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# New Opportunities for Job Creation in Maryland's Life Sciences Industry

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MARYLAND LIFE SCIENCES
ADVANCING INNOVATIONS FOR HEALTH

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# EXECUTIVE SUMMARY

Maryland has one of the nation's strongest life sciences industries. The state's array of universities, federal labs, and firms employ 54,000 people, generate breakthrough discoveries, and supply a range of technologies that have been key to the COVID-19 pandemic response. Despite Maryland's high concentration of employment in research and development (R&D), the sector's 7.4 percent growth between 2015 and 2020 trailed other leading states such as Massachusetts (58 percent) and North Carolina (38 percent). Beyond R&D employment, the state's life sciences manufacturing sector expanded at one of the fastest rates nationwide (31 percent), but remains relatively less concentrated than the national average, indicating significant potential for further growth. Maryland's life sciences industry also faces competition from other states for investment, particularly in entrepreneurs and startup firms that have the potential to sustain job creation across the state.

The state's existing policy architecture provides a foundation for state leaders to develop new, collaborative strategies among public, private, and non-profit actors that expand not only the total number of job opportunities but also their accessibility to state residents. Streamlining industry job creation could provide an incentive for employers to invest in creating more local jobs in these sectors and increase Maryland's attractiveness to venture capital.

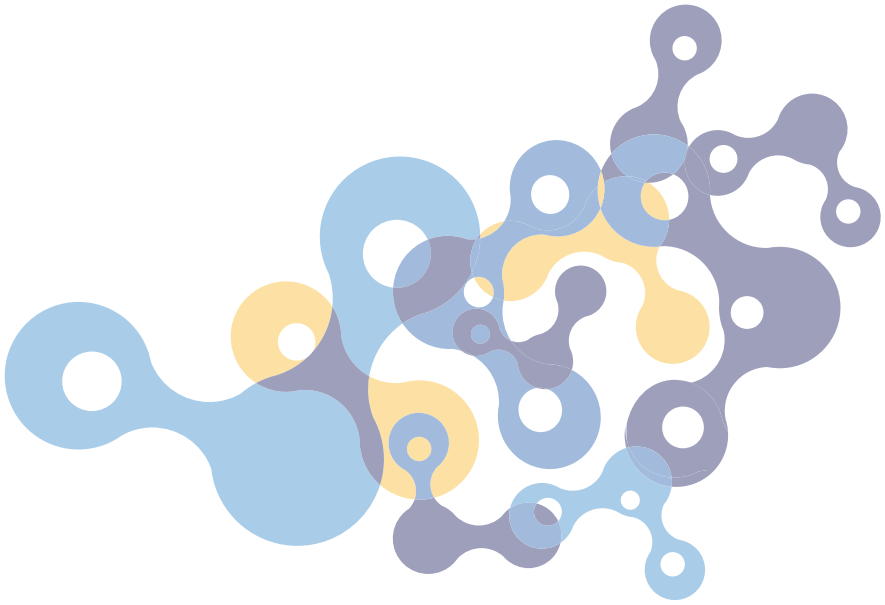
To grow the talent pipeline and improve workforce development, programs are needed to inform and attract workers and equip them with the skills they need to perform these jobs. State leaders should:

- Collaborate on developing an industry-certified training curriculum that maximizes the number of workers capable of meeting existing industry needs and that prepares prospective employees for occupations with future growth potential, particularly jobs that do not require four-year degrees.
- Increase awareness of life sciences career opportunities for residents in more rural counties through industry skills training extension programs hosted by community colleges.
- Support dedicated training programs and facilities for advanced biomanufacturing, especially cell and gene therapies.

To enhance Maryland's entrepreneurial ecosystem and increase its attractiveness to venture capital, greater public-private cooperation is needed to make the state a place worth investing in, by providing an innovation-ready workforce and expanding access to physical infrastructure that can help entrepreneurs and startups move from R&D to development and testing. State leaders should:

- Evaluate the feasibility of matching private funds raised by institutions of higher education to establish technology incubators and provide early-stage companies with greater resources—particularly lab and manufacturing space—that will support local job creation. These efforts could parallel the Maryland E-Nnovation Initiative Fund's matching support for endowed university chairs.[1]
- Explore the viability of additional region-specific incentives targeting the conversion of existing commercial or industrial spaces for use in small-scale, modular life sciences manufacturing.

Maryland could also generate additional opportunities through the adoption of place-based investment strategies used in other states, such as an expansion of local manufacturing and improvements to career and technical education programs. A more cohesive strategy among industry, government, academic, and nonprofit leaders could enhance the life sciences industry's growth trajectory and further increase the number of job opportunities available to residents across the state.



# INTRODUCTION

Maryland is at the forefront in many areas of the national life sciences industry economy. The state is home to 2,700 life sciences firms and more than 500 biotech companies, and its 74 federal research labs—including the National Institutes of Health (NIH) and the Food and Drug Administration (FDA)—and leading research universities deploy innovative research and entrepreneurial drive to generate technological breakthroughs. Maryland is also the cornerstone of the BioHealth Capital Region—a regional collaboration with Virginia and Washington, DC, to drive life sciences innovation and entrepreneurship—which was ranked No. 4 in the top biopharma clusters in the nation in 2021.[2] Furthermore, the state has the world's largest cell therapy manufacturing facility and leads the world in adult stem cell production and vaccine research and development (R&D), with 20 percent of the world's top influencers in vaccine development.[3]

Since the beginning of the COVID-19 pandemic, Maryland's leadership in the life sciences has become even more evident. The National Institute of Allergy and Infectious Diseases (NIAID) in Bethesda received $1.5 billion in federal funding to conduct research and clinical trials to develop treatments and vaccines.[4] The NIH Rapid Development of Diagnostics (RADx) initiative led development of new technologies for COVID-19 testing.[5] And experts at Johns Hopkins University in Baltimore have been at the forefront of data reporting and analysis. The BioHealth Capital Region received more than $7 billion in total federal funding,[6] and five of the 10 funding recipients from Operation Warp Speed—the federal effort to speed the development and production of COVID-19 vaccines—are in the state.[7]

As R&D in the life sciences industry continues to expand the frontiers of human knowledge, the commercialization of new technologies also offers the potential to create new jobs. However, Maryland's employment in biotechnology R&D increased by 52 percent from 2015 to 2020, below the national growth rate of 60 percent during that period.[8] Despite playing a prominent role in the life sciences industry, Maryland faces increasing competition from other states for investment in R&D and particularly in manufacturing new technologies, from vaccines and gene and cell therapies to medical devices and tools for digital health. Consequently, any efforts for sustained job creation in the industry will require enhanced collaboration among public, private, and non-profit actors.

By harnessing its already substantial assets, Maryland can create new opportunities to enhance its life sciences industry leadership. Key components of a proactive approach include expanding the local talent pipeline, supporting the entrepreneurial ecosystem through greater public-private cooperation, and developing a strategy for place-based investment that generates new industry connections for communities across the state.

## CURRENT STATUS OF THE LIFE SCIENCES WORKFORCE

Maryland's life sciences industry has a substantial footprint, directly employing over 54,000 people across a wide range of jobs in R&D, manufacturing, and laboratories—more than the number of workers employed in the state's information or real estate industries.[9] Jobs in the scientific R&D sector account for roughly two-thirds of total industry employment, while job creation in the life sciences manufacturing sector registered the highest rate of growth from 2015 to 2020, as shown in **Table 1**.[10]

**TABLE 1:** LIFE SCIENCES INDUSTRY EMPLOYMENT IN MARYLAND (BY SECTOR)

| INDUSTRY | 2015 | | 2020 | | EMPLOYMENT GROWTH (PERCENT) |
|---|---|---|---|---|---|
| | Employment | Concentration* | Employment | Concentration* | |
| **R&D in the Physical, Engineering, and Life Sciences** | **31,734** | **2.76** | **34,069** | **2.61** | **7.4** |
| R&D in Biotechnology & Nanotechnology | 8,002 | 2.72 | 12,150 | 2.66 | 51.8 |
| All other R&D | 23,732 | 2.79 | 21,917 | 2.60 | –7.6 |
| **Life Sciences Manufacturing** | **9,262** | **0.77** | **12,104** | **0.95** | **30.7** |
| Pharmaceutical & Medicine | 7,278 | 1.40 | 9,593 | 1.69 | 31.8 |
| Medical Equipment & Supplies | 1,821 | 0.32 | 2,335 | 0.41 | 28.2 |
| Electromedical & Electrotherapeutics | 163 | 0.15 | 176 | 0.13 | 8.0 |
| **Life Sciences Laboratories** | **7,452** | **0.94** | **8,322** | **1.01** | **11.7** |
| Medical & Diagnostic | 5,632 | 1.16 | 6,325 | 1.24 | 12.3 |
| Testing | 1,820 | 0.60 | 1,997 | 0.64 | 9.7 |

** **Note:** Concentration measured by location quotient (LQ). If LQ>1, area employment has a larger relative share than it does nationwide.*

***Source:** US Bureau of Labor Statistics—Quarterly Census of Employment and Wages (2020)*

Although Maryland has a relatively high concentration of R&D jobs compared with most states, its growth rate in R&D employment from 2015 to 2020 did not keep pace with rates in some other leading states, as shown in **Table 2**. Its life sciences manufacturing sector expanded at one of the fastest rates nationwide, but remains relatively less concentrated than the national average, indicating significant potential for further growth.

**TABLE 2:** LIFE SCIENCES INDUSTRY EMPLOYMENT ACROSS US STATES (BY SECTOR)

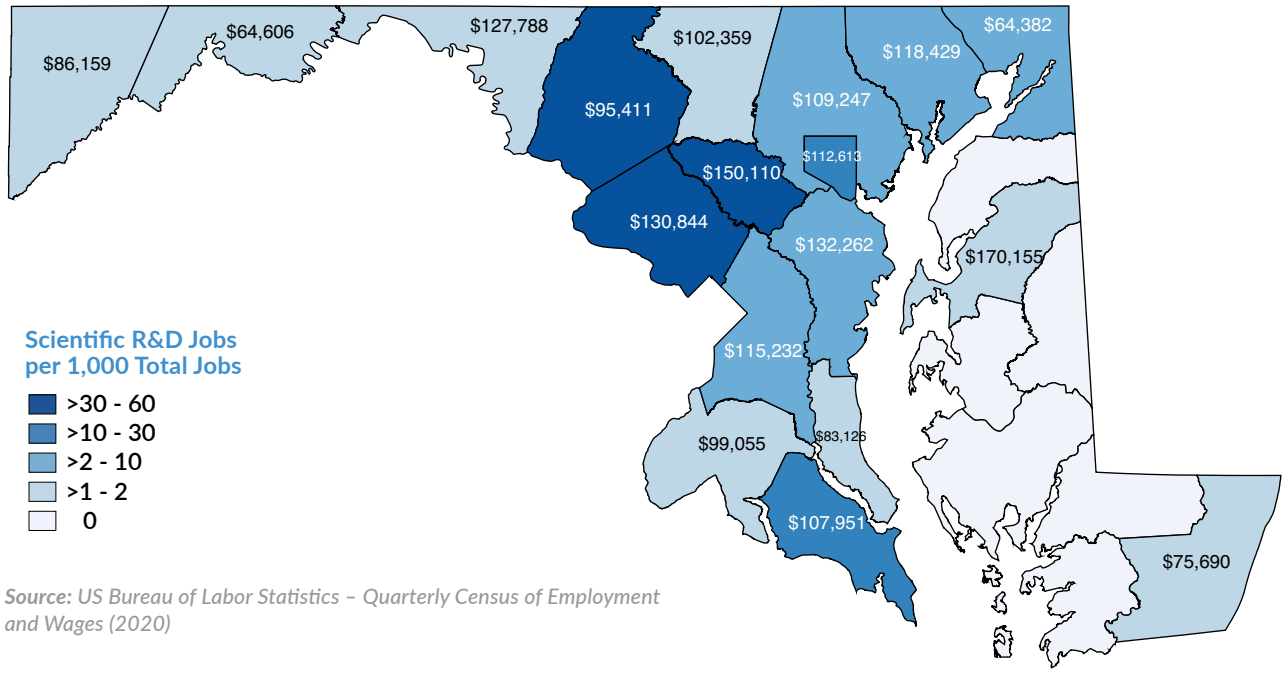
| STATE | R&D EMPLOYMENT | | MANUFACTURING EMPLOYMENT | |
|---|---|---|---|---|
| | Concentration 2020* | Growth 2015-2020 | Concentration 2020* | Growth 2015-2020 |
| California | 1.78 | 17.6% | 1.47 | 8.7% |
| Maryland | 2.61 | 7.4% | 0.95 | 30.7% |
| Massachusetts | 4.74 | 58.1% | 1.42 | –6.7% |
| New Jersey | 1.57 | 5.1% | 1.98 | 4.1% |
| North Carolina | 1.24 | 38.3% | 1.42 | 0.3% |
| Virginia | 1.19 | 11.8% | 0.36 | 8.6% |

** **Note:** Concentration measured by location quotient (LQ). If LQ>1, area employment has a larger relative share than it does nationwide.*

***Source:** US Bureau of Labor Statistics—Quarterly Census of Employment and Wages (2020)*

The distribution of life sciences employment across the state remains relatively concentrated. Montgomery County has long been the industry's primary hub due to the presence of the NIH, FDA, and 38 federal labs. As the industry grew, R&D employment spilled over to neighboring Frederick and Howard counties, as shown in **Figure 1**, while the city of Baltimore also started to account for an increasing number of R&D jobs supported by the presence of Johns Hopkins University and the University of Maryland Medical Center.

**FIGURE 1:** MARYLAND SCIENTIFIC R&D EMPLOYMENT CONCENTRATION AND AVERAGE ANNUAL INCOME (BY COUNTY)




***Source:** US Bureau of Labor Statistics – Quarterly Census of Employment and Wages (2020)*

In addition to institutions of higher education and federal labs, major life sciences firms such as AstraZeneca, Kite, BioNTech, Catalent, Charles River Laboratories, Emergent BioSolutions, Lonza, and Novavax have a substantial presence in Maryland and account for some of the state's highest-paid jobs. Annual incomes in the life sciences average $128,800 across the state, almost $60,000 more than the statewide average for all industries ($68,900).[11]

## NEXT STEPS TO SUPPORT INDUSTRY JOB CREATION

Maryland's life sciences manufacturing and laboratories show significant potential for further expansion, and the state's existing policy architecture provides a foundation for state leaders to develop new, collaborative strategies that expand not only the total number of job opportunities but also their accessibility to state residents. On the industry side, the same companies that develop breakthrough technologies can be enlisted to help identify the skills that an expanded life sciences workforce will require, and on the government side, expanding laboratory and manufacturing space can entice more local innovators and entrepreneurs to remain in Maryland as they expand. Preparing Marylanders to fill these positions will provide an incentive for employers to invest in creating more local jobs in these sectors, particularly since the state can already leverage its extensive assets in the knowledge economy to stimulate additional investment. It can also address some of the main limits on Maryland's attractiveness to venture capital highlighted by prior reports, such as helping coalesce and expand the state's innovation ecosystem, increasing the number of business accelerator spaces, and providing more workers with exposure to career paths in startups.[12]

The remainder of this section reviews two central policy considerations for state leaders: Grow the talent pipeline by improving workforce development and enhance the entrepreneurial ecosystem through greater public-private cooperation.

### Grow the Talent Pipeline

With the state's renowned research universities and numerous federal labs, Maryland has a high concentration of PhD recipients relative to other US states. Overall, Maryland ranks No. 1 in the nation for the concentration of employed doctoral scientists[13] and No. 5 for the number of life sciences PhD holders per capita—ahead of California but behind Massachusetts.[14] A large population of residents with doctoral degrees can spur innovation, but non-degree workers with training in other areas, such as laboratory technology and manufacturing, are also crucial for industry growth. As researchers spin off their innovations to become entrepreneurs and seek to develop new companies, the presence of a technically proficient local workforce is a key consideration for making Maryland an attractive place to do business in the long term. Expanding technical education, training, and certification programs is therefore crucial to growing the state's talent pipeline. Maryland could help satisfy the demand for qualified workers by expanding awareness of these opportunities as well as programming to help develop new pathways in career and technical education.

Attracting workers to these opportunities need not be a daunting challenge. The state's unemployment rate—which counts unemployed individuals who are actively looking and available for work—remained relatively high in June 2021 at 6.2 percent,[15] and overall manufacturing employment had not returned to pre-pandemic levels, with approximately 5,400 fewer employees than in January 2020.[16] In addition to the large supply of available workers, many life sciences manufacturing jobs pay higher wages than the median wages by degree level in the state (the median wage with an associate's degree is $43,000 and $31,000 with a high school diploma or equivalent) without requiring a bachelor's or graduate degree, as shown in **Table 3**.[17] And a recent survey of life sciences firms found that more respondents considered an employee's competencies and skills to be very important (59 percent) than a degree from a four-year college (53 percent).[18]

**TABLE 3:** MARYLAND LIFE SCIENCES INDUSTRY OCCUPATIONS AND EDUCATIONAL REQUIREMENTS

| OCCUPATION | TYPICAL ENTRY-LEVEL EDUCATION | TOTAL EMPLOYMENT | MEDIAN ANNUAL INCOME |
|---|---|---|---|
| **Clinical laboratory technologists and technicians** | Bachelor's degree | 6,900 | $55,100 |
| **First-line production and operation supervisors** | HS diploma or equivalent | 6,070 | $66,600 |
| **Biological technicians** | Bachelor's degree | 3,670 | $45,900 |
| **Life, physical, and social science technicians, all other** | Associates degree | 1,750 | $61,900 |
| **Helpers–production workers** | HS diploma or equivalent | 1,500 | $30,400 |
| **Medical equipment preparers** | HS diploma or equivalent | 1,000 | $41,000 |
| **Chemical plant and system operators** | HS diploma or equivalent | 840 | $67,000 |
| **Chemical equipment operators and tenders** | HS diploma or equivalent | 520 | $46,700 |
| **Medical appliance technicians** | HS diploma or equivalent | 240 | $47,800 |

*Source: US Bureau of Labor Statistics—Occupational Outlook Handbook (2020) and Occupational Employment and Wages (2020)*

Programs are needed to equip workers with the skills they need to perform these jobs. Several existing initiatives provide a solid foundation for further growth of the talent pipeline. For example, the Biotechnical Institute of Maryland (BTI) offers a tuition-free Laboratory Associates Program to help participants secure laboratory jobs or paid internships and earn credits toward an associate's degree in biotechnology.[19] The state-funded workforce development grant program, EARN Maryland, establishes industry partnerships to train, educate, and employ workers.[20] And several academic institutions in Montgomery County have partnered to launch a "Bio Boot Camp" for training entry-level workers in local biotechnology companies.[21]

With many companies in Maryland already at the forefront of biomanufacturing,[22] this presents an opportunity for the state to support the development of training programs and facilities to provide workers with skills they need. This advantage, combined with the current boom in biomanufacturing,[23] presents Maryland with a unique opportunity to support the growth of a skilled workforce which would help attract and retain companies in the state.

### NEXT STEPS FOR STATE LEADERS

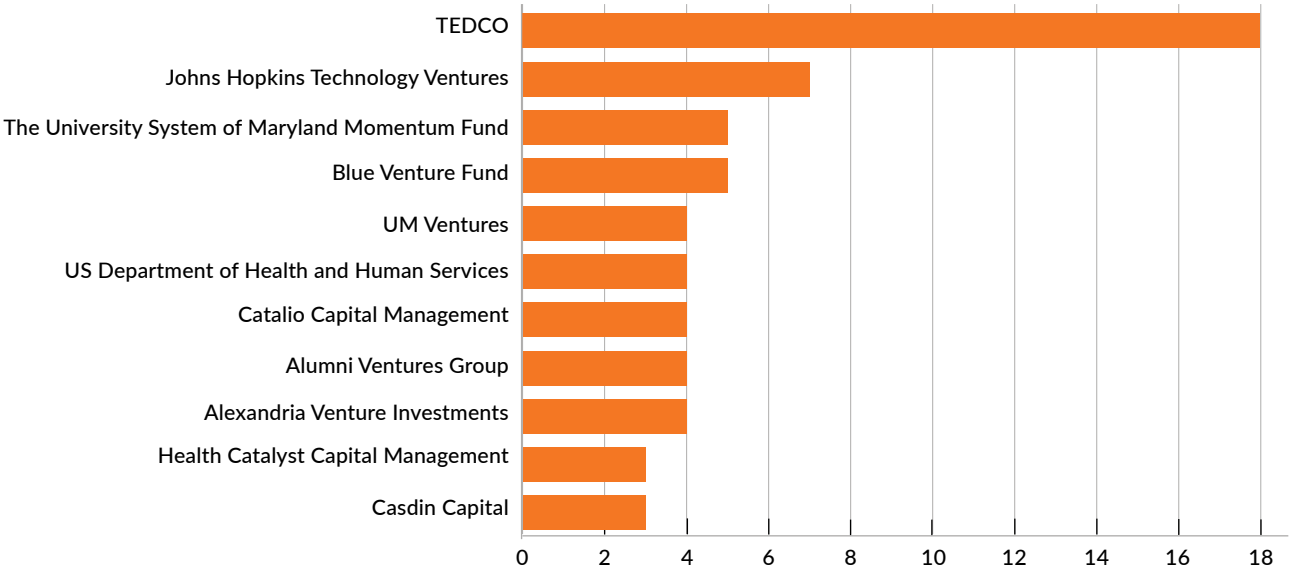
- *Collaborate on developing an industry-certified training curriculum that maximizes the number of workers capable of meeting existing industry needs and that prepares prospective employees for occupations with future growth potential, particularly jobs that do not require four-year degrees.*
- *Increase awareness of life sciences career opportunities for residents in peripheral counties through industry skills training extension programs hosted by community colleges.*
- *Support dedicated training programs and facilities for advanced biomanufacturing, especially cell and gene therapies.*

## Enhance the Entrepreneurial Ecosystem

Historically, Maryland has struggled to develop an entrepreneurial ecosystem to rival its counterparts in Massachusetts and California. A disproportionate share of Maryland's doctoral graduates work in federal labs—more than 26 percent, compared with 2 percent in Massachusetts and 3 percent in California[24]—where barriers to commercialization are often higher than in academia or industry.[25] Whereas federal R&D investment in Maryland during 2016 totaled $115.0 billion, total technology licensing income was just $179.2 million, representing a return on investment of 0.16 percent.[26] And Maryland ranked No. 18 on the Milken Institute's State Technology and Science Index 2020 for risk capital and entrepreneurial infrastructure—a measure of states' ability to attract venture capital investment, patenting, and business formation—far behind California at No. 1 and Massachusetts at No. 3.[27] The life sciences industry clusters in Boston, the San Francisco Bay Area, and San Diego captured 70 percent of all venture capital investment in the industry in 2019.[28]

Nonetheless, the total volume of life sciences venture capital invested in Maryland over the last five years ($22.50 per 100,000 residents) compares favorably to other states with a significant industry presence such as New Jersey ($21.05) and North Carolina ($11.63), as well as to the US national average ($20.55).[29] Maryland's universities and federal labs are a tremendous starting point for developing assets for attracting venture capital to the life sciences industry, but government agencies (such as the Maryland Technology Development Corporation [TEDCO]) and institutions of higher education remain the predominant sources of venture capital investments, as shown in **Figure 2**.

**FIGURE 2:** MARYLAND LIFE SCIENCES VENTURE CAPITAL INVESTMENTS, 2015–2021




*Source: PitchBook Data, Inc. (through July 2021)*

Although these government agencies and institutions of higher education can play crucially important roles in providing seed funding, experience has demonstrated that the private sector (particularly venture capital) plays a more central role in providing the sustained investment required for life sciences companies to grow. Because these investors seek relatively larger potential rewards and lower risks, ensuring that technologies and talent stay in Maryland could enhance its attractiveness to venture capital, such as by improving workforce development to supply a ready workforce. Unlike other leading states (including California and Massachusetts), Maryland offers a refundable R&D tax credit for small businesses with limited tax liabilities, and the state also provides a Biotechnology Investment Incentive Tax Credit designed to expand funding available to firms that are less than 10 years old and have fewer than 50 full-time employees.[30] Existing programs available through the Maryland Innovation Initiative and the Maryland Stem Cell Research Fund also support the commercialization of research.

Another significant need facing many entrepreneurs and startups is access to physical infrastructure that can help them move from R&D to demonstration and testing. Interviews with stakeholders across Maryland's life sciences industry indicated that a relatively limited amount of laboratory and manufacturing space[31] is a significant constraint on the state's ability to incubate the growth of local firms (as discussed in the previous section). Technology incubators such as the Johns Hopkins University Technology Ventures initiative have made important strides in this area.[32] Nonetheless, there are relatively few manufacturing spaces in Maryland available to support early-stage commercialization, and working with contract development and manufacturing organizations (CDMOs) can often be prohibitively expensive.[33]

Counties adjacent to Washington, DC, and metro Baltimore not only have the highest concentration of scientific R&D activity but are also the site of most life sciences manufacturing, with additional activity extending into Washington and Anne Arundel counties as well as Talbot County on the Eastern Shore, as shown in **Figure 3**. Although most of Maryland's more rural counties have few connections to the life sciences industry, they play much larger roles in the state's overall manufacturing activities. These regions include Caroline, Cecil, Dorchester, Kent, Queen Anne's, Somerset, and Wicomico counties on the Eastern Shore as well as Allegany and Garrett counties in Western Maryland, as shown in **Figure 4**.

**FIGURE 3:** MARYLAND SCIENTIFIC MANUFACTURING JOB CONCENTRATION

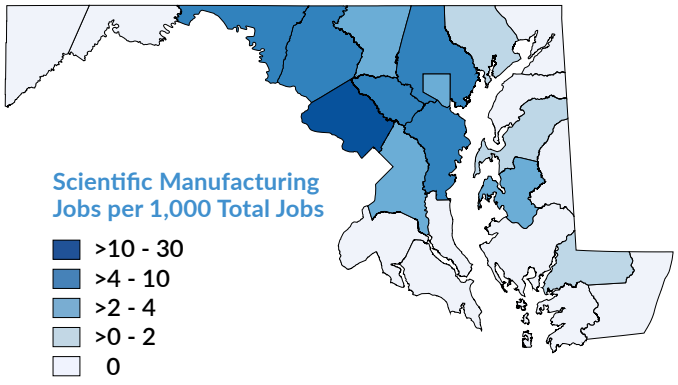
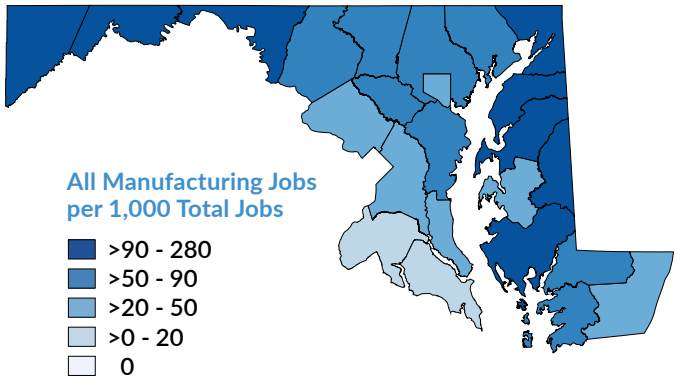



**FIGURE 4:** MARYLAND MANUFACTURING JOB CONCENTRATION ALL INDUSTRIES




*Source: US Bureau of Labor Statistics—Quarterly Census of Employment and Wages (2020)*

Several existing incentives already support industry expansion in these regions: the Biotechnology Investor Incentive Tax Credit currently provides tax credits of up to 33 percent for eligible investments in a qualifying company and up to $250,000 or 50 percent for investments up to $500,000 in specific counties (Allegany, Dorchester, Garrett, and Somerset); enhanced tax credits are also available for investments in Opportunity Zones.[34] Moreover, Maryland's affordability relative to other life sciences hubs offers a potentially significant advantage for companies scaling up and needing additional space. In 2020, average rents for life sciences companies in Maryland were $28.85 per square foot, or less than half the cost for similar companies in San Francisco ($58.30) and Boston ($69.31).[35] Taken together, these incentives provide a strong rationale for expanding hiring in counties outside the industry's existing core.

### NEXT STEPS FOR STATE LEADERS

- *Evaluate the feasibility of matching private funds raised by institutions of higher education to establish technology incubators and provide early-stage companies with greater resources—particularly lab and manufacturing space—that will support local job creation. These efforts could parallel the Maryland E-Nnovation Initiative Fund's matching support for endowed university chairs.*[36]
- *Explore the viability of additional region-specific incentives targeting the conversion of existing commercial or industrial spaces for use in small-scale, modular life sciences manufacturing.*

## FINAL CONSIDERATIONS: A MORE STRATEGIC APPROACH

Prior initiatives, including the Excel Maryland development strategy focused on the life sciences, have established the value of a more coherent approach to pursuing growth by leveraging the state's existing assets.[37] The next steps outlined above are largely tactical measures that merit additional consideration for their ability to attract investment and stimulate job creation in the life sciences industry. However, it is still important for state leaders to consider strategies for adopting best practices that have been successful elsewhere, particularly in the face of increased competition from other states:

- Massachusetts has fostered one of the nation's strongest life sciences industries by implementing multiple initiatives that have been specifically designed to support investment across the state. For example, MassDevelopment deployed its Brownfields Redevelopment Fund to convert a former General Electric campus in Pittsfield to the Berkshire Innovation Center,[38] and the Massachusetts Biotechnology Council has developed a BioReady rating system to evaluate municipal zoning and infrastructure as a means of helping life sciences companies find the most favorable destination in the state.[39]
- North Carolina's strong connection between industry and institutions of higher education has helped firms recruit and hire local residents. For example, the BioWork community college initiative trains process technicians in biotechnology, pharmaceutical, or chemical manufacturing[40] and the Biomanufacturing Training and Education Center at North Carolina State University provides training in biomanufacturing technologies, ensuring that program graduates have the requisite skills while minimizing the time and costs incurred by industry when taking on new hires.[41]

- Pennsylvania has successfully demonstrated that existing facilities can be converted to expand the state's life sciences manufacturing capacity. In Philadelphia, the former Budd Company Hunting Park auto and train parts plant is slated for redevelopment as the Budd Bioworks.[42] And in King of Prussia, the Center for Breakthrough Medicines is being developed as a CDMO through partnerships among Discovery Labs, GlaxoSmithKline, WuXi Biologics, and the University of Pennsylvania Gene Therapy Program.[43]

Using these examples, Maryland's state leaders should focus on developing—and executing—strategies that can help sustain the state's identity as a leader in the life sciences industry by enhancing the entrepreneurial ecosystem through greater investment in early-stage life sciences companies, increasing the amount of manufacturing and lab space available to entrepreneurs and startup firms, and expanding the size of its innovation-ready workforce.

The state already has considerable assets, particularly the large volume of new technologies generated through research by academics, federal labs, and the private sector. And Maryland's prominent role in responding to the COVID-19 pandemic—from testing and analysis of data to the development, manufacturing, and distribution of treatments and vaccines—clearly demonstrated the value of these assets. Pursuing new opportunities for job creation in Maryland's life sciences industry will require using these assets to support even greater collaboration among industry, government, academic, and nonprofit leaders. And a more cohesive strategy—such as the broad range of place-based initiatives found in other states—can enhance the life sciences industry's growth trajectory and further increase the number of job opportunities available to residents across the state.

# ENDNOTES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9. The life science industry's impact on Maryland's economy also includes indirect support for employment by contract manufacturers and suppliers of key inputs as well as a broad range of service industry jobs. When these are considered, the bioscience industry supported a total of 117,600 jobs in 2018. See "Maryland. The Bioscience Economy: Propelling Life-Saving Treatments, Supporting State & Local Communities," *Teconomy Partners LLC and Biotechology Innovation Organization*, 2019, https://www.bio.org/sites/default/files/2020-06/BIO2020-report.pdf.

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## ACKNOWLEDGMENTS

The authors thank the Maryland Technology Council for its technical support in the completion of this policy brief, as well as the academic, nonprofit, private, and public sector leaders (particularly members of the Maryland Technology Council Advisory Board) who shared their time, experience, and perspectives to help complete this analysis. They also give special thanks to Milken Institute colleagues Matt Horton, Samuel Hanigan, and Joyce Yun for their assistance in completing this brief. All errors and omissions are attributed to the authors.

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