

Window on the Workplace 2023



NC Central University/BRITE



Durham Tech Community College



NC State/BTEC



Johnston Community College



NCBiotech/Accelerate NC Ambassador Program



Central Carolina Community College



Thermo Fisher Scientific/Greenville

Workforce Training Needs for North Carolina's Biopharma Manufacturing Industry

North Carolina Biotechnology Center®



Created in partnership with:

NCLifeSci

Acknowledgments

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Letter from the Presidents

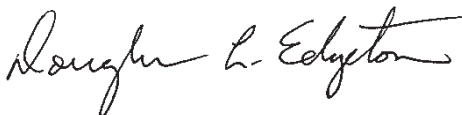
The 2020 Window on the Workplace report projected strong and steady growth of the biopharma manufacturing industry. Even with COVID-19 impacting biopharma workplaces, North Carolina life sciences companies did not slow down. FUJIFILM Diosynth Biotechnologies, which broke ground for expansion of its Research Triangle Park (RTP) site just before the pandemic, announced a new \$2 billion facility in Holly Springs in March 2021, the largest single life sciences investment announced to date in N.C. Eli Lilly selected RTP for its first N.C. location in early 2020, followed by the announcement of a second facility in Concord in 2022, and then doubled down in RTP in 2023 with a \$450 million expansion. Thermo Fisher Scientific is expanding its footprint in the Greenville area, hiring nearly 800 additional workers. Amgen, Astellas Gene Therapies, and numerous other companies have joined N.C.'s life sciences community. Between January 2020 and December 2022, there were 31 public announcements from biopharmaceutical manufacturing companies totaling nearly 6,200 new jobs and \$7.6 billion investment.

Talent continues to be key to N.C.'s success in the life sciences. The North Carolina Biotechnology Center (NCBiotech) and the North Carolina Life Sciences Organization (NCLifeSci) – previously known as NCBio – have been collaborating on WoW studies since 2002. During the study released in 2003, NCLifeSci worked with a group of biomanufacturing companies on efforts to improve the availability of workers for the industry. As a result of that collaboration, NCBiotech and NCLifeSci initiated NCBioImpact, a consortium of industry and academia, to coordinate biopharma manufacturing education and training programs.

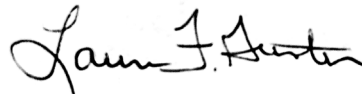
As part of the 2022 survey, training institutions were surveyed to assess current training programs and the capacity to add more courses to meet the needs of the industry. New equipment and more instructors are critical to the ability of these institutions to meet the growing demand for talent. Institutions are formalizing long-held collaborations with Wake Tech and Durham Tech's RTP BIO to serve the companies in the Research Triangle area. Both institutions are opening new facilities to meet the demand. Alamance Community College opened a new building in 2022 to serve the Triangle and Triad regions. Twelve community colleges now offer the BioWork certificate course, which provides entry-level training for the industry, and more courses are offered to strengthen the skills of entry-level employees.

In 2022, a statewide coalition of public and private organizations, led by NCBiotech, was awarded \$25 million as part of the Build Back Better Regional Challenge by the U.S. Economic Development Administration. This award will further strengthen N.C.'s biopharma manufacturing cluster by expanding, connecting, and promoting training and career opportunities to underserved and distressed communities, including historically excluded populations. Further, this award represents a significant inflection point that will enable the state to accelerate progress to make biopharma manufacturing careers accessible to more North Carolinians, while ensuring that current and future employers have access to top talent.

In reading this report, you may have ideas and suggestions on steps that we can take to enhance opportunities for N.C. companies and to recruit more employees into this workforce. We encourage you to visit our [WoW page](#) and offer your feedback.



Doug Edgeton
President & CEO, NCBiotech



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President, NCLifeSci

Executive Summary

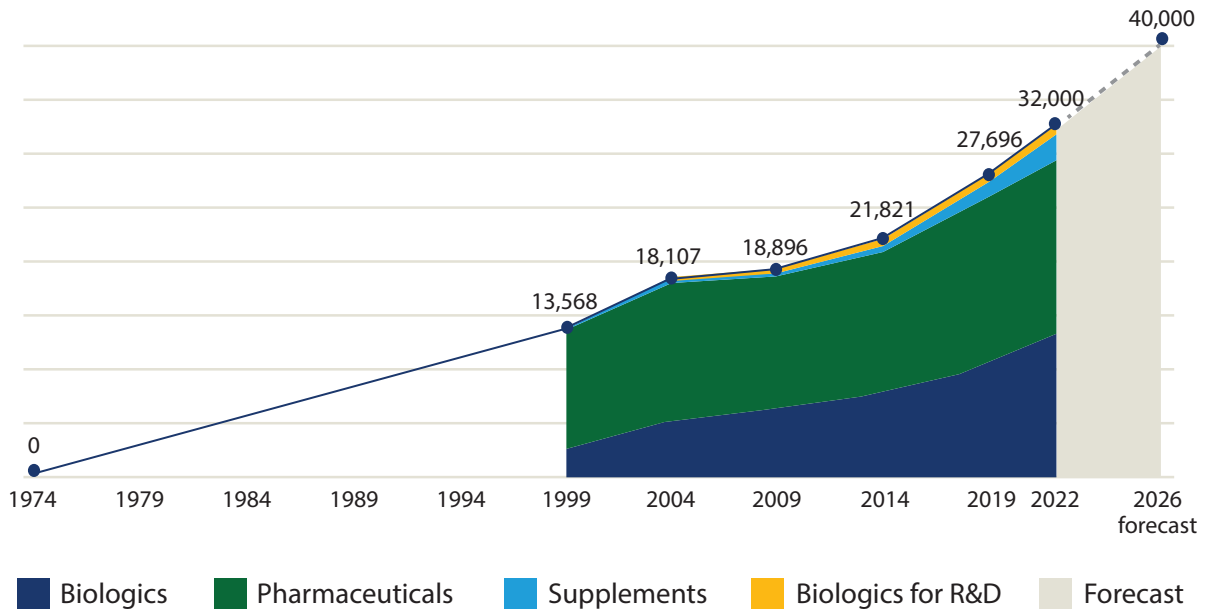
The 2020 Window on the Workplace report (WoW 2020) projected strong and steady growth of the biopharma industry. Today, N.C. remains a global leader in biopharma manufacturing with 108 biopharma manufacturing sites employing more than 32,000 people with average salaries of \$92,652. Biopharma manufacturers rely on a highly skilled and trained workforce. NCBIoImpact, a consortium of industry and academia in the state, has been developing training programs to meet those specific needs for more than two decades.

In 2022, NCBiotech and NCLifeSci surveyed biopharma manufacturing sites and biopharma manufacturing training programs. These Window on the Workplace (WoW) surveys were designed to understand workplace environments, needs, employee demographics, and expected growth, as well as explore how well current training programs match industry requirements and are positioned to meet future demands. Data was collected from 33 biopharma manufacturing sites and 19 training programs.

Growth

NCBiotech predicts that total employment at N.C. biopharma manufacturing sites will grow by approximately 8,000 more employees between the end of 2022 and the end of 2026. This estimate includes expected employee growth provided by surveyed sites, public expansion and relocation announcements between October 2020 and July 2022, and projected announcements.

Employment at biopharmaceutical manufacturing sites in NC



Strengths

- N.C. has a broad range of biopharma manufacturing sites producing biologic therapeutics, pharmaceuticals, biologics for R&D, supplements and nutraceuticals at both clinical and commercial stages of production. Sites are located across the state with a concentration in the Research Triangle region.¹
- The average starting salary across entry-level roles is \$51,142, with entry-level salaries ranging from \$45,900 for manufacturing roles to \$69,500 for validation roles.
- Training programs extend from certificate courses to associate degrees, bachelor's degrees, and graduate programs. Overall, training programs report a remarkably high placement rate for graduates.
- While existing programs were well matched to train graduates with the skills most in demand by employers, several new training programs have been developed since WoW 2020.

Challenges

- Survey responders reported employee turnover rates from 0% to 40% with an average of 13.4%. This is an increase of approximately 50% over the 8.8% average turnover rate reported in WoW 2020.
- Some training programs are currently operating at capacity and need increased funds to provide for additional equipment, space, and instructors. Other training programs are not filling their existing capacity.
- Training program participants are more diverse and younger on average than the existing workforce, highlighting the opportunity to improve Diversity, Equity, and Inclusion efforts at biopharma manufacturing sites.

Opportunities

- As novel cell- and gene-based therapies gain approval from the U.S. Food and Drug Administration (FDA) and market acceptance, this segment of biopharma is emerging as a key driver of manufacturing growth in N.C.
- The U.S. Economic Development Administration Build Back Better Regional Challenge Phase 2 grant awarded in 2022 is expected to have a significant impact. The \$25 million grant is focused on innovating and growing training capacity in the state with an emphasis on increasing both demographic and geographic diversity of N.C.'s biopharma manufacturing workforce.
- For biopharma manufacturing training programs not currently at capacity, improving awareness of the training programs among potential job seekers and industry sites is essential. For training programs currently at capacity, additional resources to expand capacity are imperative. N.C. educational institutions that do not currently offer biopharma manufacturing-specific training programs can improve graduates' awareness of local training and career opportunities.
- Closer collaboration between existing N.C. biopharma manufacturing companies and training programs will ensure skillset alignment with industry needs and accessible jobs for graduates.

¹ NCBiotech defines the Research Triangle region as the following counties in central N.C.: Chatham, Durham, Franklin, Granville, Harnett, Johnston, Lee, Moore, Orange, Person, Vance, Wake, and Warren.

Background

Coevolution of Industry and Training

N.C.'s biopharma manufacturing industry and associated training infrastructure have coevolved for more than two decades. Determining the needs of the biopharma manufacturing industry has been an essential task since the early years of the sector's growth in the state (Figure 1). NCBiotech conducted the first Window on the Workplace study in the mid-1990s (report released July 1997) and held a forum for company representatives and educators to discuss training and education needs for the industry. Since then, both the industry and training infrastructure have grown significantly.

By the early 2000s, N.C.'s biopharma manufacturing cluster grew to the point of requiring a major investment in talent to meet increasing demand. In 2001, NCBiotech partnered with the N.C. Community College System to create the BioWork certificate program to provide foundational training for entry-level technicians and operators. BioWork remains a best practice in specialized biopharma manufacturing training to this day.

In 2003 the Golden LEAF Foundation made a \$60 million investment to create a consortium of industry and academia now known as NCBioImpact. NCBioImpact supported the development of training programs, including the Biomanufacturing Training and Education Center (BTEC) at North Carolina State University, the Biomanufacturing Research Institute and Technology Enterprise (BRITE) at North Carolina Central University, the specialized education and training resources of the North Carolina Community College System's BioNetwork at community colleges across the state, and most recently the North Carolina Pharmaceutical Services Network (NCPSN) at East Carolina University and Pitt Community College. This investment in talent created the world's most comprehensive biomanufacturing education and training capability and also fueled the next 20 years of biopharma manufacturing growth in N.C. Today, there are more than 32,000 employees at 108 biopharma manufacturing sites in N.C. with average salaries of \$92,652.



Training Program Activities

- 1997:** First WoW Report Released
- 2001:** NCBiotech developed BioWork curriculum and inaugural class was held at Vance-Granville CC
- 2003:** Golden LEAF invested \$60 million to create NCBioImpact Consortium
- 2004:** BioNetwork CC Program founded
- 2005:** National Center for the Biotechnology Workforce at Forsyth Tech opened
- 2007:** Biomanufacturing Training and Education Center (BTEC) opened at NC State
- 2008:** Biomanufacturing Research Institute and Training Enterprise (BRITE) opened at NCCU
- 2011:** Pharmaceutical Education and Research Center (PERC) at Campbell University established
- 2016:** NIIMBL, one of the now 16 manufacturing innovation institutes in the Manufacturing USA network, was created
- 2017:** North Carolina Pharmaceutical Services Network (NCPSN) established at ECU and PCC
- 2018:** Johnston CC Workforce Development Center reopened after \$1.3 million industry-funded renovation
- 2019:** BioWork curriculum updated and redesigned with industry input
- 2021:** Eastern Region Pharma Center (ERPC) at ECU opened
- 2022:** Alamance CC Biotechnology Center of Excellence opened
- 2023:** BBBRC-funded program activities began

Biopharma Manufacturing Industry Growth



Figure 1: Coevolution of industry and training since 1997.

Need for Highly Skilled Talent

A recent national assessment of life sciences talent by TEconomy and the Coalition of State Bioscience Institutes (CSBI) highlighted the especially intensive employment within the industry of roles related to science, technology, engineering, and mathematics (STEM), finding that: “The life sciences are among the most intensive in their deployment of STEM talent—nearly one-in-three industry workers is employed in a STEM occupation, a concentration five times that of all U.S. industries.”²

The TEconomy/CSBI study found that not only is the industry especially STEM-intensive in its jobs requirements, but it also has a much greater concentration of both high- and middle-skilled roles requiring postsecondary credentials, including certifications and associate degrees. Specifically, the study found:

“In 2020, nearly half (47%) of life science industry employment was in high-skilled occupations compared with 27% for all other industries. These include the vast majority of scientist, engineering, IT, and data sciences roles, or STEM-related talent, and reinforce the critical need for robust national postsecondary education degree programs to meet industry talent needs.



At the same time, about one-in-three life science industry jobs fall in the middle-skills categories, again well above the share for all industries. As a leading advanced manufacturing industry, life sciences companies rely heavily on the skilled technician workforce, both in engineering and scientific domains; production workers with varied skills; transportation and material-moving occupations; installation, maintenance, and repair; and more. These workers are operating in increasingly digital and automated manufacturing environments, a shift represented by ‘Industry 4.0’ with significant and important implications for community colleges and other training providers.” Here, industry 4.0 refers to “smart manufacturing” and the increasing digitization of the manufacturing process.

N.C.’s diverse industry-specific training programs ensure that the state has the necessary highly skilled talent across all levels within biopharma manufacturing facilities from operators and technicians to quality assurance and quality control up through manufacturing sciences and management roles.



“Many people in the region already have pharma/biotech experience, especially in manufacturing. Additionally, the Triangle’s top-class university and community college systems are continually infusing new talent into the workforce.”

– Andrew Stober,
Chief Manufacturing Officer
Encoded Therapeutics

² 2021 Life Sciences Workforce Trends Report: Taking Stock of Industry Talent Dynamics Following a Disruptive Year. Coalition of State Bioscience Institutes (CSBI) & TEconomy Partners, LLC. June 2021.

NC Biopharma Manufacturing Training Programs



BioNetwork is the life sciences training initiative of the N.C. Community College System that includes:

- BioWork certificate program offered at 12 community colleges.
- Customized training and coursework for incumbent employees and transitional workers.
- Professional development for science teachers and STEM outreach.



Biomufacturing Research Institute and Technology Enterprise (BRITE) at North Carolina Central University is a 52,000-square-foot classroom and lab facility providing hands-on learning opportunities including:

- Undergraduate and graduate degree programs.
- Basic and translational research experiences.
- Outreach and community programs for middle and high school students and teachers.



Golden LEAF Biomufacturing Training and Education Center (BTEC) at North Carolina State University offers the latest biomufacturing technologies to provide hands-on learning including:

- Professional Science Master's degrees, both undergraduate- and graduate-level certificates and minors.
- Customized short courses for industry professionals.
- Contract bioprocess and analytical services.



The North Carolina Pharmaceutical Services Network (NCPSN) is a collaboration between East Carolina University and Pitt Community College that provides a continuum of pharmaceutical education and training including:

- GMP/GLP courses and short courses for undergraduate and graduate students.
- Hands-on oral solid dose training program.
- Analytical services for government, academia, and industry.

Industry Footprint & Impact

North Carolina's life sciences community includes more than 800 companies that employ over 75,000 North Carolinians. A recent TEconomy Partners study of the life sciences industry in the state found average annual wages of almost \$112,000 in 2021, nearly double the \$60,000 annual wages reported for N.C.'s overall private-sector workforce.³ While approximately two-thirds of all N.C. life science company sites and workers are concentrated in the Research Triangle region, this industry has a statewide reach and impact (Figure 2).

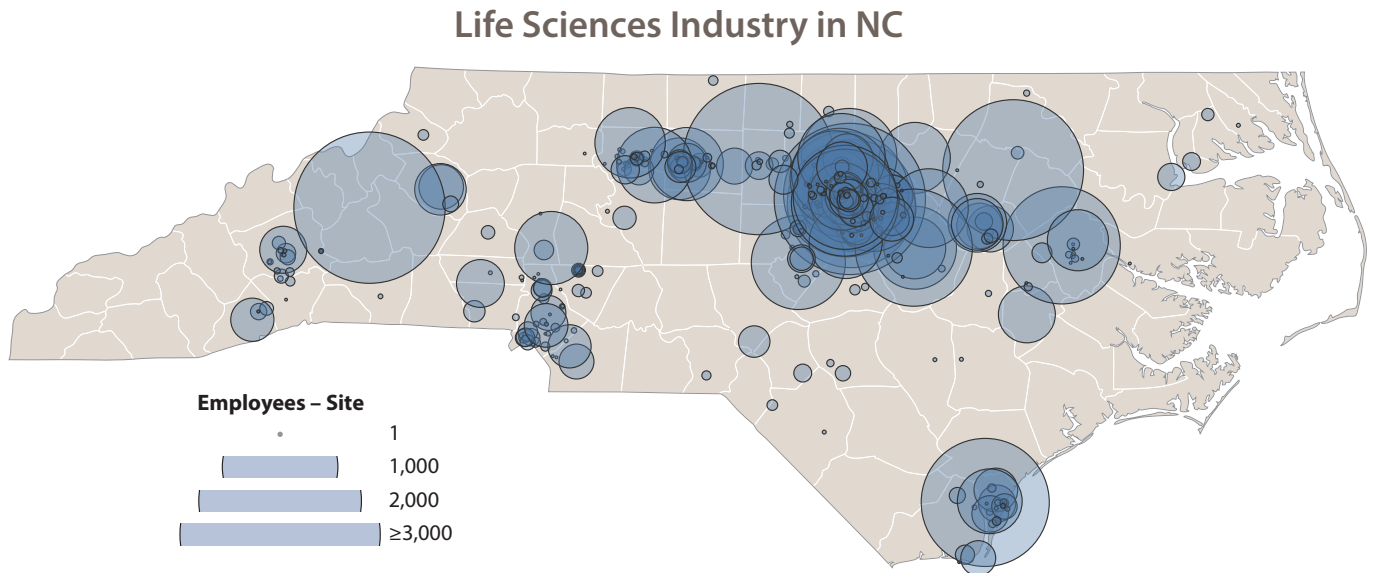


Figure 2: Life sciences industry in NC. Circle size indicates employment at site.

The life sciences industry is a significant economic driver in North Carolina. TEconomy Partners' analysis estimated that wages and salaries directly paid or supported by the life sciences industry generate \$11.4 billion in economic activity and support more than 70,000 jobs earning \$3.5 billion in labor income in the form of induced impacts. In addition, N.C.'s 800+ life sciences companies directly generate \$1.1 billion in combined state and local government revenues annually. To support operations, the life sciences industry purchases goods and services generating another estimated \$18.3 billion in economic activity statewide. Including all multiplier effects, these 800+ companies generate an estimated \$88.3 billion in economic activity in N.C.³ This represents an increase in total economic output from \$84.4 billion in 2020⁴ and \$83.3 billion in 2018.⁵

From 2018 to 2021, life sciences employment growth in N.C. accelerated and outperformed national growth, increasing by 13% compared to 11% growth for the U.S. life sciences sector overall, placing N.C. among the top four performing states. Importantly, during 2020 and 2021 when the economy was heavily impacted by the COVID-19 pandemic, the life sciences sector in N.C. averaged 5% annual growth while the private sector overall was flat, averaging 0.6% annual growth. Additionally, N.C.'s life sciences industry base is incredibly broad and features a higher employment concentration than the national average in four areas: drugs and pharmaceuticals; research, testing, and medical labs; agricultural feedstock and industrial biosciences; and bioscience-related distribution.²

³ 2022 Evidence & Opportunity Impact of Life Sciences in North Carolina, TEconomy Partners LLC, November 2022.

⁴ 2020 Evidence & Opportunity Impact of Life Sciences in North Carolina, TEconomy Partners LLC, February 2021.

⁵ 2018 Evidence & Opportunity Impact of Life Sciences in North Carolina, TEconomy Partners LLC, January 2019.

Biopharma Manufacturing

The 2023 WoW survey focused on the life sciences industry subsector of biopharma manufacturing; for the purposes of this study, biopharma manufacturing includes sites manufacturing biologics, vaccines, cell- and gene-based therapies, regenerative medicines, biologics for R&D, pharmaceuticals, diagnostics, supplements, and nutraceuticals (Figure 3). The study did not include sites manufacturing other life sciences products such as medical devices, laboratory supplies, or equipment.

Biopharma Manufacturing Sites in NC by Category

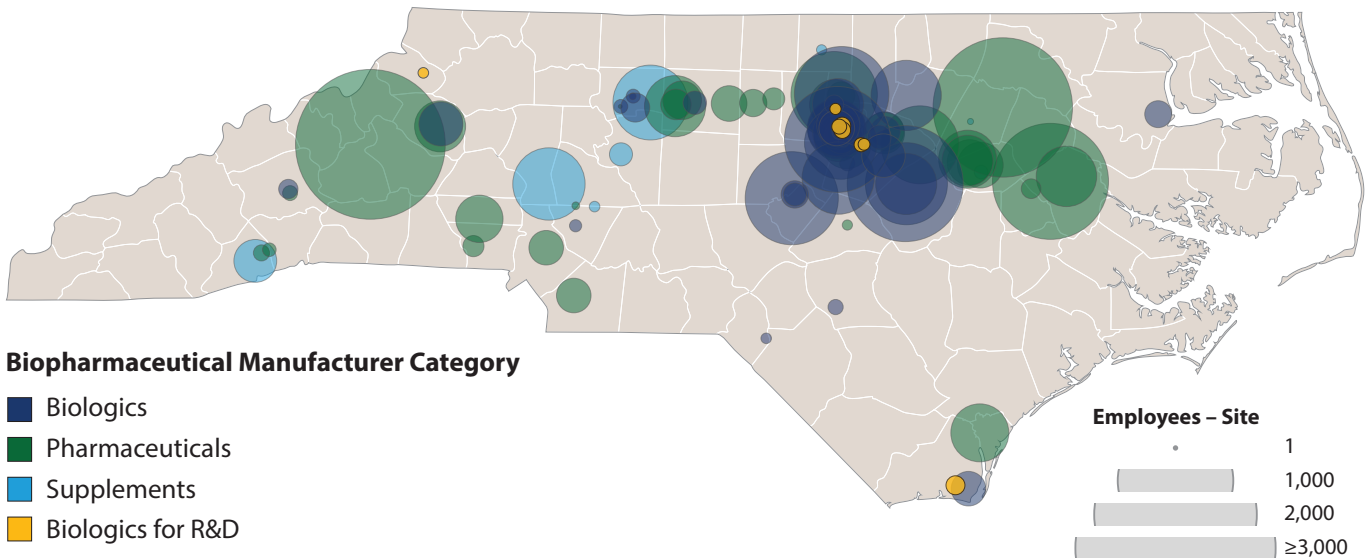


Figure 3: Biopharmaceutical manufacturing sites. Circle color indicates category by product type. Circle size indicates site employment.

Of the over 800 N.C. life sciences companies, 96 are biopharma manufacturers operating 108 sites that employ approximately 32,000 people. Biopharma manufacturing sites are dependent on highly skilled and trained workers, accounting for 43% of the state’s overall life sciences employment. Sites are widely distributed across the state, with a concentration of sites in the Research Triangle region. Biologics manufacturing sites tend to be clustered in the Research Triangle, while there are significant pharmaceutical manufacturing sites in both eastern and western N.C. (Figure 3).

	Companies	Sites	Employment
Life Sciences in NC	800+	860+	~75,000
Biopharma Manufacturing Sites in NC⁶	96	108	~32,000

Table 1: Life sciences industry in NC.

⁶This differs from the NCBiotech Company Directory category for companies whose primary activity is Production & Manufacturing. This list includes sites that may be primarily classified as R&D or Contract Research & Testing, but also perform biopharma manufacturing.

Recent Growth

Between January 2020 and December 2022, there were 92 public announcements from life sciences companies totaling more than 12,500 jobs and \$9.1 billion investment (Table 2) in North Carolina. Of those, biopharma manufacturing companies made 31 announcements totaling 6,200 new jobs and \$7.6 billion of additional investment, accounting for approximately one-third of life sciences announcements in the state during this time and half of the jobs announced due to the size of these operations (Figure 4).⁷ New jobs were announced at sites manufacturing biologics, traditional pharmaceuticals, and supplements and nutraceuticals, with biologics manufacturing sites representing the largest proportion (nearly two-thirds) of manufacturing announcements. Announced jobs were spread across the state, with two-thirds of the announced jobs in the Research Triangle region.

Industry	Announcements	Jobs	Investment
All Life Sciences	92	12,500	\$9.1 billion
Biopharma Manufacturing	31	6,200	\$7.6 billion

Table 2: NC relocation and expansion announcements from life sciences companies, 2020-2022.

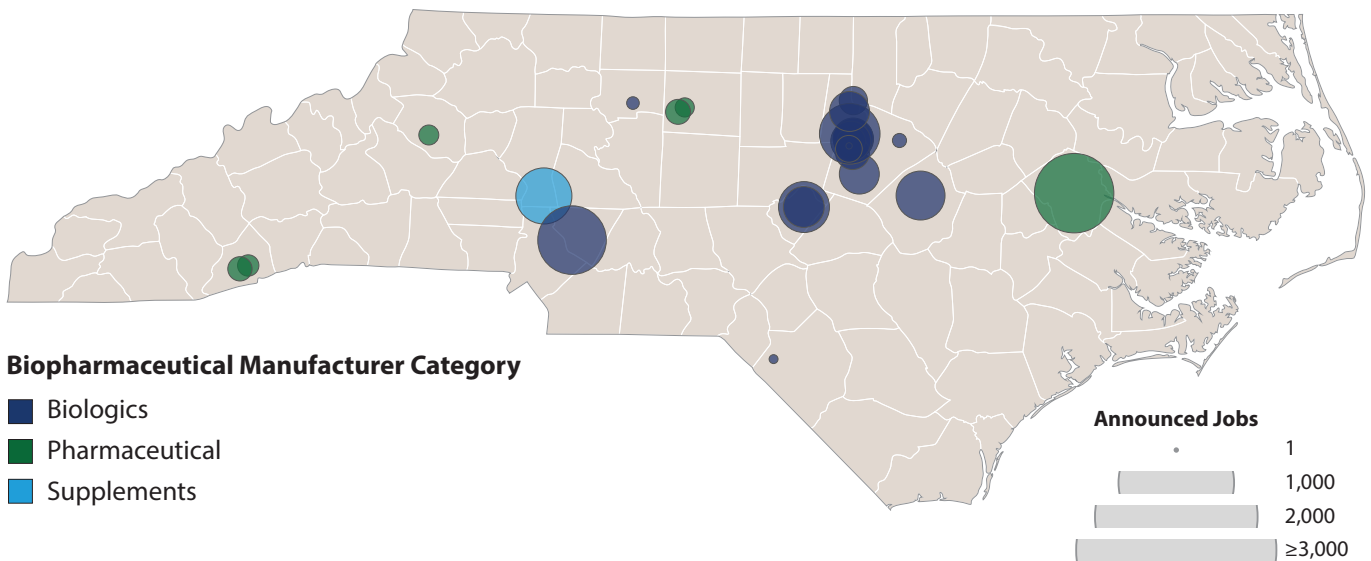


Figure 4: Biopharma manufacturing announcements, 2020-2022. Circle color indicates category by product type. Circle size indicates announced jobs number.

This significant growth comes both from new companies entering N.C. for the first time and from the expansion and continued investment of companies that have been in the state for decades (Figure 5). For example, Amgen is investing in N.C. for the first time with a \$550 million manufacturing facility in Holly Springs that will employ 355 people. FUJIFILM Diosynth Biotechnologies is both expanding at its Morrisville site, creating 145 new jobs, and establishing a new \$2 billion end-to-end cell culture facility in Holly Springs that will create an additional 725 new jobs. Upon completion, FUJIFILM Diosynth Biotechnologies’ Holly Springs site will be the largest facility of its type in North America.

⁷Of note, several companies including ApiJect, Adverum, and Taysha Gene Therapies made public announcements detailing biopharma manufacturing expansion plans in N.C. that were subsequently cancelled. As such, they have been excluded from the data.

Background

	September 2022 Clayton (Johnston County) 175 new jobs \$750M investment		April 2021 Sanford (Lee County) 325 new jobs \$213M investment
	February 2022 Mooresville (Iredell County) 394 new jobs \$177M investment		March 2021 Holly Springs (Wake County) 725 new jobs \$2B investment
	January 2022 Concord (Cabarrus County) 589 new jobs \$939M investment		December 2020 Greenville (Pitt County) 500 new jobs \$500M investment
	January 2022 RTP (Wake County) 145 new jobs		December 2020 Durham (Durham County) 200 new jobs \$150M investment
	October 2021 Durham (Durham County) 200 new jobs \$125.4M investment		October 2020 Durham (Durham County) 100 new jobs
	September 2021 Greenville (Pitt County) 290 new jobs \$154M investment		August 2020 RTP (Durham County) 201 new jobs \$83M investment
	August 2021 Winston-Salem (Forsyth County) 183 new jobs \$19M investment		June 2020 Clayton (Johnston County) 300 new jobs \$351.6M investment
	August 2021 Holly Springs (Wake County) 355 new jobs \$550M investment		February 2020 Sanford (Lee County) 209 new jobs \$109.4M investment
	May 2021 Durham (Durham County) 200 new jobs \$157M investment		January 2020 RTP (Durham County) 460 new jobs \$470M investment

Figure 5: Significant announcements (more than 100 jobs) by biopharma manufacturing companies in NC between January 2020 and December 2022. For more announcement information, each logo is hyperlinked.

As outlined in WoW 2020, this rapid industry growth stems from existing companies and technologies seeking to scale and expand capacity as well as the innovation of new technologies and processes. One recent innovation in the life sciences community has been the development and FDA approval of cell- and gene-based therapies. First approved by the FDA in 2017, these therapies represent a paradigm shift in treatment for a range of diseases that currently have no cure, with the potential to prevent or cure genetic or acquired diseases by targeting the underlying cause.

Cell- and Gene-based Therapy

N.C. has become a leader in manufacturing cell- and gene-based therapies as both home-grown companies and those new to the state seek to leverage N.C.'s existing clinical- and commercial-scale manufacturing prowess once they reach the manufacturing stage of therapeutic development. Precision BioSciences, a spin-out from Duke University, is using its proprietary ARCUS® genome-editing platform to develop Chimeric Antigen Receptor T-cell (CAR-T) immunotherapies as well as gene-editing treatments in partnerships with Novartis and Eli Lilly. Asklepios BioPharmaceutical (AskBio), which has operated as an independent subsidiary of Bayer since its acquisition in 2020, was co-founded by N.C.-based gene therapy pioneer Jude Samulski and is currently developing gene therapies for six diseases.

Since the publication of WoW 2020, multiple companies, including Astellas Gene Therapies, Beam Therapeutics, CARsgen Therapeutics, and Jaguar Gene Therapies, have announced cell- and gene-based therapy manufacturing expansions in N.C. Some companies that have long been in the state, including Pfizer and Biogen, have expanded their therapeutics portfolio and N.C. manufacturing capabilities to include cell- and gene-based therapies. Additionally, Novartis Gene Therapies received FDA commercial licensure for its N.C. site in April 2022, and earlier this year Collectis announced that the first patient in the U.S. had received CAR-T cell therapy manufactured at its N.C. site.

Cell- and gene-based therapy is a rapidly growing therapeutic area with a strong market potential. BCC Publishing forecasts the global market for cell- and gene-based therapy will expand at a compound annual growth rate of 33.6% from an estimated \$4.1 billion in 2021 to reach \$17.4 billion in 2026.⁸ Despite challenges, such as payer acceptance and small patient populations, funding for companies in this sector has been robust. In N.C., cell-and gene-based therapy companies reported raising more than \$755 million in 2022 from a variety of funding sources, including \$49.8 million in venture capital.⁹

The year 2022 was a record period for approval of new gene therapies to treat rare diseases, including the authorization of BioMarin's Roctavian, the first gene therapy to treat Hemophilia A. In addition, 2022 was a notable year for CAR-T therapies with the approval of Janssen's and Legend Biotech's Carvykti and Breyanzi in Europe making a total of six CAR-T therapies available in Europe and the United States.

The path to approval for new therapeutic modalities is fraught with challenges that include clinical failures, manufacturing scale-up, assay standardization, and negotiations with insurance companies, all of which can slow the process and success rate. While these challenges may result in layoffs or closure of facilities in some cases, these new therapeutics hold meaningful promise for patients who are currently without available treatments. Having a strong workforce to manufacture these cutting-edge therapies is imperative to their success.

⁸ Global Cell and Gene Therapy Market, BCC Publishing, February 2022.

⁹ NCBIotech database of funding to N.C.-based life sciences companies, 2022.

Cell- and Gene-based Therapy since 2020

Therapeutics
Approved Globally

19

gene therapies*

18

RNA therapies*

59

non-genetically modified
cell therapies*

1,500+

registered clinical trials
ongoing**

3,600+

therapies in development
worldwide*

* Barrett, David et. al. *Gene, Cell, & RNA Therapy Landscape, Q2 2022 Quarterly Data Report*. American Society of Gene + Cell Therapy

** Lohr, Adam. *2023's Market Outlook for Cell and Gene Therapies*. Cell & Gene. February 14, 2023

Training Program Updates

N.C. has programs ranging from K-12 industry awareness to certificate and degree programs and continuing education opportunities for current biopharma manufacturing professionals (See Appendix Table A5 for a list of institutions and training programs offered). The breadth of these programs in terms of both content and target audience ensures that N.C. employers have a highly trained and diverse workforce. NCBIoImpact and the associated training programs are the backbone of the continuum of specialized biopharma manufacturing training in the state.

To remain aligned with evolving manufacturing practices and needs, innovative programs, offerings, and facilities have been added since WoW 2020 including:



Alamance Community College's (ACC) new 33,000-square-foot Biotechnology Center of Excellence offers a variety of degrees and programs in biotechnology, histotechnology, and medical

laboratory technology to prepare students to enter the life sciences industry. ACC partners with community and business organizations such as Labcorp, Piedmont Triad Partnership, Syngenta, and Cone Health Alamance Regional Medical Center to provide students access to work-based learning opportunities. The center was funded by a \$39.6 million bond package that voters approved in 2018 and a \$3.6 million grant from the N.C. General Assembly to fund equipment.

BTEC at NC State now offers a hands-on course on cGMP biomanufacturing of vectors for gene therapy. The course was developed with funding from the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), the U.S. Department of Commerce National Institute of Standards and Technology, and additional support from NCBIotech.



**DURHAM
TECH**

Durham Technical Community College is developing a new pharmaceutical manufacturing workforce training program.

Two grants, including a \$240,000 Economic Adjustment Assistance grant from the U.S. Economic Development Administration and \$60,000 in matching funds from the Durham County Board of Commissioners, will be used to purchase equipment for aseptic process training, essential for sites manufacturing sterile products. Durham Tech's capabilities will be further expanded with the establishment of a 35,000-square-foot Life Sciences Training Center, expected to be completed in 2026, and funded by a \$6 million gift from Novo Nordisk and a 2022 bond referendum approved by Durham County voters.



Durham Tech Community College

Eastern Region Pharma Center

East Carolina University (ECU) received a \$1.9 million grant from the Golden LEAF Foundation to create a pharmaceutical training center in 2021. The Eastern



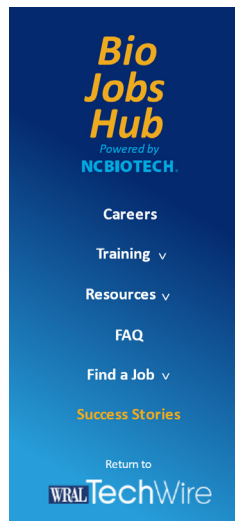
Eastern Region Pharma Center

Region Pharma Center (ERPC) is specifically designed to teach current pharmaceutical employees and students

advanced manufacturing techniques to address an unmet need for pharmaceutical workers with four-year college degrees in eastern N.C.'s BioPharma Crescent. Highlights of the ERPC include:

- Pharma Pathways Program, which enables ECU and community college staff collaborations to raise student awareness and provide job training and career opportunities, and to provide academic programs in the pharmaceutical industry.
- Building of the Manufacturing Capability and Cybersecurity Complex to serve as a hands-on, experiential education and training environment using industry-standard equipment and a pilot-scale continuous manufacturing line.
- Expansion of the N.C. Pharmaceutical Services Network (PSN at ECU) to offer employee training and opportunities for industry partners and pharmaceutical manufacturing short courses.

The **Bio Jobs Hub** website, launched by NCBiotech in 2020 with CARES Act funding, provides in-depth information about jobs in the life sciences industry in N.C. The site includes job descriptions, training qualifications, salaries, links to training programs, and a storytelling element with current workers explaining their paths to a successful career in biopharma.



Wake Technical Community College made several additions to its biopharma

manufacturing workforce training capacity. The \$47 million Lilly Science and Technology Center opened its doors in early 2022. The facility includes the Wake Early College of Information and Biotechnologies, career and technical degree programs, as well as workforce training



Wake Tech

and certifications. Additionally, Eastern Wake 4.0 was funded via a 2018 bond that raised \$349 million. The college broke ground in late 2021 on a 100+ acre site in Wendell that will include a technology 4.0 facility with labs to support biopharmaceutical technology. A 2022 bond will support the development of an Apex campus.



“Supporting students as they work toward becoming the next generation of professionals to pursue biopharmaceutical and life-science careers in our community is a passion we are incredibly proud to support and help put into action.”

– **Christine Vannais**,
NC Site Chief Operating Officer
FUJIFILM Diosynth Biotechnologies

NIIMBL bioLOGIC, a new project-based learning program for high school and middle school students, was piloted in Durham Public Schools in fall 2022 with support from NCBiotech and NIIMBL, and funding from the Office of Naval Research. The program is delivered in the classroom, incorporating exposure to both local training institutions and employers, to increase awareness and interest in biopharma manufacturing careers.



Report Overview

Given the established interconnectivity between N.C.'s biopharma manufacturing industry and training programs, WoW 2023 provides a snapshot of both. First, the report presents results from a survey of N.C.'s biopharma manufacturing industry, including growth projections and training needs. Next, the study highlights results from a survey of existing training programs with a focus on current and future capacity. The report concludes with an assessment of how this relationship between industry and training programs can be further strengthened and supported by partners within the state to ensure continued success.

Study Goals

Based on data collected from March through June 2022, this fifth WoW study provides a snapshot of N.C.'s biopharma manufacturing companies. The study focused on specific areas of interest, including:

- Securing an overview of biopharma manufacturing companies – site locations, product types, and operations.
- Assessing current and future employment – number of employees, demographics, scientific and technical areas of work, number of new hires, and turnover rate.
- Determining current and desired educational attainment and skills for employees.
- Evaluating current recruitment and hiring practices.
- Assessing company awareness of and desire to outsource training to existing training programs.
- Quantifying existing and future industry-relevant training capacity from continuing education through graduate degrees.
- Comparing industry's workforce needs to training program capabilities to identify any gaps or mismatch.

Study Design

Industry Survey

For this study, biopharma manufacturing is broadly considered to include facilities engaged in the manufacture of biologics, pharmaceuticals, supplements, and biologics for R&D as defined in Table 3. A full list of N.C. biopharma manufacturing sites and how they are classified for this study is included in Appendix Tables A1, A2, A3, and A4.

Biologics	Sites that primarily manufacture biologic therapeutics, enzymes, vaccines, cell- and gene-based therapies, and regenerative medicine products for clinical and commercial use. Includes companies that manufacture biological products for industrial use, such as enzymes and proteins. Biologics are referred to as large-molecule products and include proteins, peptides, carbohydrates, genetic material, etc.
Pharmaceuticals	Sites that primarily manufacture pharmaceuticals, pharmaceutical ingredients, diagnostic substances, and other drug products. Product forms include oral solid dose (tablets and capsules), large-volume parenteral, topical, and inhaled products. Includes companies that manufacture sterile IV fluids and nutrition.
Supplements	Sites that primarily manufacture vitamins, minerals, supplements, and nutraceuticals, including naturally nutrient-rich or medicinally active foods and herbal products. These sites may not be producing FDA-regulated products but typically function under cGMP practices and require a similar workforce.
Biologics for R&D	Sites that primarily manufacture biologic reagents, enzymes, antibodies, nucleic acids, peptides and amino acids specifically for use in research and development activities.

Table 3: Site classification in biopharma manufacturing.

Background

The survey was sent to more than 100 biopharma manufacturing sites in N.C. Thirty-three of the manufacturing sites submitted complete (24) or partial (9) responses between March and June 2022. The 33 responding sites employ 13,786 people, representing 43% of the total employees at biopharma manufacturing sites in the state (Table 4). Sites that responded represent multiple product types, a range of manufacturing stages, and diverse operations.

	Companies	Sites	Employment
Life Sciences in NC	800+	860+	~75,000
Biopharma Manufacturing in NC ¹⁰	96	108	~32,000
Biopharma Manufacturing Study Group	32	33	13,786

Table 4: Study group for WoW 2023.

Training Program Survey

Survey responses were collected between May and June 2022 from all institutions offering biopharma manufacturing-specific training programs. Representatives from five universities, 12 community colleges, and the N.C. BioNetwork Capstone Center participated in the survey for their institution (Appendix Table A5). This survey does not represent graduates with transferable skills from numerous related degree programs across the state, including biological and biomedical sciences or engineering.



¹⁰ Biopharma Manufacturing in N.C. differs from the NCBiotech Company Directory category for companies whose primary activity is Production & Manufacturing. This list includes sites that may be primarily classified as R&D or Contract Research & Testing in the NCBiotech Directory, but also perform biopharma manufacturing. Additionally, this list excludes sites that manufacture medical devices and equipment.

Study Results

The WoW 2023 study assesses the existing biopharma manufacturing industry and training infrastructure in N.C. Companies were surveyed to understand the current biopharma manufacturing workforce in the state, forecast changes to this workforce, and identify challenges that employers are facing to acquire and retain talent. As a complement, training programs were surveyed to quantify existing and future capacity and to identify challenges.

This section of the report begins with an overview of the survey responders and a snapshot of the current biopharma manufacturing industry followed by an overview of the existing biopharma manufacturing training infrastructure in N.C.

WoW Industry Survey

Existing Industry

Survey Group

Survey responders are not a perfect representation of all biopharma manufacturing sites in N.C. While only 45% of the biopharma manufacturers in the state are classified as manufacturing biologics, 73% of the survey responses (24 sites) represent biologics manufacturing sites. As a result, the data is heavily skewed towards the experience of biologics manufacturing sites (Figure 6).

Sites

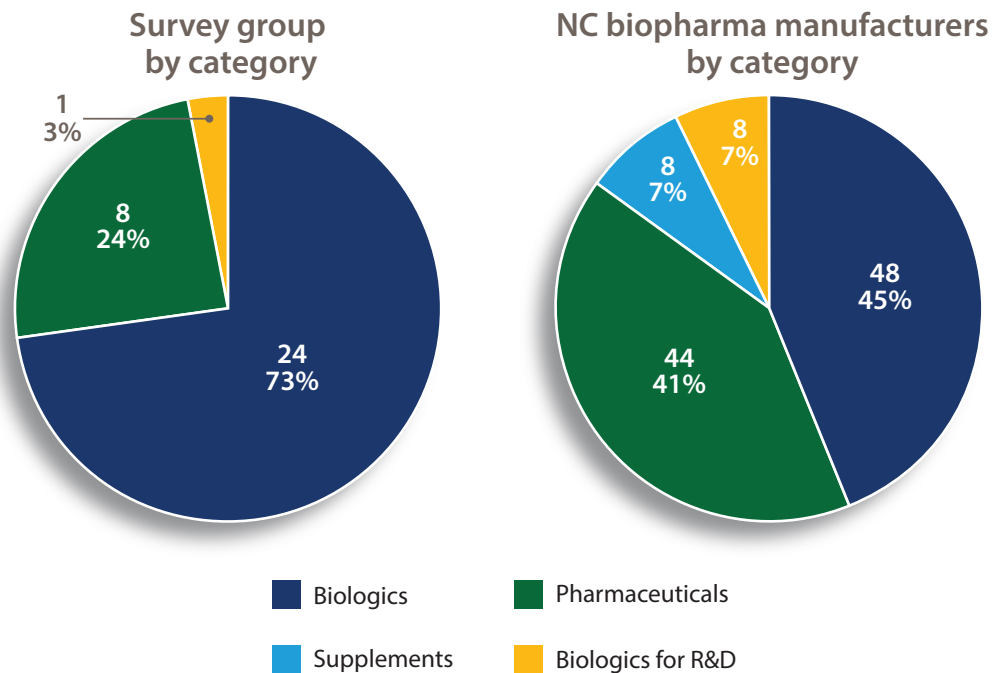


Figure 6: Categories of surveyed biopharma manufacturing sites for WoW 2023.

Employment

When analyzing the survey group by employment, there is an almost identical split between biologics and pharmaceuticals. Nearly three quarters (74%) of the 13,786 employees represented by survey responses are at biologics manufacturing sites, compared to 42% of employees at biologics manufacturing sites in N.C. overall (Figure 7). As 75% of biologics sites are located in the Research Triangle, this region of the state is also over-represented in the survey group. This distinction between the study group and the broader N.C. biopharma manufacturing community is important for interpreting the study results and acknowledging potential gaps in our understanding of the training needs of all categories of biopharma manufacturers across the state.

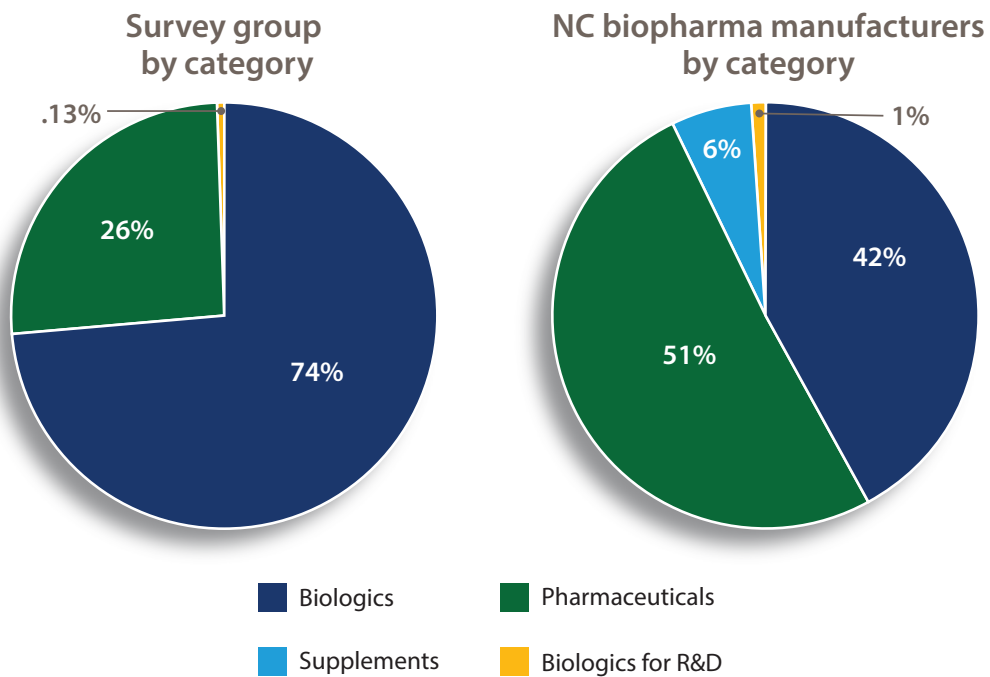


Figure 7: Employee information based on site category and manufacturing site types.



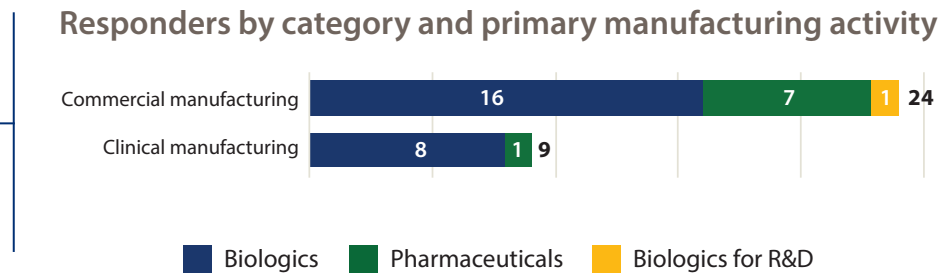
Site Activity and Product Types

Surveyed sites provided information about the type and category of products manufactured. While companies may perform multiple activities at a single site, these data reflect only the reported primary manufacturing activity for each site. Of 33 biopharma manufacturing sites that were surveyed, 73% engage in commercial manufacturing activities with the remainder engaged in clinical manufacturing activities (Figure 8).

Activity by Product Type

Seventeen of the 25 survey responders that manufacture biologics are engaged in commercial manufacturing (68%), including one manufacturing biologics for R&D. Of the eight pharmaceutical manufacturing sites, seven (88%) are engaged in commercial manufacturing. This differential reflects the industry overall, with many cutting-edge biologics, including cell- and gene-based therapies, still in clinical development.

Figure 8: Sites by manufacturing activities and product types.



Operations/Processes

Survey responders provided information about the types of operations and processes conducted at their sites (Figure 9). Responders could select multiple operations and processes, so the numbers reflect the prevalence of each activity within the study group overall. More than two-thirds of the 33 sites (69%) perform analytical testing as part of their manufacturing activity. More than half of the responders reported conducting specific biopharma development processes, including fermentation/cell culture, aseptic filling, process development, purification, and formulation. The significant number of survey responders who utilize these processes indicates a strong need for a local workforce with these skillsets.

Operations/processes conducted by responders

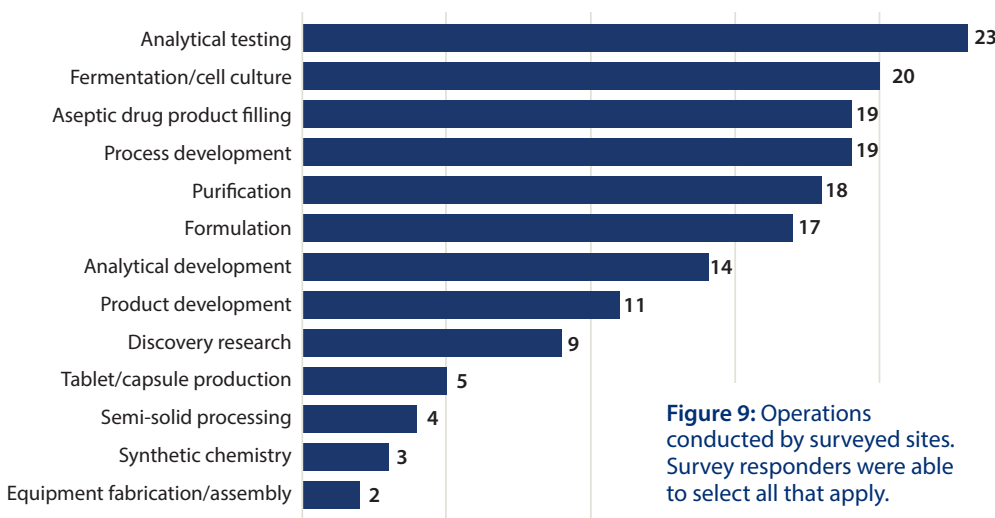


Figure 9: Operations conducted by surveyed sites. Survey responders were able to select all that apply.

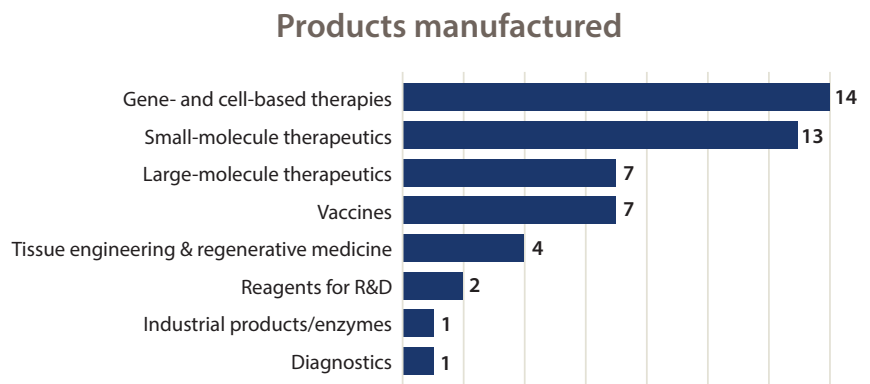
As seen in Figure 9, biopharma manufacturing sites perform a wide array of functions and need employees with broad capabilities and a depth of knowledge. These functions range from early discovery research (9 sites) and product development (11 sites) to aseptic filling (19 sites) or tablet/capsule production (5 sites). The site's focus and operations shape the scale, job type, and training required by the state's biopharma manufacturing employers.

Product Types

In addition to operations, site representatives provided information about the specific types of products manufactured at their facilities (Figure 10). While 27% of the sites manufacture more than one of these product types, the majority of sites in the study group (24 of 33) only manufacture one product type.

Fourteen sites (42%) reported manufacturing cell- and gene-based therapies while 13 sites (39%) reported manufacturing small-molecule therapeutics. Seven sites manufacture vaccines or large-molecule therapeutics, such as monoclonal antibodies. Only one site reported the manufacture of diagnostics and industrial products/enzymes, respectively. This is an over-representation of cell- and gene-based therapy manufacturers compared to the state's overall biopharma manufacturing community (17 of 108 sites or 16%), which is important to note when considering the following data.

Figure 10: Sites by product types manufactured. Note: small-molecule therapeutics include oral solid dose, parenteral, and inhaled products.



Employment

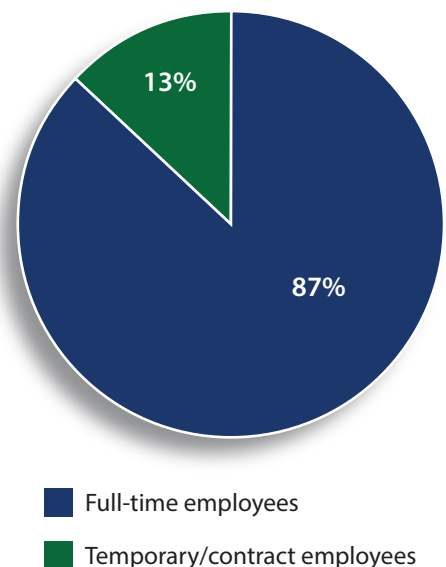
Surveyed sites provided information about their current workforce, including permanent versus temporary employee status, educational attainment, entry-level skillsets, and entry-level salaries.

Permanent Versus Temporary Employees

Surveyed sites were asked to classify the employment status of employees as either permanent full-time or temporary/contract employees. Most employees (87%) have full-time employment status (Figure 11); WoW 2020 reported that 88.4% of employees had full-time employment status, indicating that companies continue to utilize temporary and contract roles at a consistent level over time.

Figure 11: Full-time versus temporary/contract employees at surveyed sites. Thirty sites responded to this survey question.

Employment status



Educational Attainment

Survey responders were asked to provide information about the educational backgrounds of their employees. Twenty-eight biopharma manufacturing sites provided a **simplified** breakdown (i.e. AA/AS and below versus BA/BS and above) of the education level of their employees, representing 9,792 employees (31% of the state's total biopharma manufacturing workforce). Sixty-two percent of employees at biopharma manufacturing sites have a bachelor's, master's, or doctoral degree, while over one-third have an associate degree or less (Figure 12).

Given the over-representation of biologics manufacturing sites in the survey group and the increased level of complexity to manufacture these products, it is unsurprising that respondents indicated 60% of employees have a bachelor's degree or above. Interestingly, surveyed pharmaceutical manufacturing sites reported 69% of employees with a bachelor's degree or above, but this data is likely skewed due to a low sample size (1,572 employees represented).

NCBiotech also compared employee educational attainment at established N.C. manufacturing sites to sites that are in the start-up or pre-production phase. Although the sample size is small (6 sites, 336 employees), there was a notable difference in the proportion of employees with at least a bachelor's degree at new sites (80%) compared to established sites (61%). The higher educational attainment levels observed at new sites is likely due to the increased level of specialization and experience required for setting up a new facility or new product line, and NCBiotech expects these sites to increase the proportion of employees with an associate degree or below as their manufacturing processes are established.

In addition, 25 of the 33 sites provided a more **detailed** breakdown of the educational attainment level of their employees. This data represents a subset of 7,401 employees (23% of the state's total biopharma manufacturing workforce). While the percentages in the following chart do not align perfectly with Figure 12 due to three fewer sites providing this level of detail, the more detailed data for those 25 sites is still informative (Figure 13).

Almost half the employees have completed a bachelor's degree as their terminal degree (47%), while an additional 19% hold graduate degrees (Figure 13). There is a significant segment of employees without college degrees, with 28% of employees obtaining a high school education plus biopharma-specific training such as BioWork. Only 6% of employees were reported to have an associate degree. Importantly, seven sites indicated they expect or would like to hire more candidates without a bachelor's degree in the next five years.

Employment by highest level of educational attainment

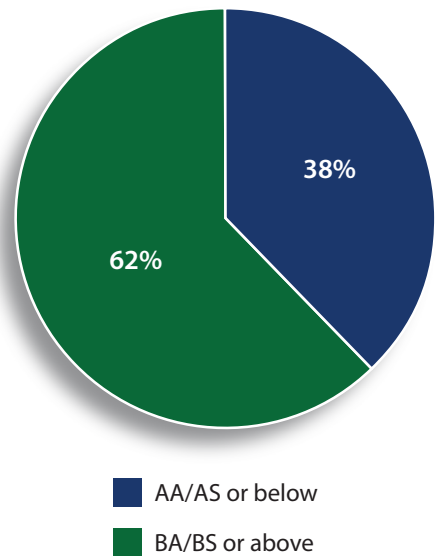


Figure 12: Simplified employment by highest level of educational attainment. Twenty-eight biopharma manufacturing sites provided this information. BA/BS or above includes bachelor's (Arts and Sciences), master's, or doctoral degrees whereas AA/AS or below includes employees with associate degrees in applied sciences or high school with a certification or work experience.

Employment by highest level of educational attainment

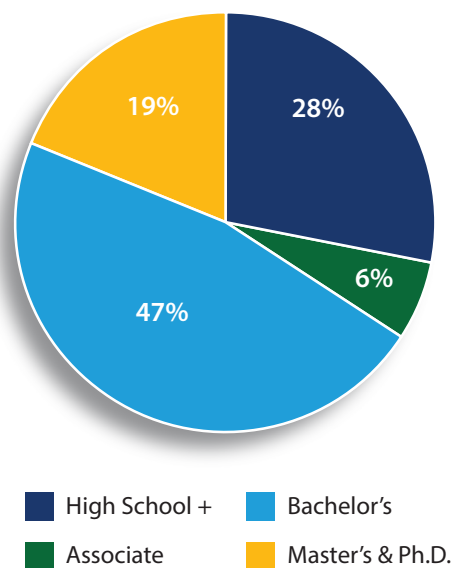
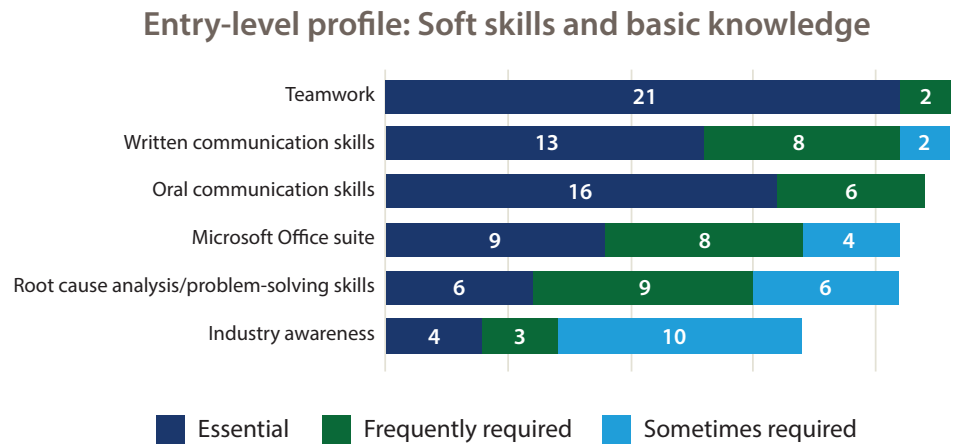


Figure 13: Detailed employment by highest level of educational attainment. Twenty-five biopharma manufacturing sites provided this additional level of detailed data.

Entry-level Skills

Survey participants were asked about the types of skills and knowledge needed for entry-level employees, and those requirements were split into two categories: soft skills/basic knowledge and technical skills/knowledge. Overwhelmingly, the most essential soft skill reported for entry-level employees was teamwork. Oral and written communication skills were the next most essential soft skills, and Microsoft Office was reported as essential or frequently required by over two-thirds of responders for basic knowledge (Figure 14).

Figure 14: Soft skills and basic knowledge requirements for entry-level biopharma employees. Survey responders selected the skills from a choice of essential, frequently required, sometimes required, not required, and N/A. Twenty-five sites responded to this survey question.



Manufacturing processes in biopharma facilities are complex and often require employees to have specialized scientific and technical skills in addition to the soft skills described above before starting work. Regulatory requirements/Good Manufacturing Practices (GMP) and knowledge of fundamentals of biology and chemistry were most often reported as essential or frequently required technical skills/knowledge for entry-level employees (Figure 15). Importantly, almost half of the responders (48%) indicated that all 10 technical skills were required at least sometimes, confirming the need for highly skilled and specialized talent in this industry.

Nearly half of survey responders reported that they expect the skills required for their workforce to change in the next five years, with automation and data sciences cited most often as the new skills that will be needed.

Entry-level profile: Technical skills and knowledge

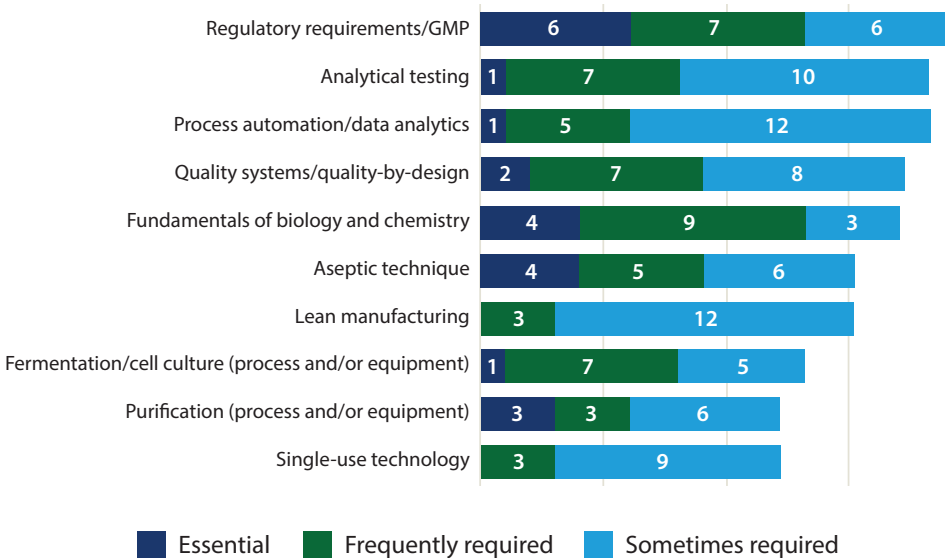


Figure 15: Technical skills and knowledge requirements for entry-level biopharma employees. Survey responders selected the skills from a choice of essential, frequently required, sometimes required, not required, and N/A. Twenty-five sites responded to this survey question.

Entry-level Salary

Survey responders were asked to provide information on starting salaries for entry-level positions. For positions that **do NOT** require industry experience, the overall average starting salary across entry-level positions is \$51,142. Average salary for manufacturing roles is nearly \$46,000 (Figure 16). Other entry-level positions pay more than this, with starting salaries up to \$69,500 annually for validation roles.

Average starting salary for entry-level positions

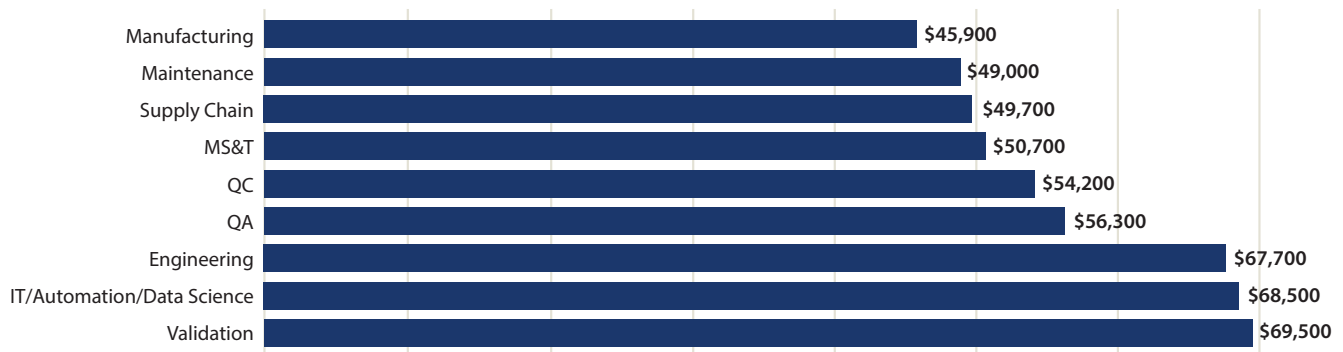


Figure 16: Average starting salary for entry-level positions by functional area. Twenty-four sites responded to this survey question.

Perhaps not surprisingly, the average starting salary for entry-level manufacturing positions is higher at biologics manufacturing sites (\$48,147) compared to pharmaceutical manufacturing sites (\$41,940) (Table 5). Many biologics are complex to produce, which requires more highly trained employees and in turn correlates with higher salaries for manufacturing positions.

Average starting salary for entry-level manufacturing positions, by site category	
Biologics	\$48,147
Pharmaceuticals	\$41,940

Table 5: Average starting salary for entry-level manufacturing positions, by site category.

This survey focused on entry-level starting salaries because most biopharma training program graduates are only eligible for entry-level positions. Additionally, data on entry-level salaries is not readily available from other sources despite the utility of that information for companies, training programs, and general awareness of opportunities in this industry. Federal salary data can be assessed by industry (NAICS codes) or by occupation (SOC codes), but salary data using occupation codes are less informative because “entry-level wages” are determined as the mean of the lowest third of wages for that occupation and are not industry specific.

Demographics

To better understand the existing biopharma manufacturing workforce, sites were asked about demographics of their current workforce and any goals or plans for changing these demographics.

Employment by Age

Nearly half of employees are “millennials” between 25 and 44 years old. There are similar proportions of employees 25-34 years old, 35-44 years old, and 45-54 years old, while only 7% are under 25. With 17% of the workforce over 55 years old, loss of institutional knowledge and additional talent pressures may occur as this group retires over the next five to 10 years (Figure 17).

Employment by age range: survey group

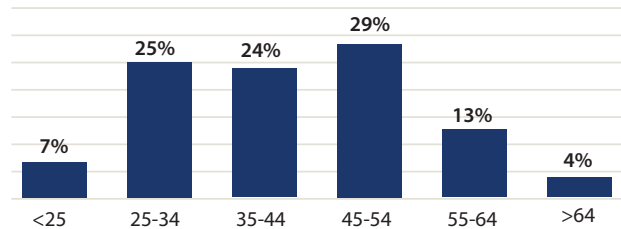


Figure 17: Employment by age range in survey group. Nineteen of the 33 surveyed sites, representing 6,722 employees (21% of the state’s total biopharma manufacturing workforce), provided age demographic information for their workforce.

Employment by Gender

Surveyed biopharma manufacturing sites reported that nearly two-thirds of their employees are male, despite women making up close to half of the American workforce (Figure 18).¹¹

Employment by gender: survey group

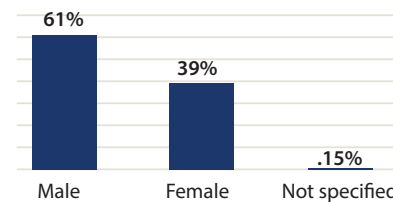


Figure 18: Employment by gender. Twenty-four of the 33 survey sites, representing 7,629 employees (24% of the state’s total biopharma manufacturing workforce), provided demographic information on the gender of their workforce.

Employment by Race and Ethnicity

Site representatives were asked to provide demographic information on the race and ethnicity of their workforce. Although there is relatively diverse representation overall by race and ethnicity, nearly two-thirds of employees are White (62.9%) (Figure 19).

Employment by race and ethnicity: survey group

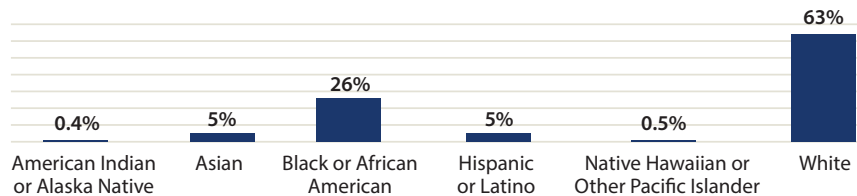


Figure 19: Employment by race and ethnicity in the survey group. Eighteen of the 33 survey sites, representing 5,981 employees (19% of the state’s total biopharma manufacturing workforce), provided data.

Based on the relatively small sample size for the demographics survey questions (Figures 17-19), this data is likely skewed. Companies with an existing commitment to diversity, equity, and inclusion (DEI) initiatives may have a more diverse workforce, track this information more reliably, and be more willing to share the information externally compared to their counterparts. In this case, the state’s overall biopharma manufacturing workforce may be less diverse than the employees represented in our study.

¹¹ “Women in the labor force: a databook.” U.S. Bureau of Labor Statistics. April 2021.

Demographic Diversity in the Future

In the next five years, most site representatives surveyed (61%) would like to see an increase in workforce diversity (Table 6). Some sites gave specifics about the demographic shifts they would like to see. Four mentioned increased gender diversity, five reported increased diversity by race or ethnicity, and three proposed increased diversity among leadership teams.

Desire for increased workforce demographic diversity	Sites
Yes	20
No	1
Did not answer	12

Table 6: Survey sites’ desire for increased demographic diversity.

NCBiotech examined the websites of the 33 sites that responded to the survey. Of the company websites, 61% contained a statement about DEI and 58% mentioned a specific goal or initiative to promote DEI within the organization. Common DEI initiatives included employee resource groups, stated goals for percentage of minorities overall or in leadership positions, and mandatory unconscious bias training for managers and hiring teams.



Recent Growth

2021 Hiring

Sites were asked to provide information on the number of employees hired in 2021 for 12 functional areas. Responders hired nearly 2,000 new employees in 2021. Of those, more than one-third (37%) were in manufacturing positions (Figure 20). QA and QC combined accounted for 18% of the new hires, while Administrative roles accounted for 11%. The Other functional area (12%) includes Manufacturing Science & Technology (4%), Maintenance (3%), Validation (2%), IT/Automation/Data Science (2%) and not specified (1%).

Recruitment by Location

To understand where biopharma manufacturers are successfully finding entry-level workers, sites were asked to provide the number of entry-level workers hired in 2021 from four different location categories: local (commuting distance), elsewhere in N.C., elsewhere in the U.S. but outside N.C., and international.

Seventeen of the 33 survey sites provided those estimates (Figure 21). Thirteen sites (76%) reported hiring more than half of their entry-level employees from within N.C. Eleven responders (65%) reported hiring at least 75% of their entry-level employees within commuting distance, with six hiring all entry-level employees locally. None of the reported entry-level hires were from international locations.

Employees hired in 2021, by functional area

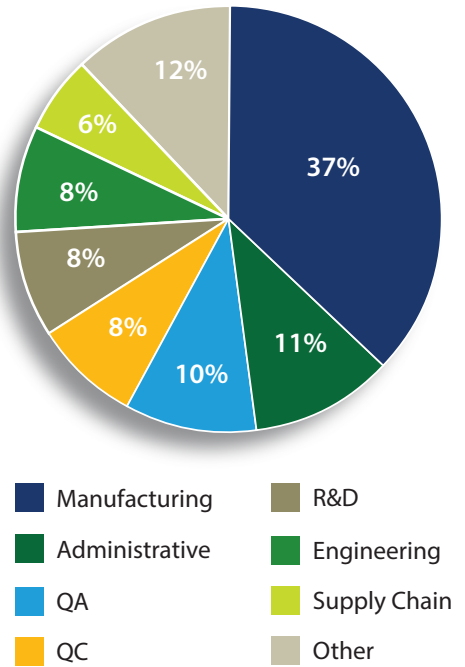


Figure 20: Employees hired at biopharma manufacturing sites in 2021, by functional area. Twenty-two sites responded to this survey question.

Entry-level employees hired by site, by location

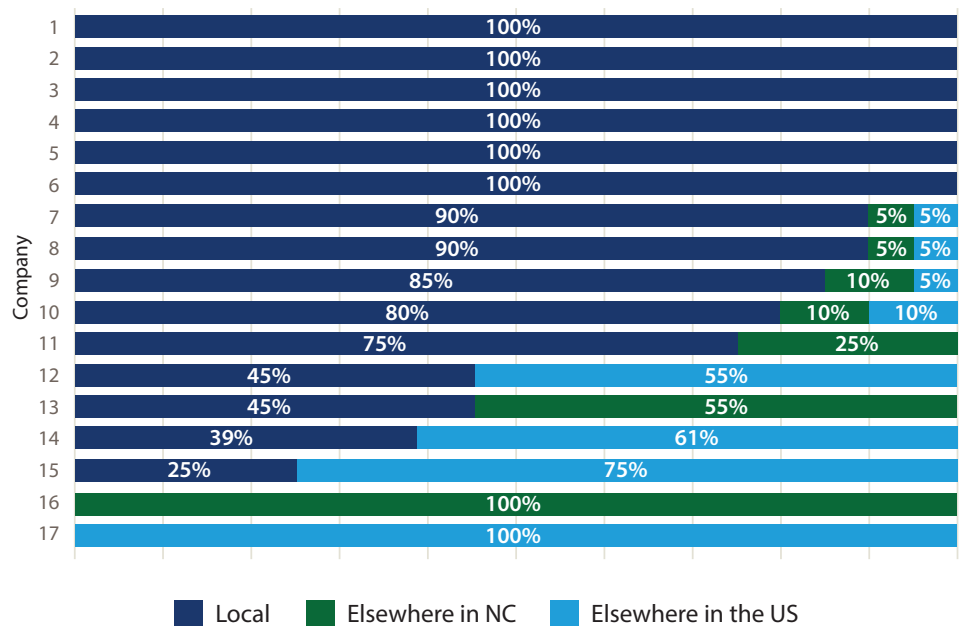


Figure 21: Entry-level employees hired in 2021 by company, by location. Survey participants indicated that they did not hire any entry level manufacturing employees from international locations.

Recruitment Tools

Site representatives were asked to rate a list of potential recruitment tools used to identify and hire entry-level workers in 2021, with internal referrals and external job boards reported as the most effective recruitment tools (Figure 22). External referrals and name recognition were reported as more effective than career fairs or social media.

Similarly, when rating recruitment tools used to hire experienced workers in 2021, internal referrals and external job boards were reported as the most effective recruitment tools (Figure 23). Recruiters/staffing firms and name recognition were reported as a more effective tool for positions that require experience than positions that do not.



Effectiveness of recruitment tools used to hire entry-level workers



Figure 22: Profile of the recruitment tools used to hire entry-level employees in 2021. Twenty-five sites responded to this survey question.

Effectiveness of recruitment tools used to hire experienced workers

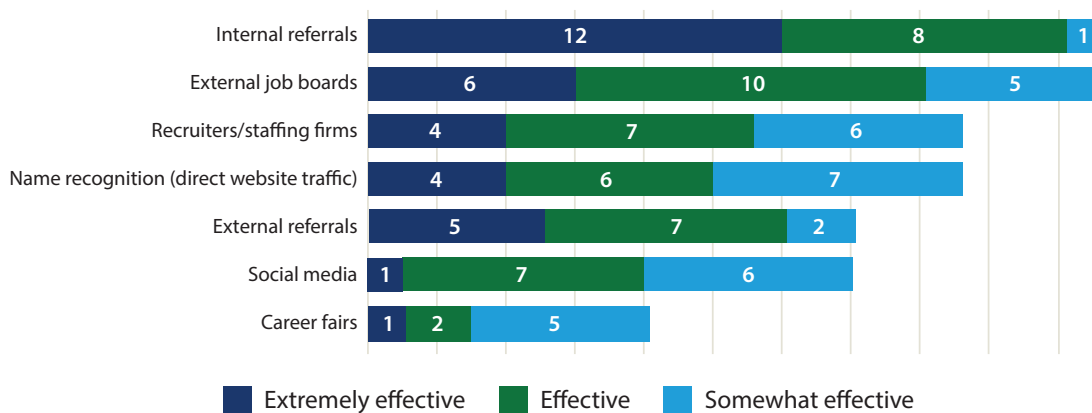


Figure 23: Profile of the recruitment tools used to hire experienced employees in 2021. Twenty-five sites responded to this survey question.

Expected Growth

Site representatives were then asked if and how they expected the site headcount to change in the next five years. Eighteen sites responded and collectively expect to add more than 3,100 new employees by 2027 (Figure 24). Given the over-representation of biologics manufacturers in the survey group, it is unsurprising that more than two-thirds (69%) of planned new jobs will come from biologics manufacturing sites.

Importantly, this planned job growth over the next five years is only representative of the biopharma manufacturing sites that responded to this question in the survey. A more comprehensive estimate of predicted industry growth is provided in the study analysis section of the report.

Industry Challenges

Turnover

Site representatives were asked to provide data on their 2021 employee turnover rates. Sites responded with a highly variable turnover rate ranging from 0% to 40%. Most companies with 0% turnover have recently expanded into N.C., and the current lack of turnover is unlikely to be sustained in the long term. Average turnover was 13% for biologics and 15% for pharmaceuticals manufacturing sites (Figure 25). The slightly lower rate for biologics manufacturing facilities may be due to the slightly higher entry-level salaries reported by responders.

In comparison, WoW 2020 reported an average turnover rate of 8.8% and a range from 0% to 24%. The significant increase reported for 2021 may have multiple causes, including COVID-19 and the associated “great resignation,” more biopharma sites competing for employees, and a wave of baby boomers retiring.

Planned/expected growth in the number of employees by 2027 (survey group)

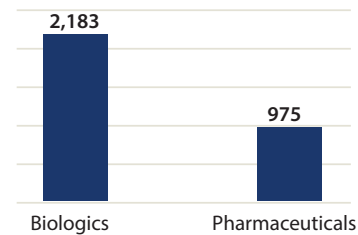


Figure 24: Expected job growth by product type over the next five years. To maintain confidentiality of survey data, the chart does not include data from the single survey participant in the Biologics for R&D category.

Average turnover rate in 2021

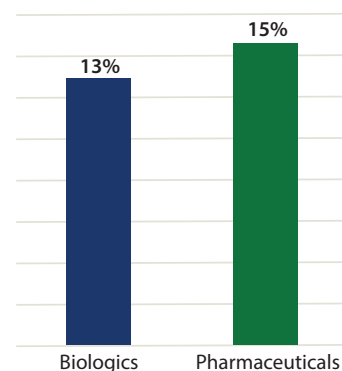


Figure 25: Average biopharma manufacturing employee turnover rate in 2021 by product type. Twenty-eight sites responded to this survey question.

Training

Awareness of Training Programs

Site representatives were asked to classify their awareness of 10 training resources for biopharma manufacturing in N.C. Possible responses included: used, aware but haven't used, or unaware. Company representatives were most aware of BTEC at NC State and N.C. BioNetwork and least aware of regional programs, such as the PSN at ECU (Figure 26).

Awareness of NC training resources for biopharma manufacturing

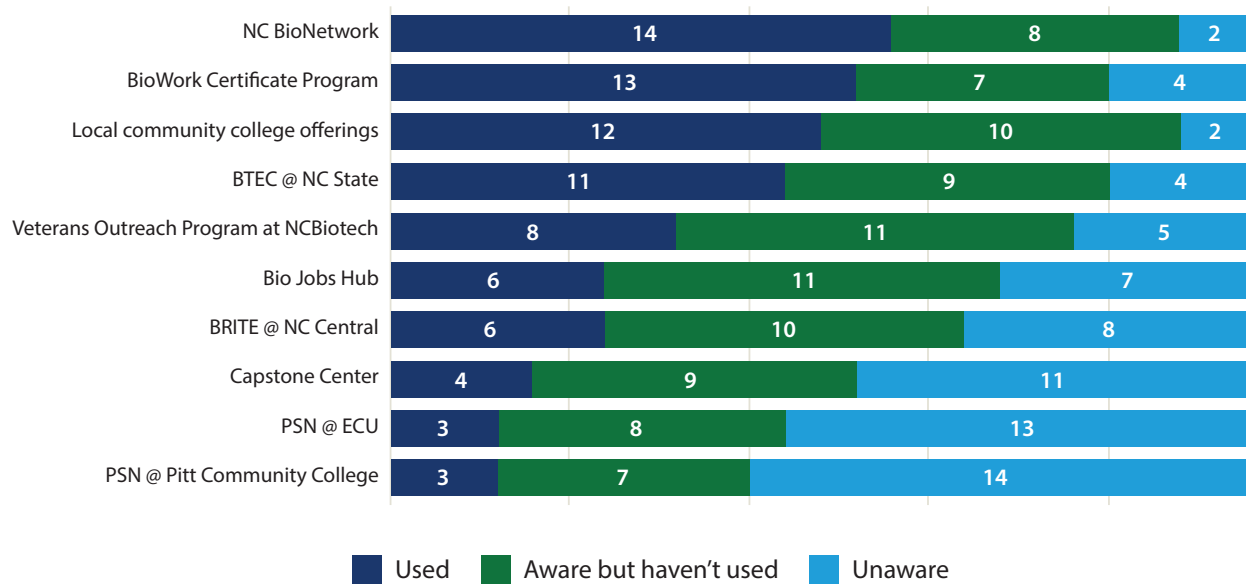


Figure 26: Awareness of NC training resources for biopharma manufacturing. Twenty-five sites responded to this survey question.

Given that the PSN at ECU focuses on training for pharmaceutical manufacturing, which is under-represented in the survey group, a lack of awareness of this resource among biologics manufacturers is understandable. Similarly, the Bio Jobs Hub website primarily targets job seekers rather than employers, so a lack of awareness of that resource among company representatives is unsurprising. The low level of awareness for the BioNetwork Capstone Center is unexpected given the high level of awareness of both BTEC at N.C. State where it is housed and N.C. BioNetwork itself. However, the reported lapse in awareness may simply be a brand-recognition issue.



Willingness to Outsource Training

Site representatives were asked which skills they would consider outsourcing for employee training. Most sites responded that outsourcing regulatory requirements/GMP, problem-solving skills, and Microsoft Office for employee training would be considered. In general, sites expressed more interest in outsourcing training for soft skills than for technical skills. Existing programs offer training in the top two technical skills most likely to be outsourced: regulatory requirements/GMP and aseptic processing (Figure 27).

Skills that companies would consider outsourcing for employee training

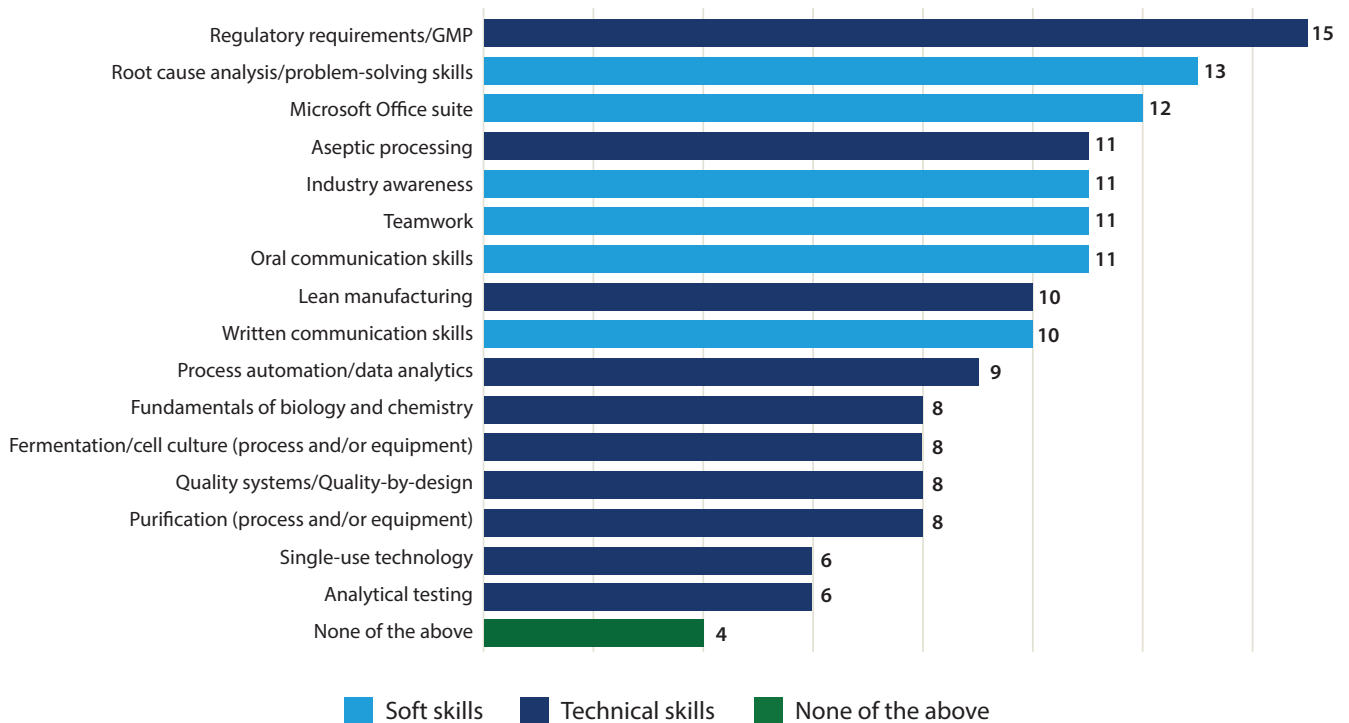
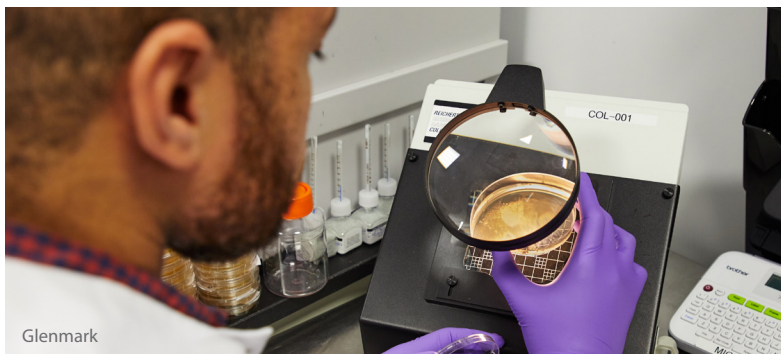


Figure 27: Skills sites would consider outsourcing for employee training. Twenty-four sites responded to this survey question.



WoW Training Programs Survey

Training Programs Overview

Nineteen training programs housed at 18 institutions were surveyed. At the time of the survey, this represented all the existing biopharma manufacturing training programs in N.C. All 19 programs responded to the survey, though not every program answered every question.

First, survey responders were asked what type of training programs they offered. The results in Figure 28 show that 74% of the surveyed institutions offer a biopharma manufacturing certificate or short course, more than half offer associate degrees, and five offer bachelor's and graduate (master's or doctoral) degrees.

Programs Offered

Level of biopharma manufacturing training program offered

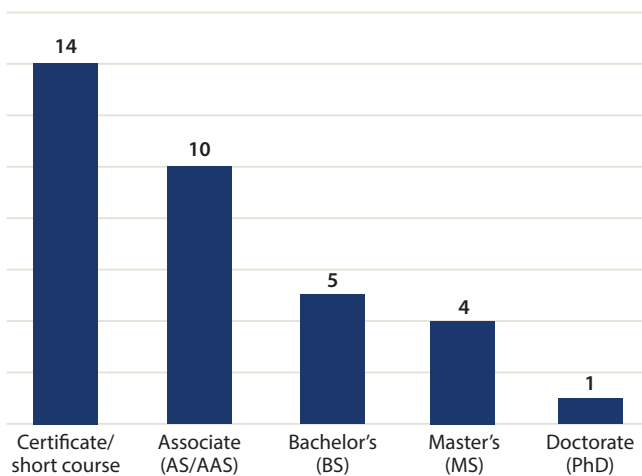


Figure 28: Biopharma manufacturing programs offered by level of training. Some surveyed institutions offer more than one level of biopharma manufacturing training program, so the total number of programs here is greater than the number of survey responders.

Capacity

Training program representatives were asked for the annual maximum training program capacity, given their current resources. The total maximum capacity for students each year across all programs is 6,651 students, with nearly half that total capacity (48%) contributed by certificate programs and other short courses (Figure 29). Importantly, survey responders were asked to differentiate between customized training and open enrollment for their certificate programs and short courses due to the different populations they serve. Customized training programs are typically for incumbent employees, while open-enrollment courses are available to job seekers, current students, and the general public.

Total capacity: maximum number of students per year by level

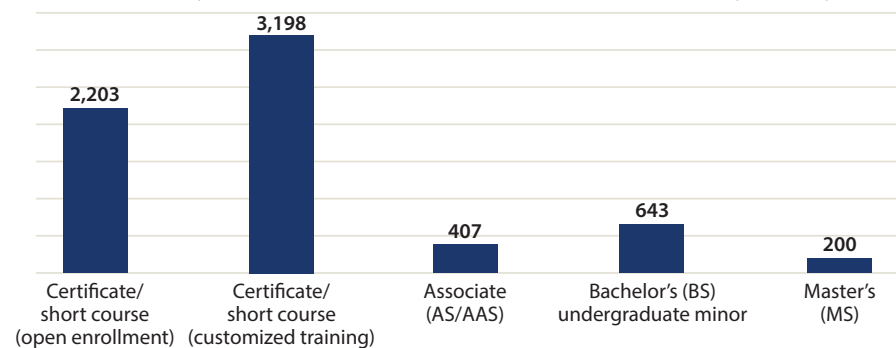


Figure 29: Capacity per year. The single doctoral program is excluded from this graph to protect confidentiality. The program's capacity is low enough not to have a significant impact on overall student numbers.

Existing certificate and short courses offered by surveyed training programs cover diverse biopharma manufacturing topics, including current good manufacturing practices (cGMP), standard operating procedures (SOP), oral solid dose manufacturing, adeno-associated virus (AAV) vector manufacturing, and instrumentation. N.C. BioNetwork’s BioWork certificate program, co-developed and updated with industry input, was recently recognized as an essential N.C. Workforce Credential for manufacturing.

Current BioWork Capacity

At the time of the survey, the BioNetwork Capstone Center and 10 community colleges offered BioWork, with the collective capacity to train nearly 2,000 students per year. BioWork is offered in four different formats by the various institutions: face to face (in-person with hands-on labs), hybrid (remote and in-person mix), fully remote “live” (instructor-led, synchronous), and fully remote on demand (asynchronous). As some institutions offer BioWork in multiple formats, survey responders were asked about their capacity for each of these formats (Figure 30). A little over one-third of the total BioWork capacity is fully remote, 42% is from hybrid course offerings, and only 22% of BioWork capacity is available in a fully in-person format. Virtual training capacity was made available during the COVID-19 pandemic and has been maintained and expanded across institutions as a mechanism to make BioWork more accessible.

BioWork accounts for 36% of certificate/short course capacity overall and 88% of open-enrollment capacity for certificate/short course training.

BioWork capacity: maximum number of students per year by instructional method

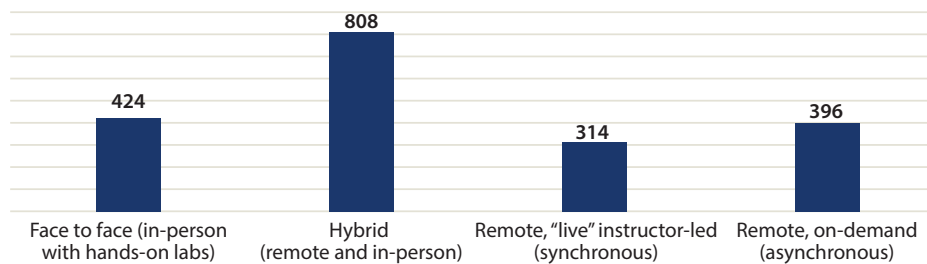


Figure 30: Current BioWork capacity.

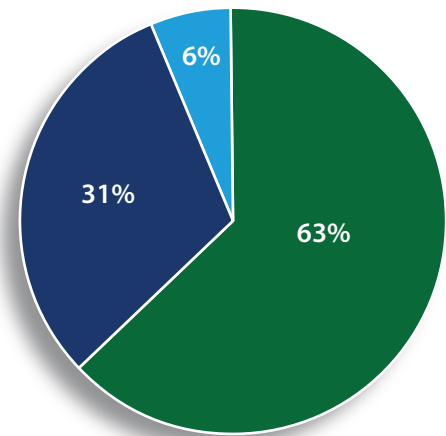


Future Capacity

Training program representatives were asked if they expected their biopharma manufacturing training capacity to change in the next year. Sixteen programs responded, with 10 programs (63%) reporting plans to add capacity to their biopharma manufacturing training programs (Figure 31). Only four programs provided a specific figure for their anticipated growth, which ranged from 36 to 1,600 additional students per year.

Figure 31: One-year growth expectations of biopharma manufacturing training programs. Sixteen programs responded to this question.

Training program growth expectations



- Number of programs that expect to grow in the next year
- Number of programs that do not expect to grow in the new year
- Number of programs that did not answer definitively



NIIMBL MSMBM/Durham Tech Community College

Capacity Utilization

Institutions were asked to assess if their training programs could train more students or were at maximum capacity. Nineteen training programs answered the survey question, with 63% responding that they are not currently training at maximum capacity (Figure 32). The seven programs currently training at capacity were asked what resources would enable expanded capacity, while the 12 programs with capacity were asked why the program is not at maximum capacity.

Eleven of 12 programs (92%) that are not fully enrolled report that a lack of program awareness is one of the core reasons for not having full enrollment. Other reasons limiting enrollment cited by three responders are cost, COVID-19, schedule, and transportation. Survey responders could select more than one reason, so the total adds up to more than the number of responders.

For the seven programs at maximum capacity, most institutions surveyed (86%) reported that additional funds will be needed to expand capacity for biopharma manufacturing training programs. In addition, the majority need equipment (71%), instructors (71%), and physical space (57%). Responders could select multiple resources necessary for capacity expansion.

Are your training programs currently at maximum capacity?

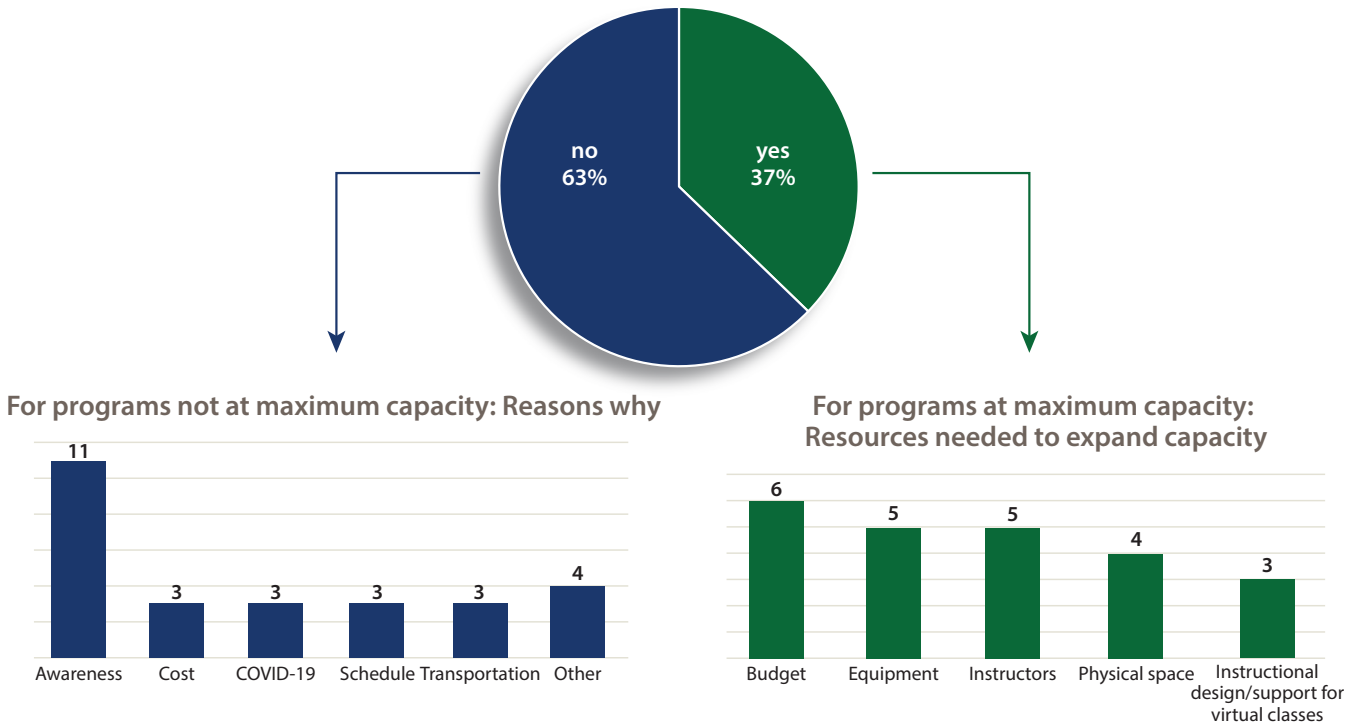


Figure 32: Assessment of existing programs and whether they are at full capacity. Programs not meeting capacity reported why; programs at maximum capacity reported resources needed to expand.

Placement Rates

Programs were asked how many graduates obtain positions in biopharma manufacturing companies within six months of completion. Programs report that a majority (87%) of graduates who completed an associate degree secure positions in biopharma manufacturing within six months of program completion. Across all programs and institutions, there are solid industry placement rates (program average 77.4%) within six months of program completion (Figure 33). The sole doctoral program has been excluded from Figure 33 to maintain confidentiality.

Percentage of graduates who secure positions with life sciences manufacturing companies within six months of program completion

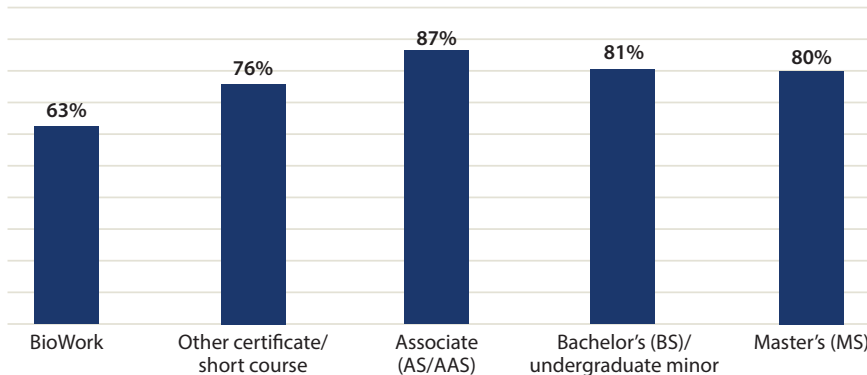


Figure 33: Percentage of graduates who secure positions with biopharma manufacturing within six months of program completion.

Student Demographics

To better understand the existing student population, programs provided demographic information about their biopharma manufacturing training program students as available. Eight programs (4 university and 4 community college responders) provided some student demographic information. As expected, most students enrolled in any training program (58%) were ages 18 to 24 (Figure 34). University biopharma programs are overwhelmingly ages 18 to 24, with 92% of students in that category. An analysis of age specifically in the community college-based training programs found a more varied population, with 55% of the students 25 or older (Figure 34).

Student demographics: age

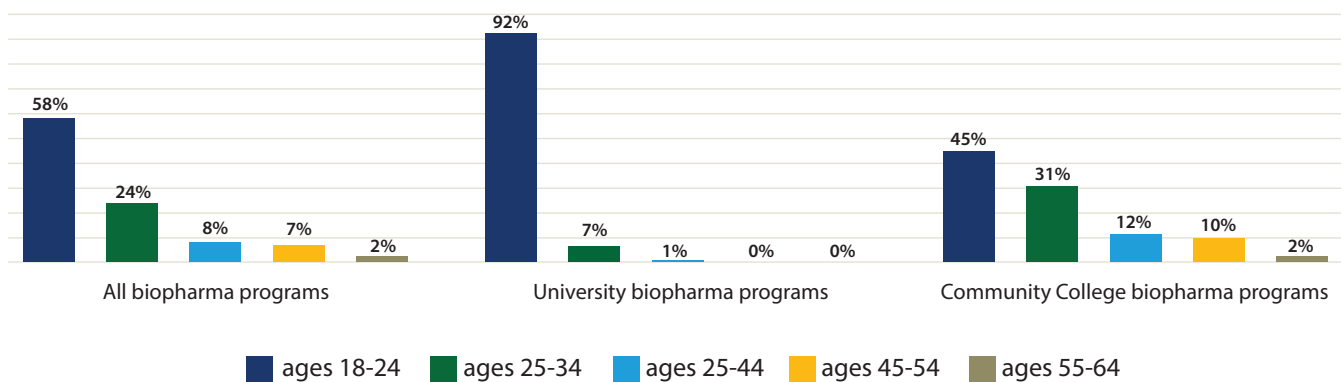


Figure 34: Student demographics by age. Five training programs (21%) provided student age information.

Survey responders reported 57% female and 43% male students enrolled in the biopharma training programs overall (Figure 35). A third option of “Other” for gender was not reported by any program. The proportion of females (70%) to males (30%) is even higher among community college students. The current gender distribution for students in N.C. biopharma manufacturing training programs does not match the current profile of the incumbent workforce in this industry, which is majority male.

Student demographics: gender

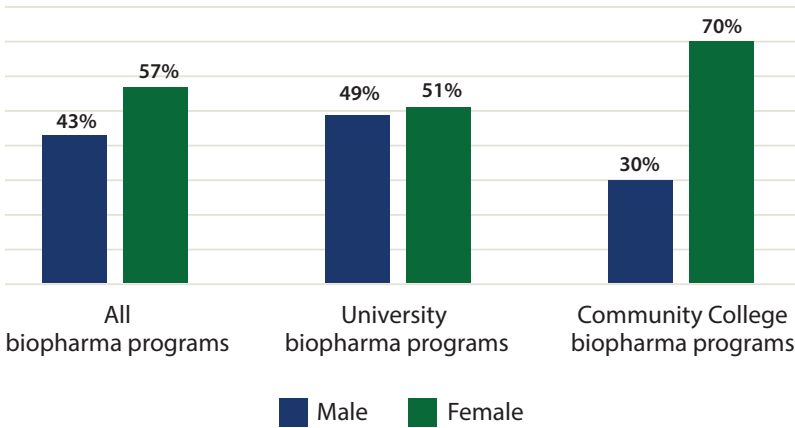


Figure 35: Student demographics by gender. Eight training programs (42%) provided student gender information.

According to the programs surveyed, a majority of students (57%) enrolled overall are White, while 22% are Black or African American, 9% are Asian, and 6% of enrolled students are Hispanic or Latino (Figure 36). University biopharma students are 64% White, 15% Black or African American, and 13% Asian. The students at community college programs are more diverse, with 39% Black or African American, 38% White, and 16% Hispanic or Latino. A smaller percentage of students in community college biopharma programs are Asian, accounting for only 1% of the enrollment.

The differences between community college demographics and overall biopharma program demographics are interesting. Lower tuition costs, ease of admission, school-life balance, and other factors provide increased accessibility to a community college education, and are likely drivers for increased diversity. Community colleges train a higher percentage of female and older students, as well as more Black or African American and Hispanic or Latino students in biopharma manufacturing programs compared to university programs.

Student demographics: race/ethnicity

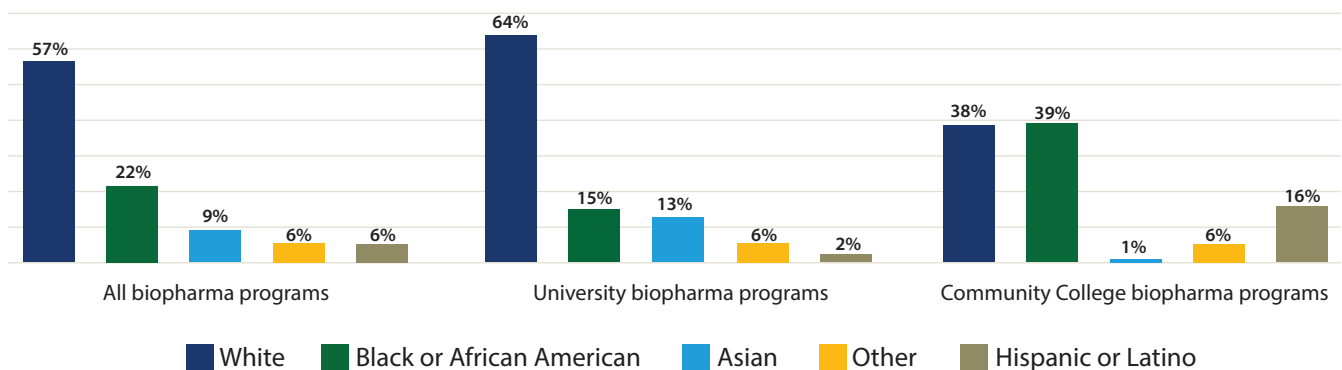


Figure 36: Student demographics by race/ethnicity. Five training programs (21%) provided student race and ethnicity information.

Study Analysis

WoW 2023 is both a continuation of a long-term industry assessment by NCBiotech and a fresh look at how the biopharma manufacturing industry in N.C. has coevolved with local training programs over time. For the first time, this study includes a simultaneous survey of companies and training programs to assess both demand and supply, capturing a more complete picture of where the biopharma manufacturing ecosystem is now and where it is going. Given this, it is useful to compare results from these two studies to draw conclusions about what is already working well for the community and where there are opportunities for improvement.



Demographics

The significant growth of biopharma manufacturing in N.C. mandates a large, well-trained workforce to meet company demand. One way to grow the existing workforce is to expand training and job opportunities to populations of North Carolinians who have not historically been well-represented in the biopharma workforce. By comparing industry and training program demographic data side by side as part of this study, it is possible to define where the community is currently. This also enables us to determine with future studies whether efforts to improve diversity of the industry workforce have been successful. This section compares demographic data for students currently in training programs, the incumbent biopharma manufacturing workforce, the Pharmaceutical and Medicine Manufacturing workforce in N.C., and the N.C. workforce overall for age, gender, race, and ethnicity.

For all following demographics plots, industry diversity data are derived from the Quarterly Workforce Indicators from the U.S. Census Bureau, aggregated and normalized by Chmura Economics (JobsEQ). Data are for the four quarters ending in the first quarter of 2021.



Employment by Age

Figure 37 shows age ranges for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry (the most comparable federal industry code for our survey group) and the overall workforce in N.C. Unsurprisingly, training program participants are younger than the incumbent workforce in all cases with 58% of students under the age of 25; it is important to note the small training program sample size. There are no major differences between the three workforce groups, but the survey group trends younger with 61% of employees under 55 compared to 55% of the N.C. workforce overall and 52% of the Pharmaceutical and Medicine Manufacturing workforce. Notably, 17% of the existing workforce for biopharma manufacturing is either already eligible or within a few years of retirement eligibility, and these roles will need to be filled in addition to newly created jobs.

Demographics: age

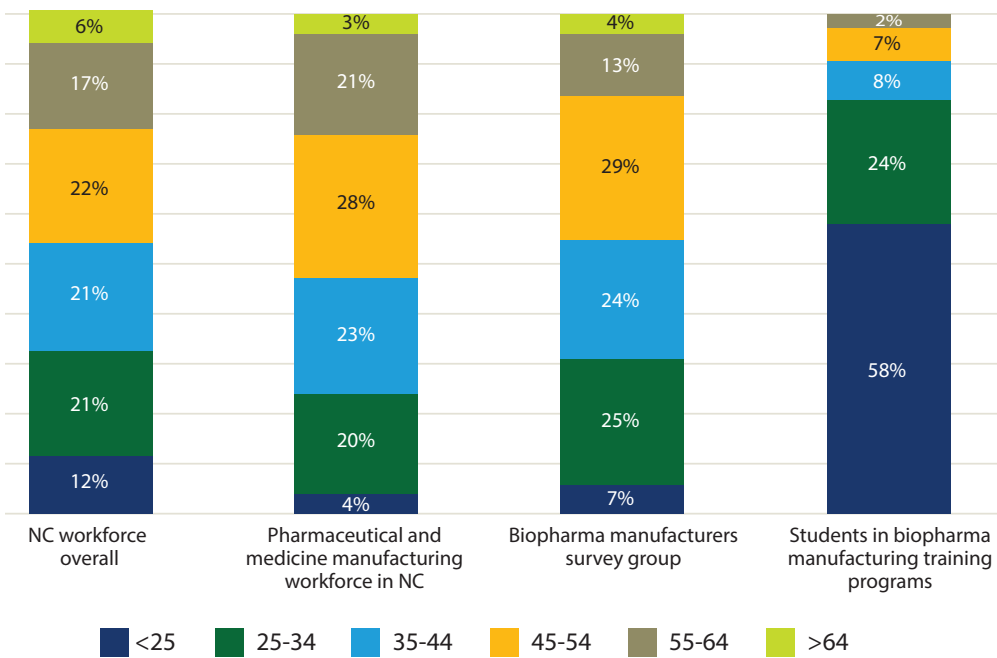


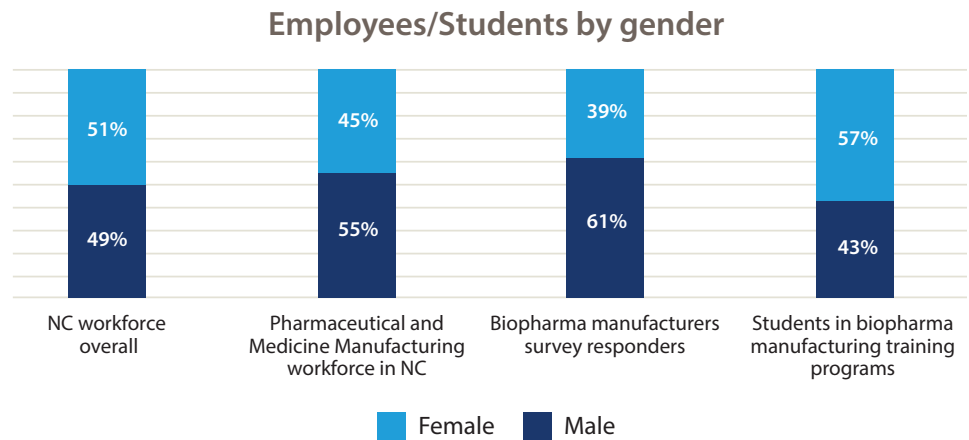
Figure 37: Employment by age (years) for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry (NAICS 3254) and the overall workforce in NC. The NC workforce overall = 4,296,692 people at time of study; pharma and medicine manufacturing workforce = 23,334 people at time of study; industry survey group = 6,722 employees. Five training programs (21%) provided student age information.



Employment by Gender

Figure 38 shows gender breakdown for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry and N.C.'s workforce. N.C.'s overall workforce has an almost even split between female and male employees, while the Pharmaceutical and Medicine Manufacturing workforce of 23,334 employees is 55% male and 45% female. Gender for the industry survey group is more skewed with 61% male and 39% female, though this may be due in part to sample size. In contrast to the incumbent workforce, more than half of students enrolled in biopharma manufacturing training programs are female (57%) versus male (43%), though this is also likely impacted by a small sample size (Figure 38).

Figure 38: Employment by gender for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry (NAICS 3254) and the overall workforce in NC. NC Workforce overall = 4,296,692 at time of study; Pharma & Medicine Manufacturing workforce = 23,334 at time of study; industry survey group = 7,629 employees. Eight training programs (42%) provided student gender information.



Employment by Race and Ethnicity

Figure 39 shows race demographics for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry (NAICS 3254) and the overall workforce in N.C. The Pharmaceutical and Medicine Manufacturing and industry survey groups are more racially diverse than N.C.'s overall workforce, but not as diverse as the students enrolled in biopharma manufacturing training programs, with the small training program sample size as an important caveat to consider.

Demographics: race/ethnicity

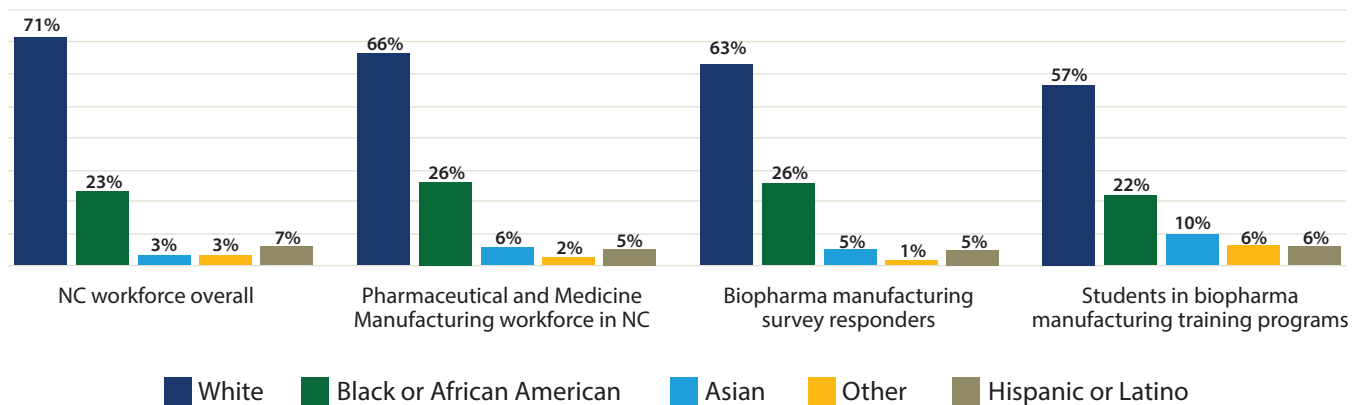


Figure 39: Employment by race for the industry and training program survey groups compared to the Pharmaceutical and Medicine Manufacturing industry (NAICS 3254) and the overall workforce in NC. NC workforce overall = 4,296,692 at time of study; Pharmaceutical and Medicine Manufacturing workforce = 23,334 at time of study; and industry survey group = 6,909 employees. Five training programs (21%) provided student race and ethnicity information. Importantly, due to the way the ethnicity survey question was asked, it is not accurate to make a direct comparison of the survey data to industry or overall workforce information.

Future Growth

Overall Employment Growth

More than half of the current biopharma manufacturing workforce (32,000 overall) is employed at pharmaceutical manufacturing facilities (51%). Biologics manufacturing facilities employ 42% while 7% are employed at supplement and biologics for R&D manufacturing facilities combined. This represents a significant shift from 2004 when biologics manufacturing facilities employed only 28% of workers, supplements and biologics for R&D accounted for less than 2% of workers, and pharmaceutical manufacturing facilities employed approximately 70% of the workforce.

To predict the number of workers needed at biopharma manufacturing sites by 2027, data was compiled from three sources: surveyed companies, public expansion and relocation announcements between October 2020 and December 2022, and projected announcements for the coming years. Altogether, NCBiotech predicts that total employment at N.C. biopharma manufacturing sites will grow by approximately 8,000 more employees between 2022 and 2027, bringing the total industry employment in the state to 40,000 (Figure 40).

Employment at biopharmaceutical manufacturing sites in NC

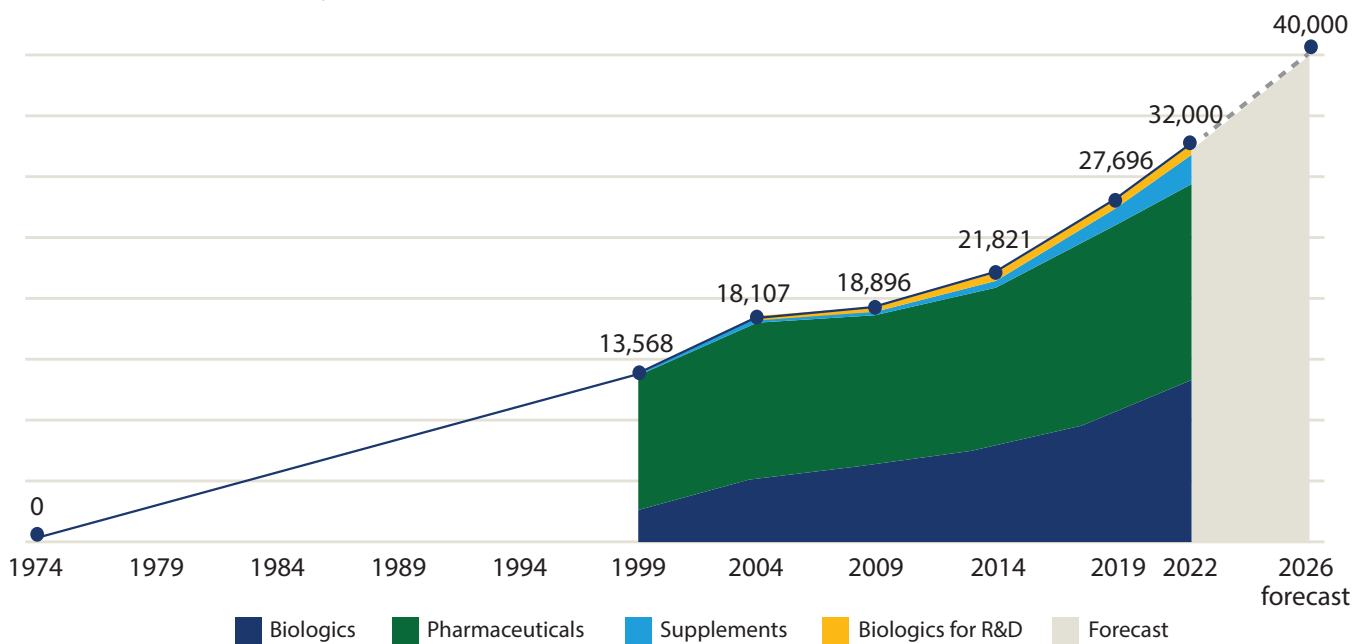


Figure 40: Biopharma Manufacturing Employment Growth in NC, with projection through December 31, 2026. The 8,000 new jobs predicted in the next five years is based on 3,100+ planned new positions by survey responders, 3,300 new jobs announced by biopharma manufacturing companies between October 2020 and December 2022, plus an estimated 500 additional new jobs per year forecast for 2023 through 2026 (based on historical data) to be created by companies that will announce NC job growth between now and 2026. Notes: October 2020 was selected as the start date for this projection because many jobs announced before that time will have been created by the time of publication. Note: the 2019 employment number here (27,696) differs from the 26,804 jobs published in WoW 2020 because additional companies were added to NCBiotech’s data set following publication of the 2020 report.

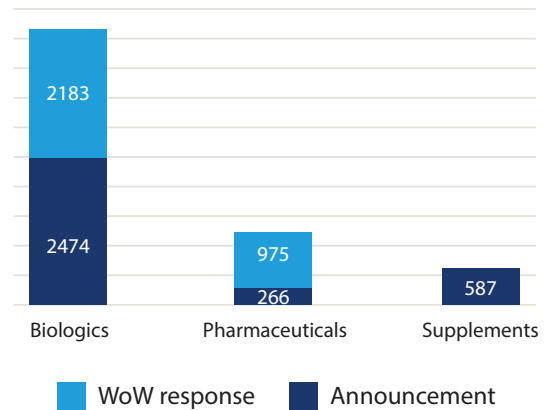
The WoW 2020 report predicted 5,000 new jobs would be created over five years (2019-2024; 31,804 total jobs). By the end of 2022, just 3 years from when this prediction was made, more than 5,000 net new jobs had already been created at N.C. biopharma manufacturing sites. Given this, NCBiotech’s prediction of 8,000 new jobs over the next five years may also be conservative. That said, announced employment growth was less explosive in 2022 compared to 2020 and 2021, and a slightly slower growth rate may continue as economic uncertainty increases.

Employment Growth by Category

When segmenting this predicted employment growth (i.e. planned growth based on survey responses and publicly announced new jobs) into the four categories of biologics, pharmaceuticals, supplements, and biologics for R&D, NCBiotech expects 71% or more than 4,600 new jobs at biologics manufacturing facilities, 19% or more than 1,200 new jobs at pharmaceutical manufacturing facilities, and 10% or nearly 600 new jobs at supplement manufacturing facilities (Figure 41).

Figure 41: Announced/planned job growth by site category at NC biopharma manufacturing sites. Survey respondent growth is split with 69% from biologics and 31% from pharma facilities. Public announcements are split 74% biologics, 8% pharma, and 18% supplement manufacturing workforce growth. Note: some companies made public expansion announcements and reported job growth through the WoW survey; in this case, we included the planned new jobs with the WoW responses rather than the announcements.

Growth: Announced/planned hires, totals by site category and source of info



It remains important to note that the survey pool has an over-representation of biologics manufacturing sites and an under-representation of supplements manufacturing sites that is likely contributing to this growth differential. However, publicly announced jobs are even more skewed toward biologics manufacturing growth with 74% from biologics, only 8% from pharmaceuticals, and 18% from supplements. This prediction is also consistent with the fact that the biologics manufacturing workforce has grown at a faster rate than the pharmaceutical manufacturing workforce in N.C. for as long as we have historical employment data (1999-present).

Workforce Growth

When excluding customized training programs for incumbent workers from total training capacity data, N.C. biopharma manufacturing training programs can currently train nearly 3,500 individuals annually (Figure 29). This translates to a maximum capacity of more than 2,600 new graduates entering the workforce annually based on the total student capacity and the average number of years required to complete each program.¹² Additionally, while not all existing programs are fully enrolled, 10 of the 16 programs surveyed reported plans to increase training capacity next year, which will increase this estimate.

In addition to the biopharma manufacturing-specific training programs that were included in this survey, N.C. higher education institutions graduate more than 10,000 students annually with biological and biomedical science, engineering, and other relevant degrees. These graduates can help fill these jobs if provided the opportunity and necessary industry-specific training by employers.

¹² 2,200+ certificates, 407 associate students (~200 graduates), 643 bachelor's students (~160 graduates), 200 master's students (100 graduates).

Talent Pipeline Versus Job Growth

NCBiotech's prediction of 8,000 new jobs over five years translates to approximately 1,600 new jobs per year. While this number is lower than the maximum capacity of the biopharma manufacturing training programs alone, it does not account for turnover (approximately 4,300 per year based on 13.4% average turnover rate from our study) or retirement (640 people per year based on an estimated 2% retirement per year¹³). While turnover poses a challenge for companies facing open roles that need to be filled, many employees leave one N.C.-based biopharma manufacturing company for another in the state, meaning that only a proportion of these openings due to turnover will need to be filled by new entrants into the workforce. Using these conservative estimates, biopharma manufacturing companies likely need to fill between 2,500 and 3,000 jobs annually¹⁴, which is much closer to the number of graduates available from local training programs. However, not all of these new jobs are entry-level or appropriate for a new graduate, even those with a relevant graduate degree. In addition to well-trained graduates, biopharma manufacturing companies will benefit from hiring well-trained individuals with transferable skills (i.e. transitioning military, other related industries) capable of starting in higher-level roles after gaining a basic knowledge of the industry.

Opportunities

As indicated in this report, there is a significant and growing need for trained biopharma manufacturing workers in N.C. While the state has established a strong training infrastructure and progress has been made to expand recruitment strategies to attract the necessary workforce for this rapidly growing industry, more is needed to ensure the continued growth and success of this industry in N.C.

Ecosystem

NIIMBL published a report in October 2022 that stated, "Our industry, academic, and workforce development infrastructure are currently hamstrung by tradition. Traditional degree programs. Traditional hiring practices. Traditional ways of demonstrating 'experience.'"¹⁵ The report goes on to encourage non-traditional innovative approaches to "attract and inspire, increase the diversity of, and train tomorrow's biopharmaceutical manufacturing workforce." Indeed, to keep up with the significant industry growth detailed in this report, companies and training institutions in N.C. will have to be creative.

One significant challenge the biopharma manufacturing industry faces is awareness. While most North Carolinians have benefited from biopharma products, and many from products manufactured in the state, there is limited awareness in the general population of who these companies are, where they are located, what they do, and the career opportunities they offer. It is not uncommon for community members to be unaware of biopharma manufacturing sites and careers within their towns, while these same companies struggle to fill open positions. Another challenge is an apprehension toward "science" and/or "manufacturing" that can keep qualified individuals from pursuing opportunities in this industry. Community perceptions of who can thrive at these facilities and in these careers must be changed, and the opportunities for advancement highlighted.

¹³ 2% retirement per year estimate is based on 17% of the current biopharma manufacturing workforce being 55+ and an average retirement age of 64 years old.

¹⁴ This estimate is based on 1,600 new jobs per year, ~700 retirements per year, and an estimated 10-20% of people leaving biopharma manufacturing jobs leaving the industry entirely rather than jumping to a different company.

¹⁵ Innovation of the Biopharmaceutical Manufacturing Talent Pipeline. National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL). October 2022.

Finally, U.S. labor force participation has been decreasing since 2000 and took a significant additional hit during the COVID-19 pandemic beginning in 2020.¹⁶ Contributing factors include early retirements, lack of access to affordable child-care, and increased savings accumulated during the pandemic among other factors.¹⁷ The current Labor Force Participation rate in N.C. is approximately 61%. It is imperative to promote careers in biopharma manufacturing to a diverse audience of North Carolinians as hiring remains a challenge for growing companies. Of note, N.C. is one of the nation's fastest growing states by population, with a 1.3% population growth rate and net in-migration of nearly 100,000 people per year, according to the U.S. Census Bureau.¹⁸ Talented individuals who are relocating to N.C. from other states and around the world present a significant workforce opportunity for this industry.

Industry

Focus on Diversity, Equity, and Inclusion

DEI efforts at biopharma manufacturing companies in N.C. aim to increase the proportion of underserved populations who can take advantage of these career opportunities and grow the available workforce. While 70% of survey responders have specific DEI initiatives in place, another 30% do not have any diversity initiatives. Initiatives shared by survey responders include employee resource groups, targets for women and minorities in managerial positions, and mandatory unconscious bias training for all employees and/or managers and/or hiring managers.

Best practices not mentioned by surveyed companies include reassessing and removing degree requirements from job descriptions, publicly sharing current female and minority representation in the company and management roles, as well as annual pay equity analysis. BIO's annual Measuring Diversity in the Biotech Industry report mentions explicitly linking DEI to important business outcomes including attraction and retention of both talent and customers plus increased revenue. Another recommendation is to ensure diversity of suppliers by working with women-owned and minority-owned suppliers, demonstrating a commitment to DEI efforts.¹⁹



Companies that already have DEI initiatives might consider implementing additional best practices, and companies that do not currently have any DEI initiatives can learn from their peers on how to successfully establish these programs at biopharma manufacturing facilities.

¹⁶ Labor force participation: what has happened since the peak? U.S. Bureau of Labor Statistics. September 2016.

¹⁷ Understanding America's Labor Shortage. U.S. Chamber of Commerce. February 2023.

¹⁸ N.C. continues to attract domestic migration, data show. The News & Observer. January 4, 2023.

¹⁹ Measuring Diversity in the Biotech Industry: Tracking Progress in Small and Large Companies. Biotechnology Innovation Organization (BIO). June 2022.

N.C. community colleges currently serve a diverse group of students (Figures 34, 35, & 36) and represent a key training and recruitment partner for biopharma employers. Despite BioWork’s reputation as a well-regarded certificate program, and the fact that 28% of biopharma manufacturing employees require no more than this level of educational attainment (Figure 13), 37% of BioWork completers do not secure employment within 6 months (Figure 33). As training programs continue to attract more diverse students, companies will need to adapt to ensure they have the tools to attract and retain the increasingly diverse talent available in N.C. Some examples of specific DEI initiatives that N.C. companies are currently implementing include:

- NIIMBL bioLOGIC, a novel program to bring awareness and foster interest in careers in the biopharma manufacturing industry for high school and middle school students in N.C.
- Merck hosted career fairs at a local African Methodist Episcopal (AME) church in support of its participation in the OneTen initiative. Amgen and Eli Lilly are also OneTen partner employers.
- Eli Lilly and Novo Nordisk are offering entry-level jobs that require only a high school diploma. These and other local companies are increasingly listing the BioWork certificate as a preferred credential.
- Thermo Fisher Scientific and Catalent have guaranteed interviews to recent high school graduates who complete the N.C. Grads2Work program.
- The N.C. Life Sciences Apprenticeship Consortium is currently soliciting industry and community college members to expand industry-relevant apprenticeship opportunities across the state.
- Pfizer and CSL Seqirus have hosted military interns to support transitioning service members from Fort Liberty (formerly Fort Bragg) to prepare for civilian careers.



“The skills and knowledge gained through BioWork are fundamental to most of the diverse manufacturing roles we hire at Novo Nordisk, as well as the other 800+ biotech companies in the state.”

– Shaylah Nunn Jones, J.D.,
Principal, Government & Public Affairs
Novo Nordisk

Increased Community Engagement

Importantly, industry survey responders overwhelmingly reported internal referrals as the most effective hiring method. While referrals are undoubtedly an effective recruitment tool, they are often a poor strategy to promote diversity because they tend to attract candidates with similar socioeconomic, racial, geographic, and/or educational backgrounds. Perhaps new ways to enable existing employees to effectively reach members of their communities more broadly with these career opportunities exist. Indeed, according to the second NIIMBL talent pipeline report, understanding regional training programs and effectively communicating hiring preferences and needs to those programs is imperative to program graduates securing available jobs.²⁰



²⁰ Innovation of the Biopharmaceutical Manufacturing Talent Pipeline Part II. National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL). October 2022.

Training Programs

Fill Existing Capacity

To meet the needs of growing biopharma manufacturing companies in N.C., an obvious opportunity is to maximize the capacity of existing industry-specific training programs. Lack of awareness is the most cited reason that training programs are below capacity. While there are ongoing efforts to increase awareness of these opportunities, more can be done. The [Bio Jobs Hub](#) is a prime example of an existing resource that would benefit from additional industry participation and a deeper reach into underserved communities. The recently funded Accelerate NC: Life Sciences Manufacturing coalition also has a focus on awareness with a new life sciences manufacturing Ambassador Program and designated individuals from community colleges across the state who will be directing students to these training programs and careers.

Increased Focus on Soft Skills and New Technical Skills

The community college-based BioWork certificate program offers training in the most cited essential technical skills: regulatory requirements, GMP, and knowledge of fundamentals of biology and chemistry (Figure 15). However, companies reported a significant need for teamwork as well as written and oral communication skills (Figure 14). To further serve their students, training programs would benefit from incorporating additional soft skills training to complement the technical components.

Additionally, more than half of the surveyed sites expect the required skills profile of their workforce to change in the next five years. Of those companies, six specifically mentioned that increased automation or data science would be required. Existing training programs would benefit from the flexibility to modify or expand programs to include these or other new technical skills as the industry advances. Many programs maintain advisory boards with representatives from local biopharma employers. These forums should continue to be fully leveraged to gain as much insight as possible regarding current and future skills needed by the industry.



NCPSN/NCGrad2Work

Community College Opportunities

One opportunity for N.C. community colleges that already offer biopharma manufacturing training programs is increased industry engagement. Deeper partnerships with local companies will ensure that graduates from industry-specific programs have the necessary skills and connectivity to find employment after program completion. Community colleges have a critical role in creating pathways to biopharma careers for job seekers, as well as training via customized training for incumbent employees and new hires. Close ties with local biopharma employers are essential to assess the expectations and specific needs for pre-employment and post-employment training, and to inform the deployment of resources to secure new equipment and expand programming. Determining when and where to add training resources is a difficult task as institutions have limited resources and biopharma companies have varied views regarding proximity, equipment, skills, and more.

Additionally, community colleges interested in developing industry-relevant training programs may benefit from engagement with InnovATEBIO an NSF-ATE-funded initiative that partners with the Biotechnology Innovation Organization (BIO), its state affiliates, K-12 teachers, and the Manufacturing USA institutes to meet regional industry needs, determine emerging workforce trends, promote efficient use of educational workforce resources, and serve as a bridge between education and industry.²¹ Of note, N.C.'s National Center for the Biotechnology Workforce at Forsyth Tech Community College is a key collaborator with InnovATEBIO. Additionally, the following institutions have InnovATEBIO Programs: UNC-Charlotte; Wake Forest Institute for Regenerative Medicine; and Alamance, Durham Tech, Vance-Granville, Central Carolina, Wake Tech, and Johnston community colleges.

University Opportunities

Surveyed universities with specific biopharma manufacturing training have significant success placing graduates into industry positions. However, the majority of higher-education institutions in N.C. do not offer targeted biopharma programs. More than 10,000 students graduate each year with a relevant degree but without an awareness of the biopharma manufacturing industry or how these careers might align with their education or interests. This is a significant missed opportunity for both the graduates from these programs and companies seeking a highly skilled workforce.

Call to Action

Biopharma manufacturing companies provide North Carolinians with meaningful work, competitive salaries, and opportunities for advancement that rival any industry. These opportunities are increasing both in number and geographic diversity across the state. The COVID-19 pandemic accelerated growth of this industry while disproportionately impacting traditionally distressed communities and historically excluded populations. N.C. has an opportunity to build a more diverse, inclusive, and equitable biopharma manufacturing workforce that will ensure the continued success of companies already making life-saving medicines here and attract additional investment, jobs, and prosperity for the entire state for years to come. The NCBiotech-led Accelerate N.C. coalition aims to tackle this challenge head on, however, sustaining the proposed solutions will require motivated partners to join us in these efforts.

²¹ Innovation of the Biopharmaceutical Manufacturing Talent Pipeline Part II. National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL). March 2023.

Appendix

Companies

Biopharma manufacturing sites in N.C. can be separated into four categories based on product type. NCBiotech’s definition of those product types is included with each category below. At the time of the study, there were 108 sites categorized as biopharma manufacturers in N.C. (Tables A1-A4). For an updated list, check [NCBiotech’s Company Directory](#).

Biologics

Sites that primarily manufacture biologic therapeutics, vaccines, enzymes, gene- and cell-based therapies, and regenerative medicine products for clinical and commercial use. Includes companies that manufacture biological products for industrial use, such as enzymes and proteins. Biologics are referred to as large-molecule products and include proteins, peptides, carbohydrates, genetic material, etc.

Site	County	Site Established
Ajinomoto Health & Nutrition NA Inc.	Wake	1982
Amgen	Wake	2022
Archer Daniels Midland Co.	Brunswick	1975
AskBio *	Durham	2001
Astellas Gene Therapies *	Lee	2020
Avoca LLC	Bertie	1962
Beam Therapeutics *	Durham	2021
Biogen *	Wake	1995
CARsgen Therapeutics *	Durham	2022
Cellectis *	Wake	2019
Colmmune Inc.	Durham	2019
CSL Seqirus	Wake	2007
Eli Lilly and Company	Cabarrus	2022
Eli Lilly and Company	Durham	2023
Encoded Therapeutics Inc. *	Wake	2020
FUJIFILM Diosynth Biotechnologies USA Inc.	Wake	1995
Grifols	Johnston	1974
Hemo Bioscience Inc.	Durham	2020
Humacyte Inc.	Durham	2005
Huvepharma Inc.	Scotland	2004
Ingredion Inc.	Forsyth	1981
Jaguar Gene Therapy LLC (Process Sciences Lab) *	Wake	2020
KBI Biopharma Inc.	Durham	2004
KBI Biopharma Inc. (Process Development Facility)	Durham	2014

Site	County	Site Established
KeraNetics LLC	Forsyth	2008
Kriya Therapeutics Inc. *	Durham	2020
Locus Biosciences Inc. *	Durham	2018
Medicago USA Inc.	Durham	2010
Merck & Co. Inc.	Durham	2004
Nitta Gelatin NA Inc.	Cumberland	2006
Novartis Gene Therapies *	Durham	2018
Novex Innovations LLC	Forsyth	2014
Novo Nordisk Pharmaceutical Industries LP (API facility)	Johnston	2021
Novo Nordisk Pharmaceutical Industries LP (IFP facility)	Johnston	1991
Novozymes North America Inc.	Franklin	1979
Pfizer Inc. *	Lee	1987
Pfizer Sanford North (formerly Abzena LLC)	Lee	2022
Precision Biosciences Manufacturing Center for Advanced Therapeutics *	Durham	2019
ProKidney *	Forsyth	2016
Resilience *	Durham	2021
Sagent Pharmaceuticals	Wake	2009
Stallergenes Greer	Caldwell	1934
StrideBio Inc. *	Durham	2019
Taysha Gene Therapies Inc. *	Durham	2021
United Therapeutics Corp.	Durham	2009
Vertellus Specialties Inc.	Guilford	2006
White Labs Inc.	Buncombe	2017
ZenBio Inc.	Durham	1995
Zoetis Inc.	Durham	1987

Table A1. Biologics manufacturing sites in NC. At the time of this study, these companies had active manufacturing sites in NC. Asterisk (*) indicates a facility that manufactures cell- and gene-based therapeutics.

Pharmaceuticals

Sites that primarily manufacture pharmaceuticals, pharmaceutical ingredients, diagnostic substances, and other drug products. Product forms include oral solid dose (tablets and capsules), parenteral, topical, and inhaled products. Includes companies that manufacture sterile IV fluids and nutrition.

Site	County	Site Established
Alcami Corporation	Durham	2019
Alcami Corporation	New Hanover	1979
Almac Clinical Services LLC	Durham	2000
Aurobindo Pharma USA Inc.	Durham	2015
Baebies Inc.	Durham	2014
Baxter Healthcare Corp.	McDowell	1970
BD Diagnostics	Alamance	2010
Biogen (Oral Solid Dose Facility)	Durham	2010
bioMérieux Inc.	Durham	1986
Bright Path Laboratories Inc.	Cabarrus	2017
Cambrex Durham	Durham	2015
Cambrex High Point	Guilford	2000
Catalent Pharma Solutions LLC (formerly Mayne Pharma)	Pitt	2000
Catalent Pharma Solutions LLC	Wake	2007
CMP Pharma Inc.	Pitt	1986
Cosette Pharmaceuticals	Lincoln	2000
Exela Pharma Sciences LLC	Caldwell	2008
Fresenius Kabi USA LLC	Wilson	2016
Glenmark Pharmaceuticals Inc., USA	Union	2015
GSK	Wake	1983
Guerbet LLC	Wake	1987
KriGen Pharmaceuticals LLC	Harnett	2019
Livent	Gaston	1955
Mallinckrodt Pharmaceuticals	Wake	1966
MedPharm	Durham	2021
MEDTOX Diagnostics Inc.	Alamance	1996
Merck & Co. Inc.	Wilson	1982
Novo Nordisk Pharmaceutical Industries LP	Durham	2015
PETNET Solutions Inc.	Forsyth	2020
PETNET Solutions Inc.	Durham	2020

Site	County	Site Established
Pfizer Inc.	Nash	1968
Pisgah Labs Inc.	Transylvania	1981
Princeton Laboratories	Mecklenburg	2017
Procter & Gamble	Guilford	1966
Purdue Pharmaceuticals LP	Wilson	2000
Qualicaps Inc.	Guilford	1993
Raybow USA Inc.	Transylvania	2003
Relion Manufacturing Inc.	Buncombe	2004
Sandoz Inc., a Novartis Division	Wilson	1994
Sterling Pharma USA LLC	Wake	1994
Tergus Pharma LLC	Durham	2021
Thermo Fisher Scientific	Pitt	1972
Thermo Fisher Scientific	Guilford	2016

Table A2. Pharmaceutical manufacturing sites in NC. At the time of this study, these companies had active manufacturing sites in NC.

Supplements

Sites that primarily manufacture vitamins, minerals, supplements, and nutraceuticals, including naturally nutrient-rich or medicinally active foods and herbal products. These sites may not be producing FDA-regulated products but typically function under cGMP practices and require a similar workforce.

Site	County	Site Established
Asterra Labs LLC	Nash	2020
Averix Bio	Wilson	2019
BestCo Inc.	Iredell	1988
Daily Manufacturing Inc.	Rowan	1979
Gaia Herbs Inc.	Transylvania	1997
Herbalife	Forsyth	2015
Nutra-Pharma Manufacturing Corp. of NC	Davidson	2008
Open Book Extract	Person	2019

Table A3. Supplement & Nutraceuticals manufacturing sites in NC. At the time of this study, these companies had active manufacturing sites in NC.

Biologics for R&D

Sites that primarily manufacture biologic reagents, enzymes, antibodies, nucleic acids, peptides, and amino acids specifically for use in research and development activities.

Site	County	Site Established
Avioq Inc.	Durham	2007
Cygnus Technologies LLC	Brunswick	2002
EpiCypher Inc.	Durham	2019
Glycan Therapeutics Inc.	Wake	2013
ImmunoReagents Inc.	Wake	2005
LigaTrap Technologies	Durham	2015
Lonza RTP	Durham	2012
MOLTOX	Watauga	1996

Table A4. Biologics for R&D Sites in NC. At the time of this study, these companies had active manufacturing sites in NC.

Training Programs

At the time of the study, N.C. had 18 institutions that offered biopharma manufacturing-specific training programs. Four offered graduate-level training, five offered bachelor's-level training, 11 offered associate-level training, and 15 offered certificate and continuing-education programs.

Institution	Certificate/ Continuing Ed	AS/AAS	BA/BS	Graduate
NC State University Biomanufacturing Training & Education Center (BTEC)	√		√	√
NC Central University Biomanufacturing Research Institute & Technology Enterprise (BRITE)	√		√	√
Campbell University			√	√
East Carolina University (ECU)			√	
NC Agricultural & Technical State University (NC A&T)			√	√
NC BioNetwork Capstone Center	√	√		
Alamance CC	√	√		
Caldwell CC	√	√		
Central Carolina CC	√	√		
Durham Tech CC	√			
Johnston CC	√	√		
NC Biotechnology Workforce (NCBW) lab at Forsyth Tech	√	√		
Piedmont CC	√			
Pitt CC	√	√		
Rowan Cabarrus CC	√	√		
Vance-Granville CC	√	√		
Wake Tech CC	√	√		
Wilson CC	√	√		

Table A5. At the time of the study, these programs offered biopharma manufacturing training at various levels in NC. √ indicates an existing training program offering. Since the time of this survey, Craven Community College and Rowan-Cabarrus Community College have started offering BioWork.

North Carolina Biotechnology Center



Our Mission

We create North Carolina's competitive advantage
in the life sciences, engaging partners,
maximizing opportunities, and delivering solutions to
accelerate innovation, investment, and job creation.

Our Vision

North Carolina: a global life sciences leader.

North Carolina Biotechnology Center®

The North Carolina Biotechnology Center is a private, non-profit corporation that transforms North Carolina's life science opportunities into economic prosperity through innovation, commercialization, education and business growth. It's headquartered in the Research Triangle Park, with regional offices in Asheville, Charlotte, Greenville, Wilmington and Winston-Salem.

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