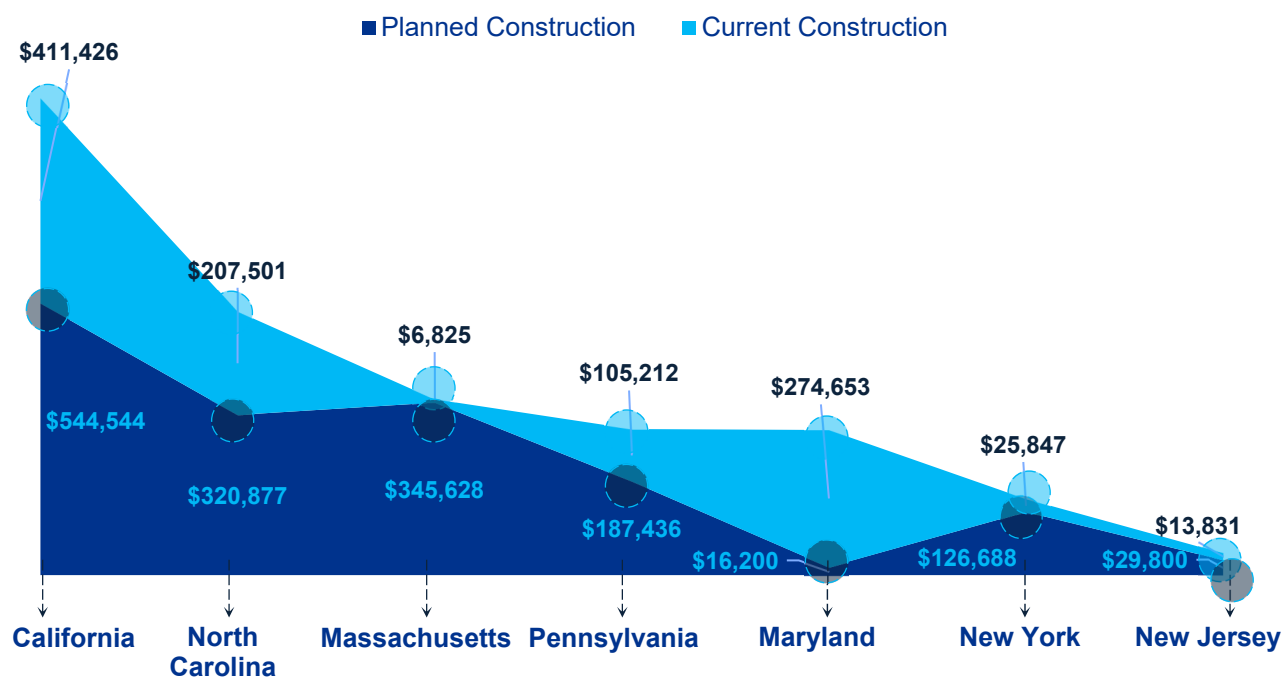


Source: National Science Foundation (NSF), FY 2021

## Facilities

There are many inputs necessary to carry out research in the life sciences industry. Some of the most important are research funding (e.g., direct spend and grants) and research space. As seen earlier in this report, compared to peer states, Pennsylvania receives a larger amount of both NSF and NIH funding in a typical year. To accommodate their continued growth, as of 2019, Pennsylvania is also currently constructing or planning to construct nearly 300,000 square feet (sq ft) of research space. When looking at pending research space, Pennsylvania is ranked in the middle of its peer states with California holding the largest amount of pending research space (over 950,000 sq ft) and New Jersey with the least (43,000 sq ft). Figure 13 below shows the planned and current construction of research spaces for Pennsylvania and each peer state.

**Figure 13: Amount of Pending Research Space (Planned for or Currently Under Construction) in the Life Sciences Industry by State in 2019<sup>15</sup>**

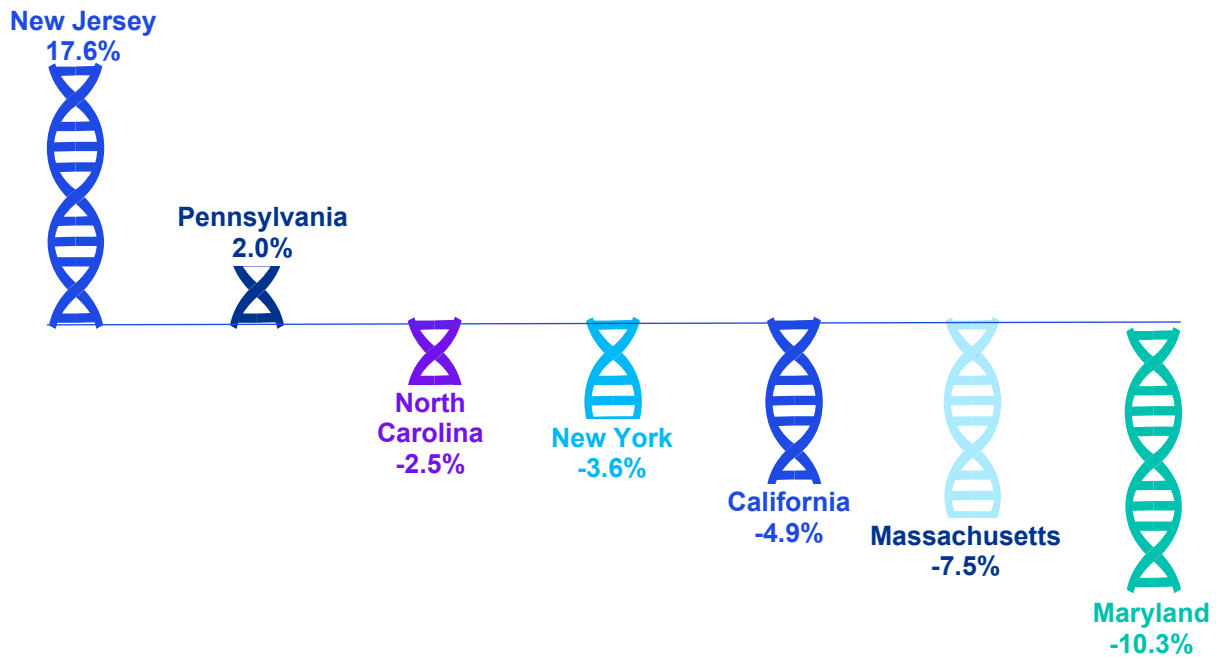


Source: National Center for Science and Engineering Statistics, 2019. Note: Amounts are cumulative.

Many life sciences companies need lab space to grow and expand, especially companies in the research and development or laboratory testing sectors. Figure 14 shows that from 2017 to 2019 in Pennsylvania, research space has increased while many other peer states registered a net decrease.

<sup>15</sup> These values are in square feet of research space.

Figure 14: Percent Change in Usage of Research Space at Institutions by State from 2017 to 2019



Source: National Center for Science and Engineering Statistics, 2017 & 2019.

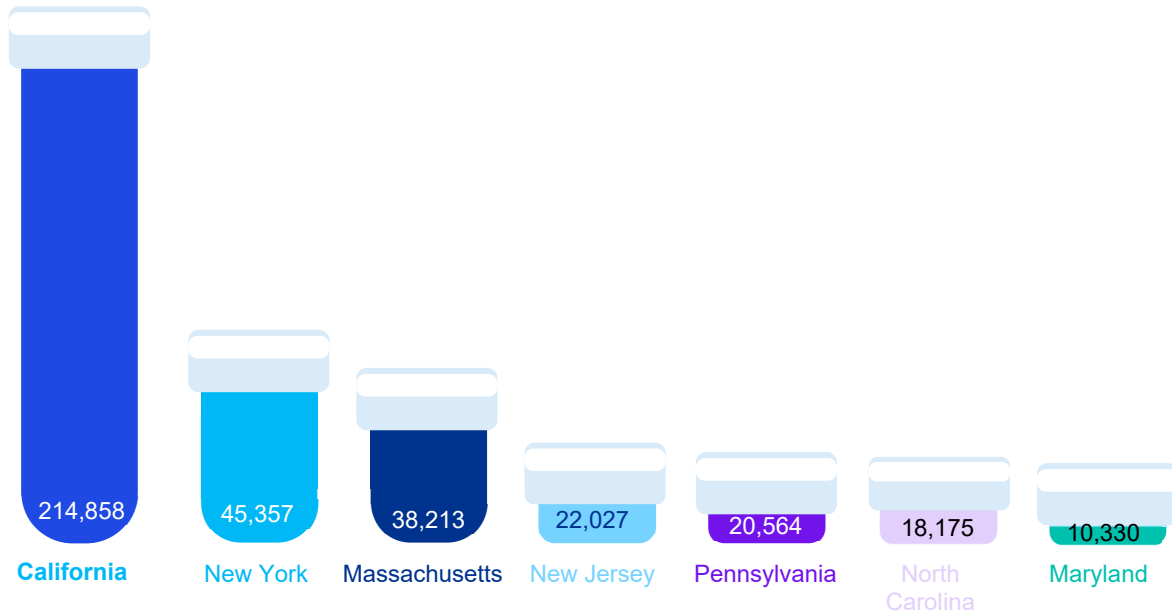
## Patents

As of 2020, Pennsylvania establishments have also issued a substantial number of life sciences-related patents. Since there is no specific designation to identify a life sciences patent, a measure of utility patents is developed as a proxy for the following analyses.

- From 2016 to 2020, Pennsylvania establishments have issued 20,564 life sciences patents.
- In 2020, life sciences patents in Pennsylvania were issued at a rate of 16 patents per 1000 individuals in a science or engineering occupation, an increase of about 9 percent from 2016. This suggests that some improvement may have occurred in the pathways connecting research and ideation with commercial application.

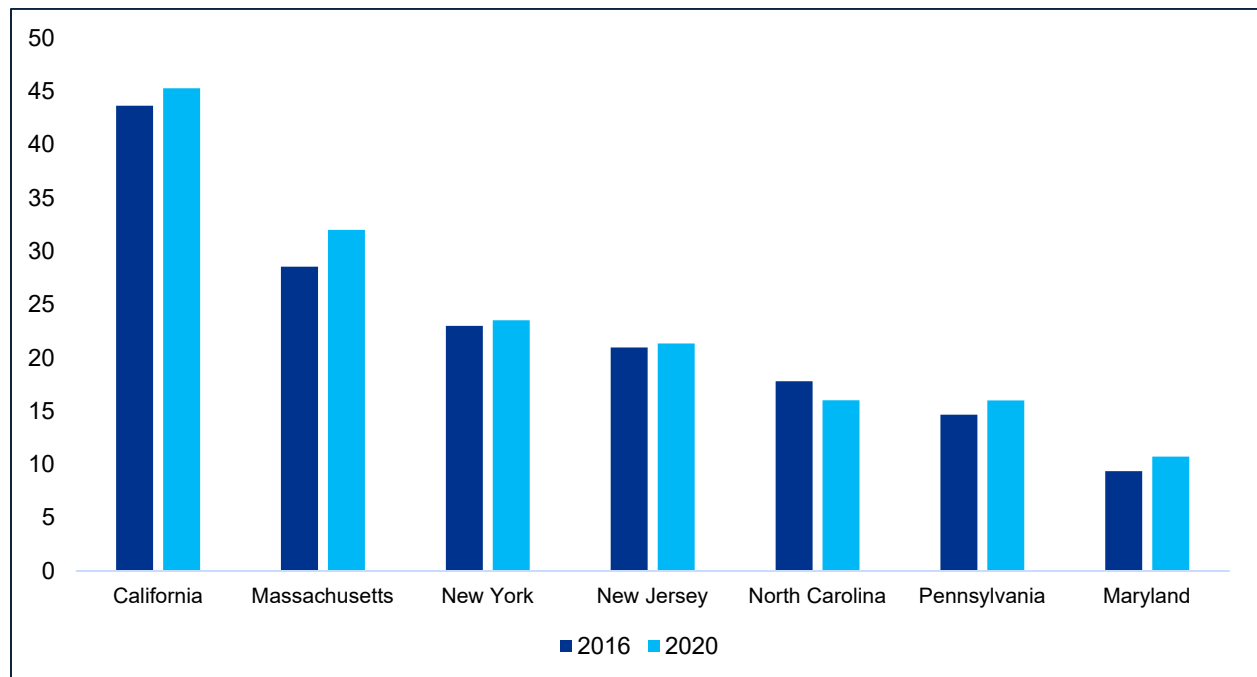
Pennsylvania’s rate of increase in patent issuances was comparable to peer states. Figure 15 shows the utility patent total and Figure 16 shows the patents awarded per capita in science and engineering occupations (a normalized level of issuance).

**Figure 15: Total Number of Utility Patents Issued by State in 2016 to 2020**



Source: Total number of utility patents according to the United States Patent and Trademark Office (USPTO) from Calendar Years 2016—2020.

**Figure 16: Patents Awarded per 1,000 Individuals in Science and Engineering Occupations for 2016 and 2020**



Source: National Science Foundation’s Science and Engineering State Indicators, 2016 and 2020. Note: Peer states selected by LSPA.

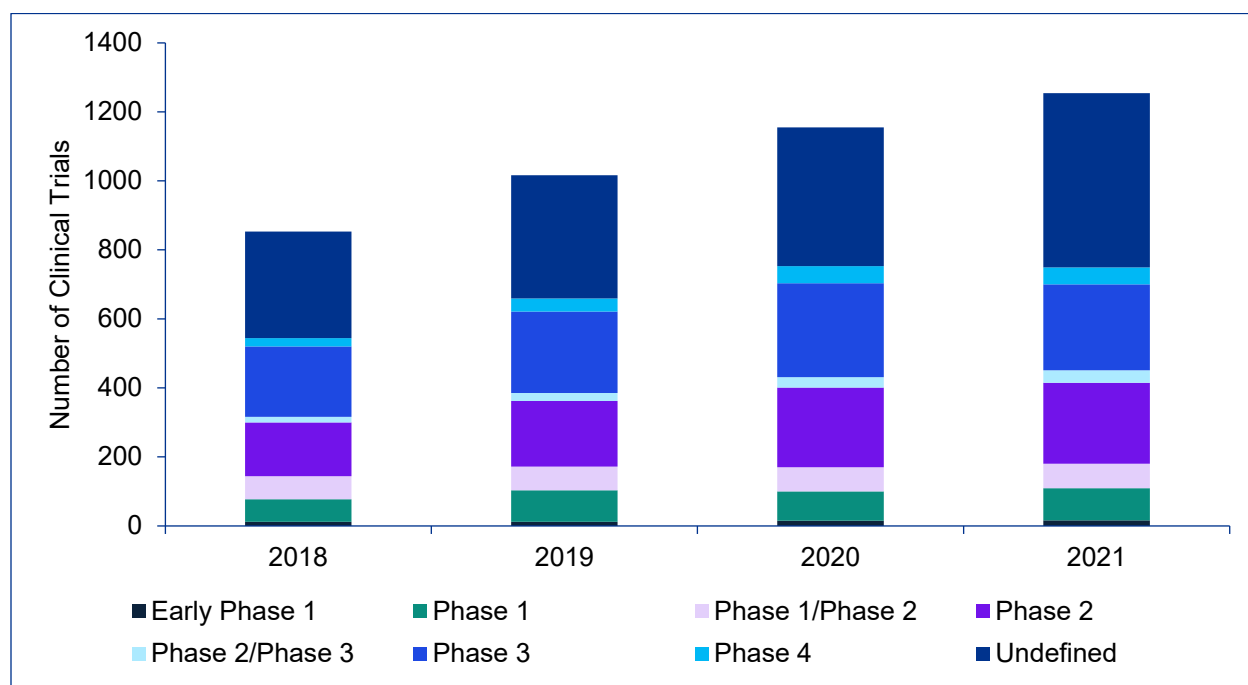
## Clinical trials

Much of the life sciences research in Pennsylvania centers on the development and investigation of new drugs. Figure 17 and Figure 18 show data for Pennsylvania clinical trials broken down by current phase of the clinical trial. The undefined category refers to trials that did not specify a phase. The following observations were made on clinical trials as of 2021 year-end.

- A total of 347 trials were carried out by companies that have their headquarters in Pennsylvania<sup>16</sup>
- A total of 907 were carried out by companies that have a facility in Pennsylvania<sup>17</sup> (but may be headquartered elsewhere)
- Among companies sponsoring trials, 248 companies both had headquarters and facilities in Pennsylvania.
- Further, of the active Pharmaceutical and Medical Technology companies headquartered in Pennsylvania, approximately 84 percent are private companies (Figure 19).<sup>18</sup>
- In Pennsylvania, out of the active clinical trials, work is currently being done on 93 orphan drugs (Figure 20).

These data points indicate that Pennsylvania remains a sought-after location for research and development among life sciences companies headquartered or operating in the region.

**Figure 17: Clinical Trials for Companies with Facilities or Headquarters in Pennsylvania as from 2018 to 2021**



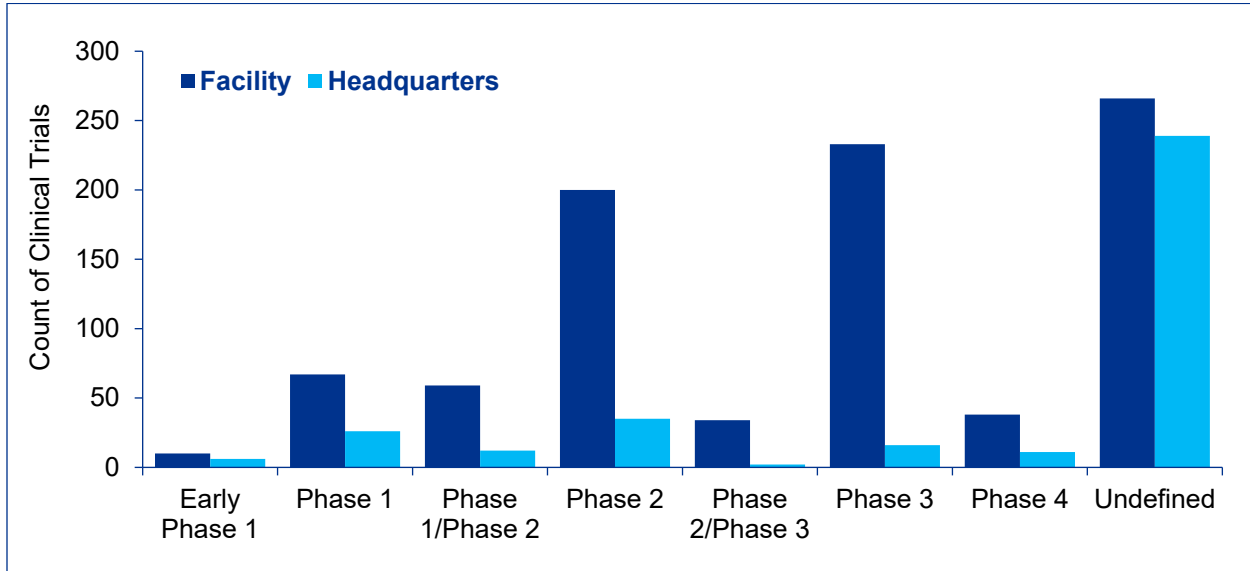
Source: Evaluate Pharma, *Clinical Trials Report—Companies in PA*; March 22, 2022. and Evaluate Pharma, *Clinical Trials Report—Sites in PA*; March 22, 2022.

<sup>16</sup> Evaluate Pharma, *Clinical Trials Report—Companies in PA*, March 22, 2022.

<sup>17</sup> Evaluate Pharma, *Clinical Trials Report—Sites in PA*, March 22, 2022.

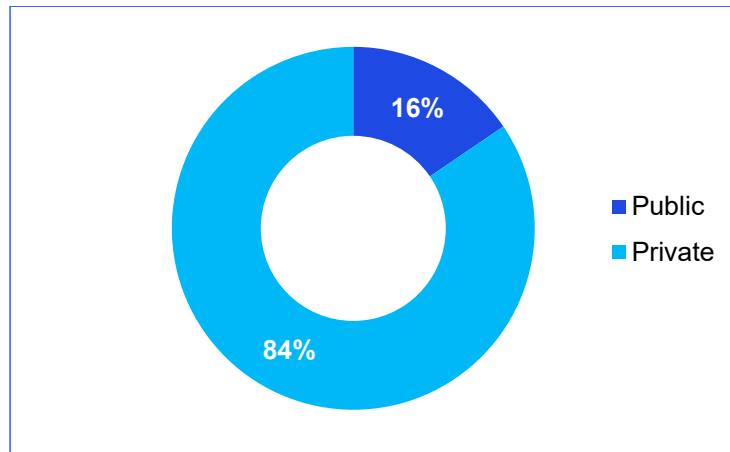
<sup>18</sup> Evaluate Pharma, *Company Profile Information*, March 22, 2022.

**Figure 18: Clinical Trials for Companies with Facilities or Headquarters in Pennsylvania in 2021 by Phase**



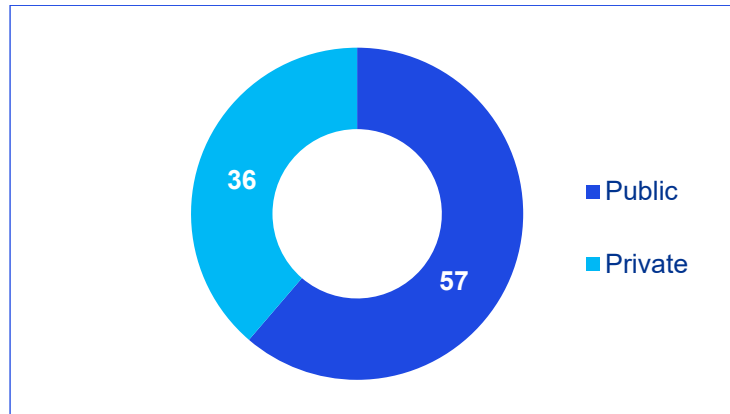
Source: Evaluate Pharma, Company Profile Information, March 22, 2022

**Figure 19: Pharmaceutical and Medical Technology Companies Headquartered in Pennsylvania as of 2021**



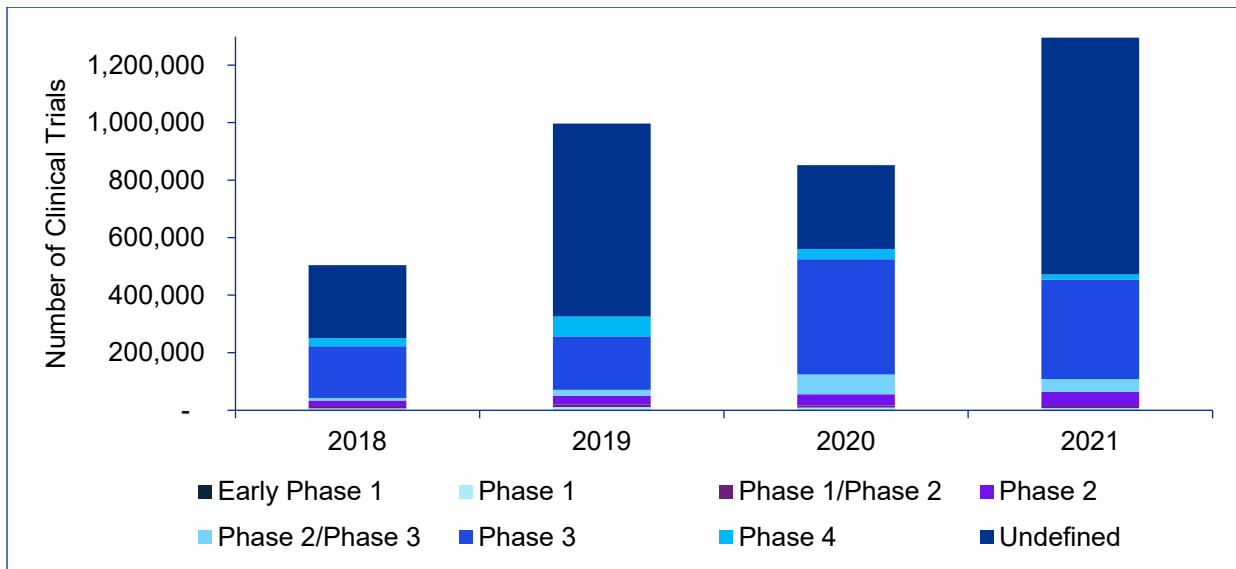
Source: Evaluate Pharma, Company Profile Information, March 22, 2022

**Figure 20: Orphan Designation Count (USA OD) as of 2021**



Source: Evaluate Pharma, Company Profile Information, March 22, 2022

**Figure 21: Enrollment in Clinical Trials by Companies with Facilities or Headquarters in Pennsylvania from 2018 to 2021**



Source: Evaluate Pharma, Clinical Trials Report—Companies in PA; March 22, 2022. and Evaluate Pharma, Clinical Trials Report—Sites in PA, March 22, 2022. Clinical Decision Support for Opioid Use Disorders in Medical Settings (COMPUTE 2.0) trial removed from 2019 to adjust for a normalized trend.

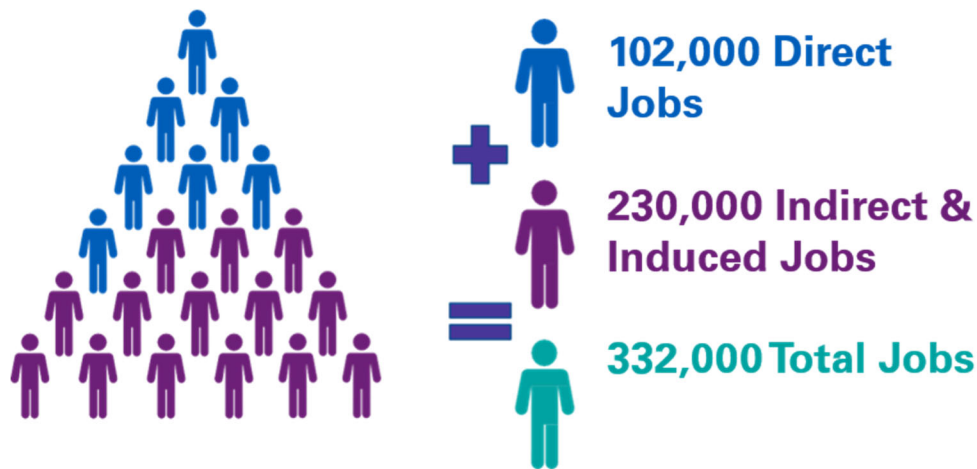
# Economic contribution

In addition to its role driving development of innovative drugs, encouraging emerging intellectual property, and leading world-class academic institutions, the life sciences industry is an integral component of the Pennsylvania economy. This section provides estimates of the economic impact that the life sciences industry brought to the Commonwealth in 2020.

Economic impact analysis recognizes the interdependence among different sectors of the economy by quantifying the direct and indirect economic impacts, including the induced impact, of companies' or industry presence as measured by economic output,<sup>19</sup> employment,<sup>20</sup> labor income,<sup>21</sup> and taxes<sup>22</sup> of spending associated with an activity/event/project on a local, state, or U.S. economy. Using IMPLAN<sup>23</sup> to quantify the direct, indirect, and induced effects<sup>24</sup> of the life sciences industry on the Pennsylvania economy, the true value and support that the industry provides to the region is shown through the resulting measures.

The life sciences industry directly contributed nearly 102,000 jobs in Pennsylvania and supported approximately 332,000 total jobs (including direct jobs) in the Commonwealth in 2020. The additional indirect and induced jobs are generated by firms in the supply chain providing goods and services to the life sciences industry, as well as jobs created because of the spending of life sciences and supporting industry workers. Figure 22 shows the breakdown of employment contribution.

**Figure 22: Employment Contribution**



*Note: Rounded to nearest 1,000 jobs.*

Employee labor income contributes to the Pennsylvania economy both directly through the life sciences industry and indirectly through supporting industries. As seen in Table 3, Labor income—including all

<sup>19</sup> The total value of goods and services produced by the life sciences industry and its supply chain.

<sup>20</sup> Annual average of full-time, part time, and seasonal employment in the life sciences industry and its supply chain.

<sup>21</sup> All forms of employment income including employee compensation and proprietor income (fully loaded compensation) paid to life sciences employees

<sup>22</sup> Total taxes generated by the economic activities attributable to the life sciences industry and its supply chain at each level of government: federal county, subcounty general, subcounty special district, and state.

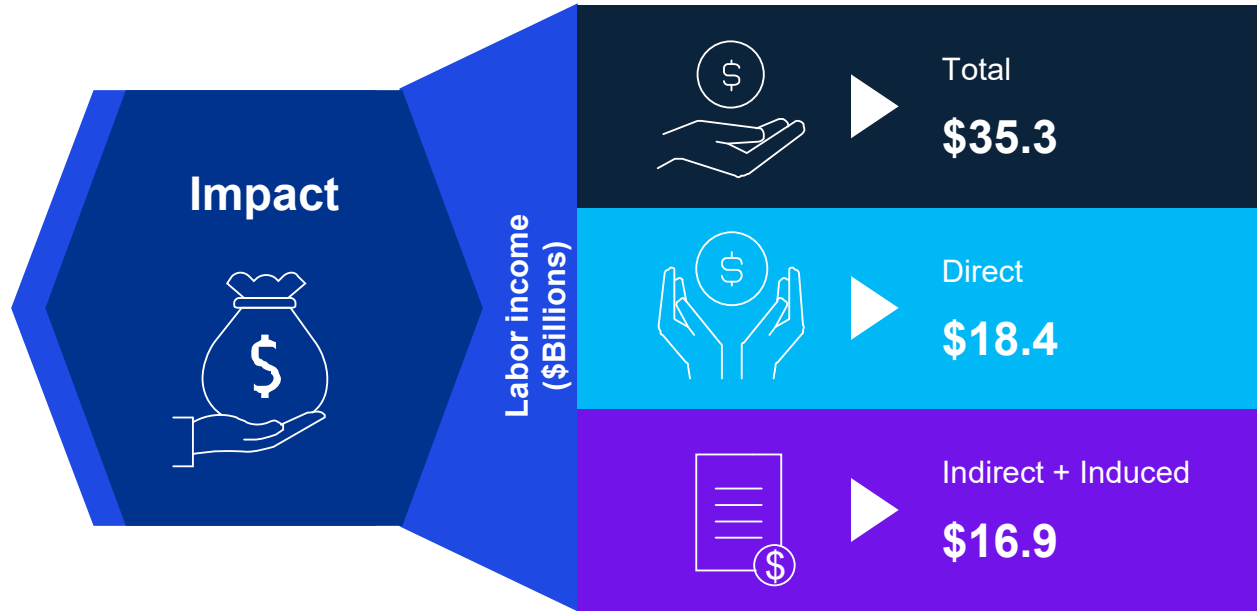
<sup>23</sup> For more information on the IMPLAN modeling process, visit [IMPLAN.com](http://IMPLAN.com).

<sup>24</sup> Direct effects refer to economic effects stemming directly from the actions of the life sciences industry. Indirect effects refer to economic effects stemming from business-to-business purchases in the supply chain. Induced effects refer to economic effects stemming from household spending of labor income in Pennsylvania (after removal of taxes, savings, and commuter income).



wages and salaries—directly attributable to the life sciences industry in Pennsylvania totaled \$18.4 billion in 2020. An additional \$16.9 billion in labor income resulted from the indirect and induced contributions of the life sciences industry in the Commonwealth. This resulted in a total of \$35.3 billion of labor income being directly or indirectly attributed to the life sciences industry.

**Table 3: Labor Income Contribution**



In addition, the life sciences industry's importance to Pennsylvania can be captured through its significant contribution to state economic output. Table 4 shows that the industry directly contributed approximately \$61.9 billion in economic output in 2020, with an additional \$43.7 billion contribution coming from the industry's indirect (including induced) activities. This resulted in a total of \$105.6 billion in state economic output contributions by the life sciences industry and its supporting activities in 2020.

**Table 4: Economic Output Contribution**



It is estimated that the Pennsylvania life sciences industry was responsible for generating approximately \$9.7 billion in federal, state, and local taxes in 2020. Table 5 shows the breakdown of total generated tax revenue.

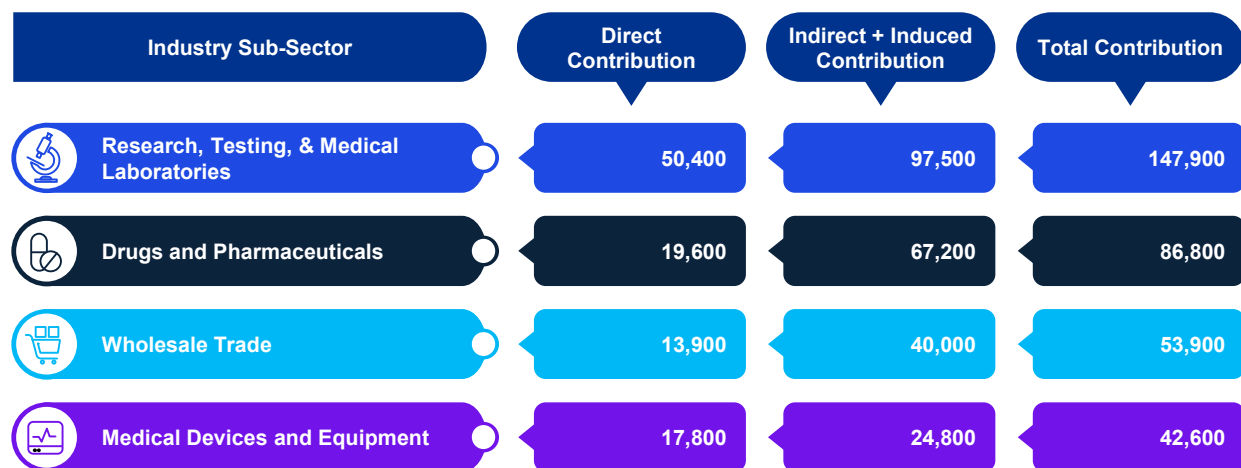
**Table 5: Generated Tax Revenue<sup>25</sup>**



<sup>25</sup> Direct, Indirect and Induced Tax Revenue may not add to Total due to rounding.

In Table 6, the total economic impact of the life sciences industry on Pennsylvania employment is broken down by industry subsector. The table below shows that the research, testing, & medical laboratories sector had the single largest contribution to employment, coming in at 147,900 jobs as of 2020.

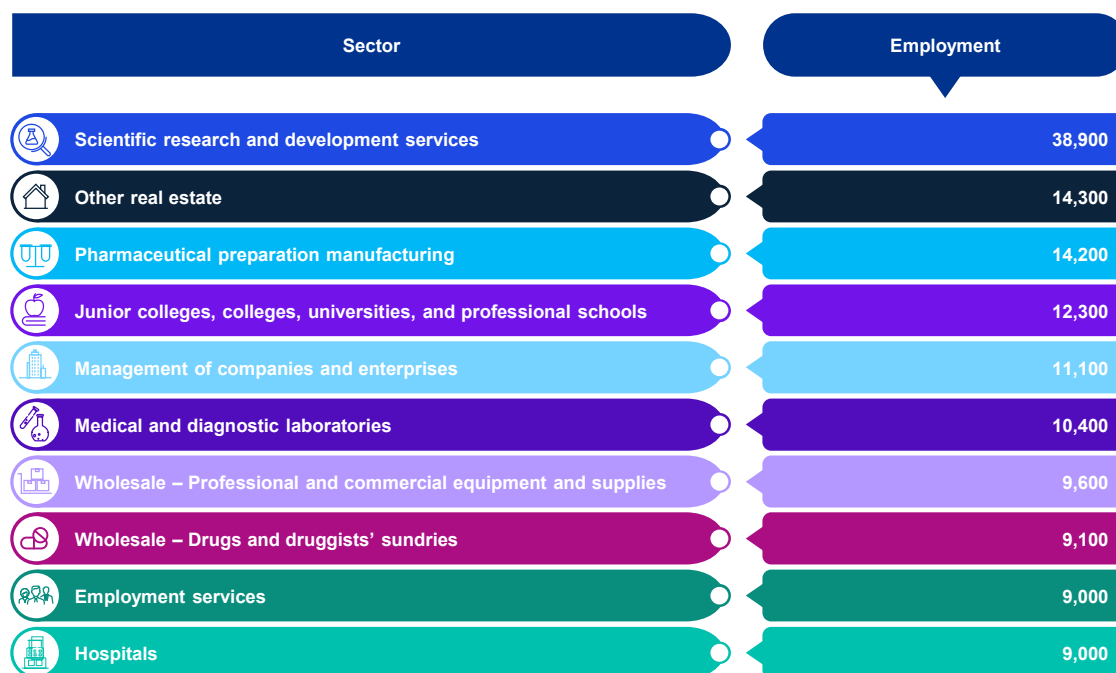
**Table 6: Employment Contribution by Life Sciences Subsectors**



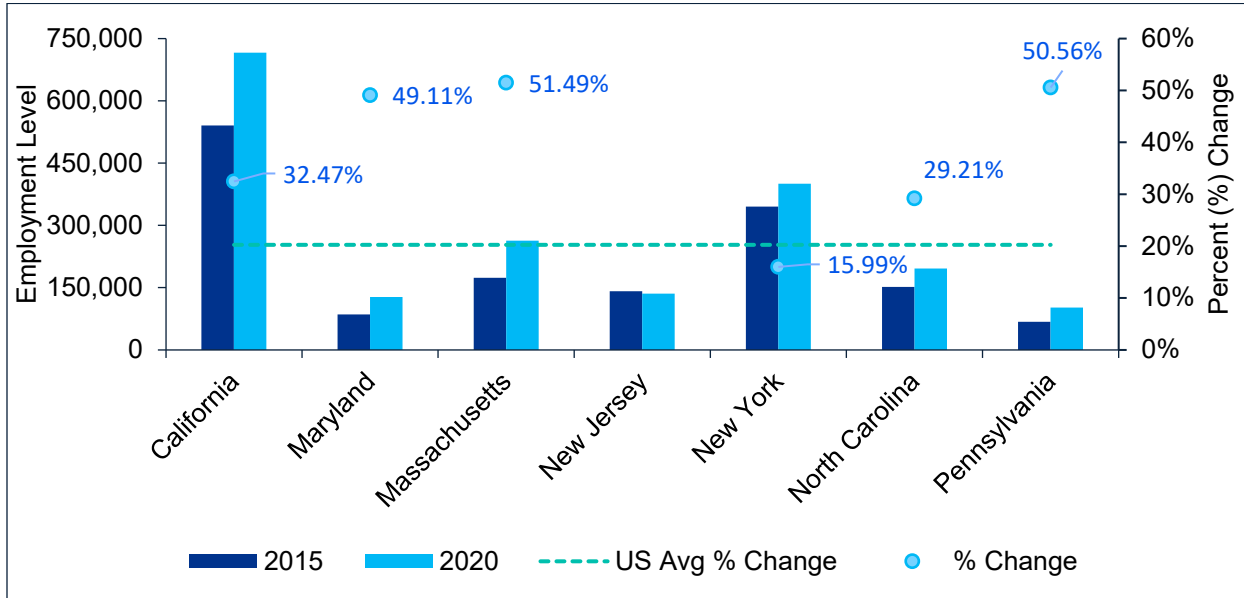
*Note: Figures may not add due to rounding.*

Table 7 below shows the sectors that benefit the most from the contributions of the life sciences industry in Pennsylvania in 2020. Many of these sectors—including scientific research and development services, pharmaceutical preparation manufacturing, and junior colleges, colleges, universities, and professional schools—are primarily the result of direct employment in the life sciences industry. Other industries including other real estate, management of companies and enterprises, and employment services are the result of indirect and induced employment in support of the life sciences industry. Figure 23 shows the employment growth from 2015 to 2020, the comparison to peer states, and the U.S. average percent change in employment growth rates.

**Table 7: Employment Contribution by Individual Industries**



**Figure 23: Direct Employment Growth and Percent Change in the U.S. and Peer States – Comparing 2015 to 2020**



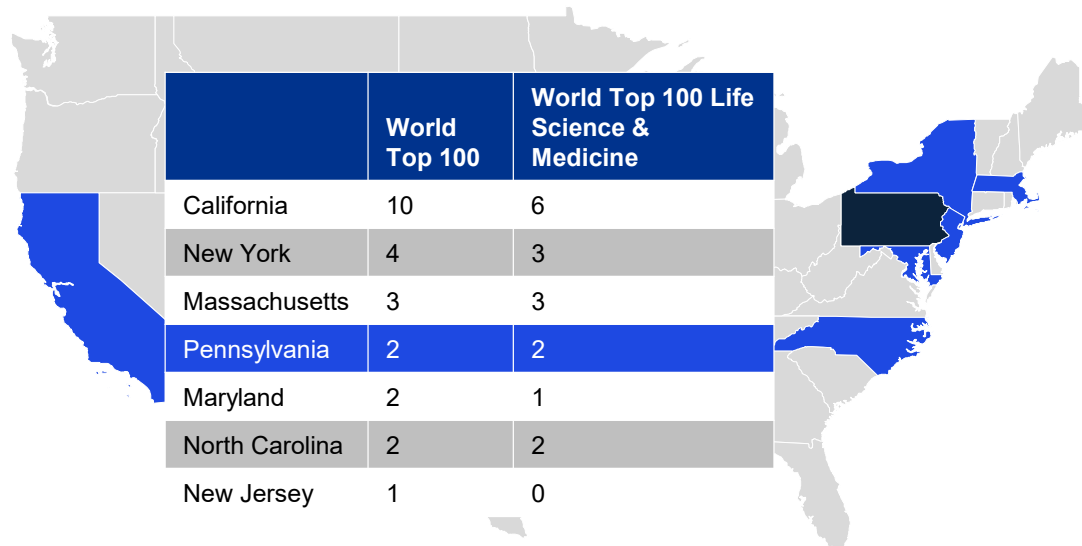
Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics

# Academic contribution

Academic excellence is crucial to any industry as it serves as the driver of scientific research and innovation. Pennsylvania’s long-standing tradition of academic excellence serves as an engine for research and innovation for the life sciences industry.

- In 2021, University of Pennsylvania and University of Pittsburgh were on the World Top 100 life sciences and Medicine Programs on the Quacquarelli Symonds World University rankings (Figure 24).
- In 2021, University of Pennsylvania and Carnegie Mellon University were both on the World Top 100 Universities according to the Shanghai Index compared to the identified peer states, with California leading with 10 universities (Figure 24).
- Over a five-year period—from 2016 to 2020—the number of degrees (i.e., Bachelor’s degree or higher) awarded in the life sciences discipline increased by 24 percent from 2.3 million degrees to 2.9 million degrees (Figure 25).
- When compared to identified peer states, Pennsylvania consistently produces the third-largest number of degrees in the life sciences field (Figure 26).
- In 2020, institutions in the state awarded a total of 559 doctoral degrees in the life sciences discipline as seen in Figure 27. When compared to its peer states, Pennsylvania ranks as fourth in doctoral degree awards. Doctoral degrees support the continuation of research and clinical trials, not only as research leads and investigators, but also as members of Institutional Review Boards and Data and Safety Monitoring Committees, which are crucial to the strict monitoring standards of trials and the safety of participants.<sup>26</sup>

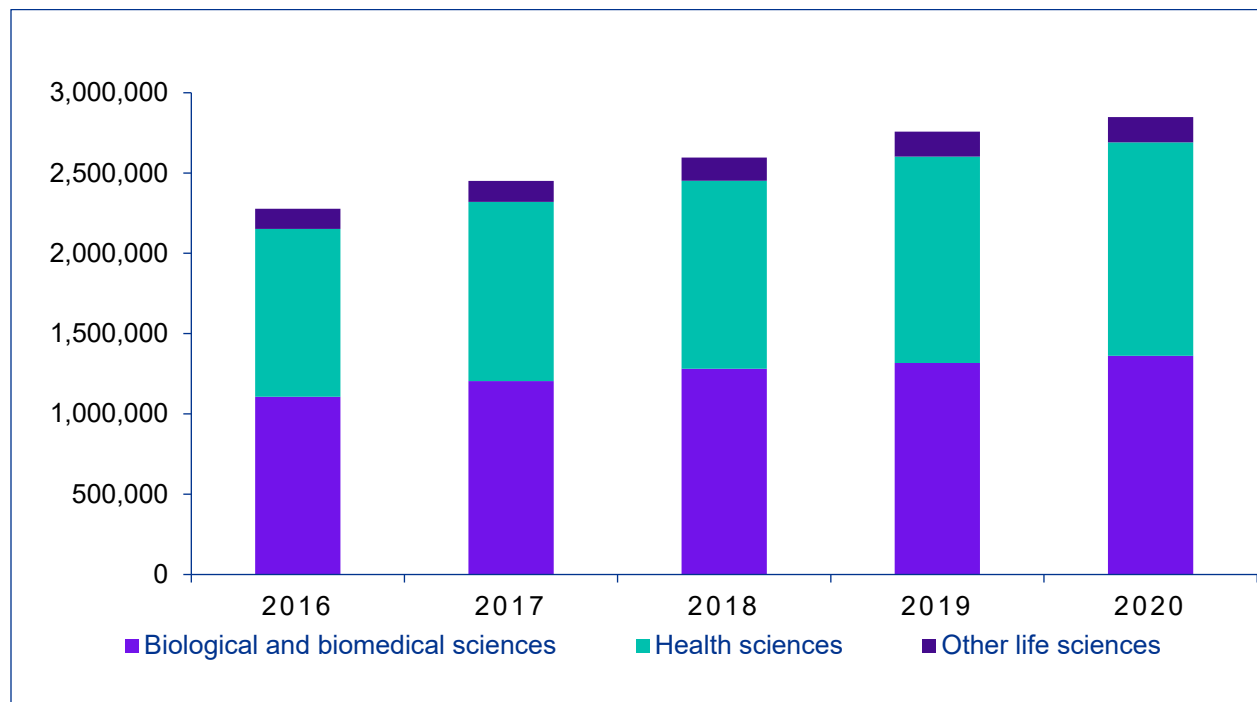
**Figure 24: Number of World Top 100 Universities by State and Number of World Top 100 Life Sciences & Medicine Programs by State in 2021**



<sup>26</sup> Source: NIH, “Clinical Trials: Benefits, Risks, and Safety,” Accessed February 2022.

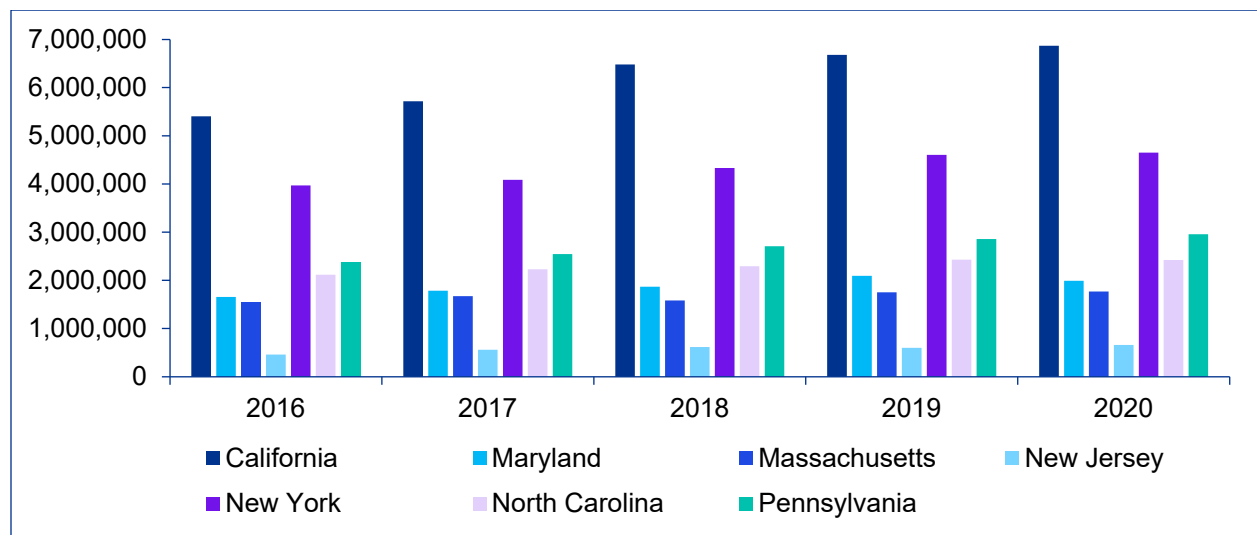
Source: Shanghai Index World University Rankings, 2021<sup>27</sup> & Quacquarelli Symonds World University Rankings by Subject, 2021: Life Sciences & Medicine<sup>28</sup>. Note: Peer states selected by LSPA.

Figure 25: Life Sciences Degrees Awarded in Pennsylvania from 2016 to 2020<sup>29</sup>



Source: National Science Foundation, National Center for Science and Engineering Statistics 2016—2020

Figure 26: Life Sciences Degrees Awarded by Pennsylvania in Comparison to Peer States from 2016 to 2020



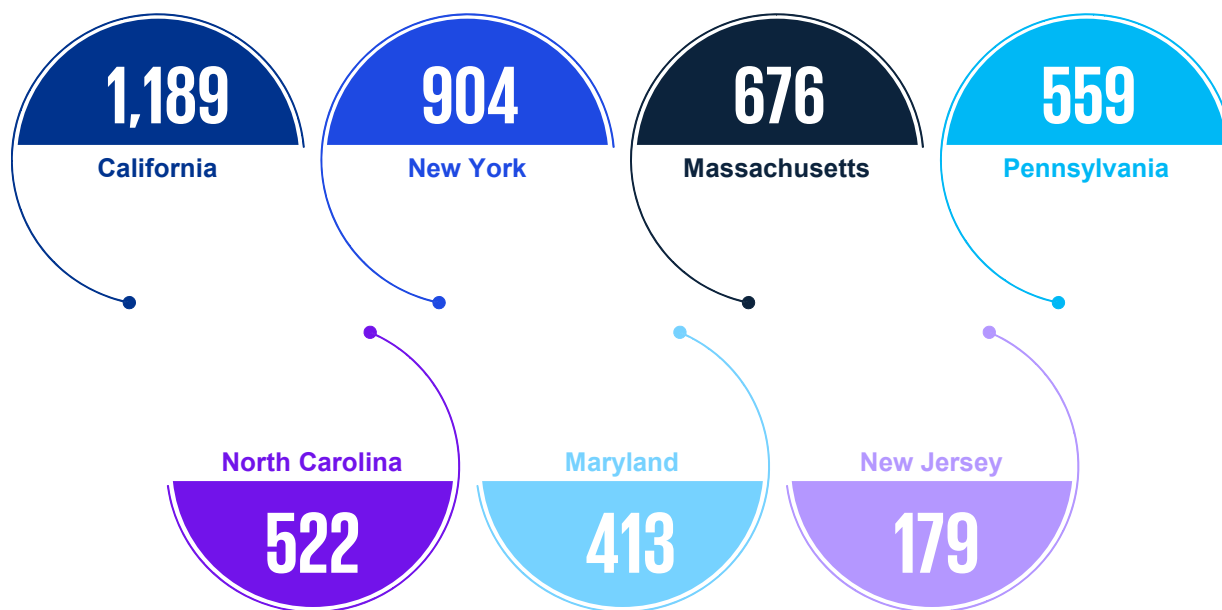
<sup>27</sup> University of Pennsylvania and Carnegie Mellon University

<sup>28</sup> University of Pennsylvania and Pittsburgh University

<sup>29</sup> Agricultural sciences and natural resources and conservation are excluded from the figure

Source: National Science Foundation, National Center for Science and Engineering Statistics 2016—2020. Note: Peer states selected by LSPA.

Figure 27: Doctorate Recipients in the Life Sciences Discipline by State 2020



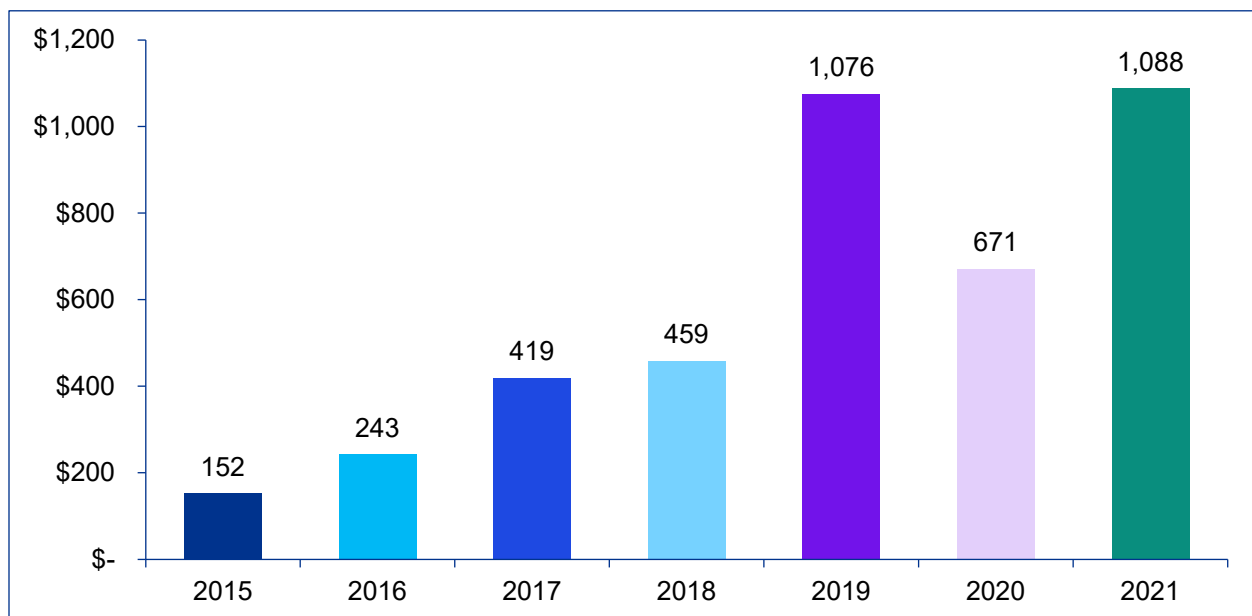
Source: National Science Foundation, 2020.

# Attracting capital

Pennsylvania's life sciences industry experienced a banner year in 2021, achieving a new high-water mark in the attraction of venture capital. There are several ways in which early-stage life sciences companies can acquire funding, including through incubators or accelerators, venture capital sources, corporate investments or acquisitions, and public offerings. Venture capital funding in particular forms a critically important source of funding for early-stage companies and those involved in managing products through clinical trials.

Figure 28 shows the total venture capital investment for the life sciences industry in Pennsylvania from 2015 to 2021. Following the slowdown of total venture capital investment during the pandemic in 2020, the level of venture capital investment in Pennsylvania life sciences companies hit a multiyear high in 2021. Investments in gene and cell therapy companies, biopharmaceuticals, and contract development and manufacturing organizations led to a higher overall level of investment.

**Figure 28: Total Venture Capital Transaction Value for Pharmaceuticals, Biotechnology and Life Sciences in Pennsylvania, USD in Millions, 2015-2021**



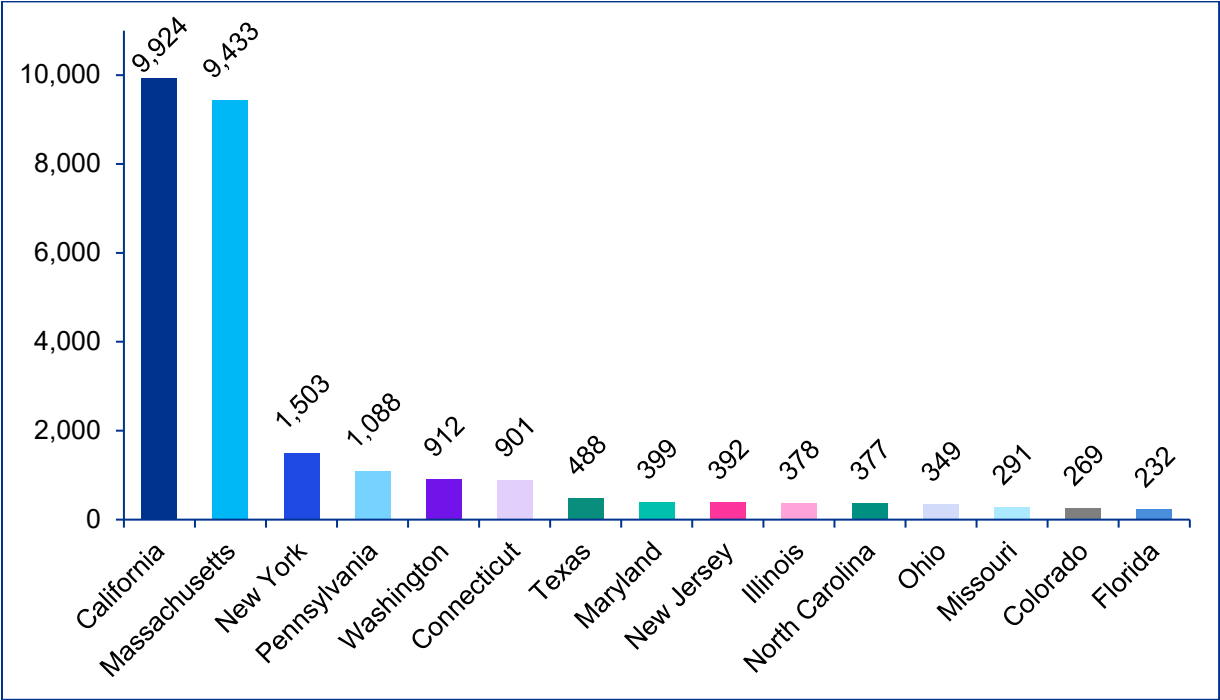
*Source: KPMG analysis of public filings obtained through S&P CapitalIQ, 2015-2021*

In 2019, Pennsylvania had the third-highest venture capital funding out of all states, securing more than \$1 billion in funding, only behind U.S. leaders California and Massachusetts. Venture capital funding decreased to \$671 million in 2020, before rebounding strongly in 2021.

Figure 29 compares the total venture capital investment of life sciences in Pennsylvania to other states in 2021. By comparison, in 2021, Pennsylvania ranked fourth in the U.S. in terms of the total venture capital transaction value, just behind New York and ahead of Washington. Pennsylvania's venture capital investments accounted for approximately four percent of the U.S. total of more than \$27 billion announced or closed transactions in 2021.



**Figure 29: Total Venture Capital Transaction Value for Pharmaceuticals, Biotechnology and Life Sciences, USD in Millions, 2021**



Source: KPMG analysis of public filings obtained through S&P CapitalIQ, 2021

# Life Sciences key trends

As part of the study, KPMG conducted a series of focus interviews with stakeholders in major markets within Pennsylvania's life sciences industry. The goal of the stakeholder interviews was to summarize industry participants' points of view on the current leading trends of the life sciences industry and document how they are evolving locally.

This section presents a summary of several themes and trends that were identified during the focus interviews. The overall topic areas discussed herein include the health of the innovation ecosystem and commercialization, workforce training and availability, attracting capital and venture funding, and the difference between life sciences ecosystems across the state.

## Commercialization

The cost of bringing new drugs and therapies to market is increasing, and stakeholders throughout Pennsylvania's life sciences ecosystem have noted how cost is impacting trends in collaboration and approaches to commercialization of new technologies. Outsourcing research and manufacturing is a trend that is expected to continue over the next several years as a cost saving measure, because this method more broadly distributes the cost of development and production. In the pharmaceutical industry, many collaborations align research and expertise across multiple products to decrease the time spent in clinical trials and thus, decrease costs.

At the university level, recent trends in technology transfer have favored decreasing the time spent negotiating, administering, and pricing terms of licensing arrangements in order to help move new technologies into development faster.

Stakeholders have noted that efforts to accelerate commercialization earlier in a new product's development cycle tend to be beneficial for getting products off the ground and into the market at a faster rate. Because of this, commercialization of new gene and cell therapy technologies continues at a strong pace in the greater Philadelphia region.

## Attracting capital and venture funding

Pennsylvania experienced a strong year of venture capital funding, but stakeholders have noted that constraints remain in terms of attraction of capital. Stakeholders have indicated that funding is generally available for early-stage companies, although recent disruptive market conditions have impacted the ability of firms to raise capital.

In addition, the recent increase in the number of new ventures and greater difficulty attracting capital from investors may lead to an increase in consolidation within the industry through mergers and acquisitions with other firms. Additionally, life sciences firms are increasingly searching for funding from sources such as foundations, sovereign funds, nonprofits, and through university partnerships. In general, the finances of the life sciences industry have become more diversified over time.

## Workforce training and availability

Several stakeholders have cited the challenge of attracting and retaining experienced managers, leaders, and entrepreneurs in life sciences as a key challenge facing the industry at present. There is a need for more skilled midlevel managers and entrepreneurs or executives with experience at early-stage

companies to assist newly formed companies with navigating the early stages of funding and product development.

Several stakeholders have also indicated that the Pennsylvania market tends to prepare very highly qualified researchers at the doctoral and masters levels and graduates with bachelor's degrees. Even so, there are many functions in life sciences that require either on-the-job training or prior relevant experience, and several stakeholders have indicated that professionals trained in these skills remain in relatively short supply. Similarly, workers with associate-level and technical training backgrounds who have experience in life sciences-related lab work and manufacturing are also in demand throughout the Commonwealth.

Several stakeholders have indicated that graduates tend to leave and move to regions of the U.S. with ample availability of jobs, including the Research Triangle Park in North Carolina, the Bay Area in California, and Boston, Massachusetts

To try and remedy this issue, training for university students and recent graduates has become a major focus within the life sciences industry with model programs such as the Jefferson Institute of Bioprocessing at Thomas Jefferson University in Pennsylvania.

## Regional differences

Life sciences industry trends are playing out somewhat differently within local markets in Pennsylvania, and these regional differentials are important to understand the variation in activity across the state.

One source of friction for the life sciences industry's growth centers on the issue of available lab space. Industry stakeholders noted that some companies that might otherwise expand in the state may need to expand or locate operations elsewhere due to an undersupply of necessary lab space. However, this factor varies across the Commonwealth, as some regions within Pennsylvania appear to have better availability of space than others. Metropolitan areas in Pennsylvania that are home to major research universities have tended to have greater availability of lab space compared to other regions, but industry stakeholders have noted that this space is quickly becoming occupied. Additional lab space is under construction in Pennsylvania, but at the time of the drafting of this report, the demand for space tended to outpace supply in most local markets.

Another region-specific issue is the levels of workforce training and availability present in different metro areas. Several stakeholders have noted that Pennsylvania is a net exporter of life sciences graduates, as students with life sciences degrees may leave the state to seek employment in other markets. For regions of the state that lie greater distances from coastal markets, attracting and retaining workers and leaders at various levels can be a challenge.

## Methodology appendix

### Life sciences definition by NAICS Codes

The table below outlines the specific NAICS codes that comprise life sciences for the purposes of this report.

**Table 8: Life Sciences Definition by NAICS Codes**

NAICS	Sector name	Share allocation*
<b>Drugs and Pharmaceuticals</b>		
325411	Medicinal and Botanical Manufacturing	100%
325412	Pharmaceutical Preparation Manufacturing	100%
325413	In-Vitro Diagnostic Substance Manufacturing	100%
325414	Biological Product (except Diagnostic) Manufacturing	100%
<b>Medical Devices and Equipment</b>		
325220	Artificial and Synthetic Fibers and Filaments Manufacturing	100%
333314	Optical Instrument and Lens Manufacturing	100%
334510	Electro medical and Electrotherapeutic Apparatus Manufacturing	100%
334516	Analytical Laboratory Instrument Manufacturing	18%
334517	Irradiation Apparatus Manufacturing	100%
339112	Surgical and Medical Instrument Manufacturing	100%
339113	Surgical Appliance and Supplies Manufacturing	100%
339114	Dental Equipment and Supplies Manufacturing	100%
339115	Ophthalmic Goods Manufacturing	100%
339116	Dental Laboratories	100%
<b>Wholesale Trade</b>		
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	100%
423460	Ophthalmic Goods Merchant Wholesalers	100%
424210	Drugs and Druggists' Sundries Merchant Wholesalers	62%
<b>Research, Testing, &amp; Medical Laboratories</b>		

NAICS	Sector name	Share allocation*
541380	Testing Laboratories	4.5%
541714	Research and Development in Biotechnology (except Nano biotechnology)	100%
541713	Research and Development in Nanotechnology	58%
541715	Research and Development in the Physical, Engineering, and life sciences (except Nanotechnology and Biotechnology)	58%
611310**	Colleges, Universities, and Professional Schools	6.1%
621511	Medical Laboratories	100%
621512	Diagnostic Imaging Centers	100%

*\*Sectors that have less than 100 percent of share allocation have less than 100 percent of activity attributed to the life sciences industry for purposes of this study. Share attributable to the life sciences industry was derived using data from the 2019 Economic Census from the U.S. Census Bureau.*

*\*\*For sector 611310, Colleges, Universities, and Professional Schools, share attributable to the life sciences industry was derived using data on bachelor's, master's, and doctor's degrees awarded from the National Center for Science and Engineering Statistics from the NSF.*

## Employment data

In order to estimate the economic contribution of the life sciences industry on the Pennsylvania economy, data from a variety of sources was leveraged. The direct employment contributions of the life sciences industry to Pennsylvania were used to inform the model and were primarily derived from the Bureau of Labor Statistics QCEW data in the years 2015 and 2020 (the last year for which complete annual data are available at time of this report's preparation). QCEW data reports employment and wages as reported by employers and covers more than 95.0 percent of U.S. jobs at the national, state, metropolitan statistical area, and county level. Data are aggregated starting at the 6-digit NAICS industry level.

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