Beyond Bricks and Mortar:

The Workforce Skilling Investments Behind the Biopharmaceutical Industry's U.S. Manufacturing Expansion

Performed For: Pharmaceutical Research and Manufacturers of America (PhRMA)
Performed By: TEConomy Partners, LLC

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Executive Summary

The innovative biopharmaceutical industry is committing to the United States through a historic wave of investments that will expand advanced manufacturing, strengthen domestic supply chains, and create skilled, high-quality jobs. To see these commitments succeed, however, requires investing in the American worker through upskilling, reskilling, and strategic talent development alongside construction, equipment, and digital infrastructure.

Historic Investments and Economic Impact

The industry's recent announcements reflect unprecedented commitments to U.S. production, R&D, and related infrastructure.

- PhRMA member companies have announced $500 billion in U.S. investments, including new, expanded, and modernized facilities across nearly half of all states.[1]
- These investments are expected to generate an estimated $1.2 trillion in economic activity and more than 100,000 jobs, including about 25,000 in biopharmaceutical facilities and operations.[2]
- Each project also generates significant economic ripple effects through construction, suppliers, logistics, and other business services.

Biopharmaceutical Manufacturing Growth and Workforce Demand

Biopharmaceutical manufacturing is a core component of America's advanced manufacturing base and a structural source of growth.

- Employment in pharmaceutical and medicine manufacturing grew 24% between 2015 and 2024, far faster than both the overall private sector and the broader manufacturing base.
- Biopharmaceutical manufacturing employment reached roughly 348,000 jobs in 2024 and is projected to exceed 377,000 by 2034.
- New and expanded facilities are increasing demand for production workers, technicians, quality specialists, maintenance personnel, and other skilled manufacturing talent.

A Skills-Intensive, Technician-Heavy Workforce

The talent challenge for the biopharmaceutical industry is not limited to scientists and engineers; it is equally a challenge of building strong pipelines for technical and skills-based roles.

- Technical and skills-based roles—which require some type of credential, certification, or experiential or skills-based training (up to and including associate's degrees) but typically less than a four-year degree—

1 Drew Voytal, "Manufacturing U.S. jobs and breakthroughs," PhRMA website blog, October 2025. See: https://phrma.org/blog/manufacturing-u-s-jobs-and-breakthroughs.
2 Stephen Ubl, "Historic biopharmaceutical investments: A prescription for America's future," PhRMA website blog, September 2025. See: https://phrma.org/blog/historic-biopharmaceutical-investments-a-prescription-for-america-s-future.

account for 42% of biopharmaceutical manufacturing employment and are projected to remain a large share of the sector's workforce over the coming decade.

- Between 2025 and 2034, industry employers are expected to need nearly 30,000 hires or reskilled workers annually across all skill levels, with technical and skills-based roles accounting for a larger share of this demand than either college degree roles or jobs requiring only high school equivalency.
- Many of these jobs are accessible through certificates, apprenticeships, associate degrees, and targeted on-the-job training rather than a traditional four-year degree underscoring the industry's labor market pressures are not only in advanced STEM occupations but also in mid-skill technical roles that keep production lines running, maintain complex equipment, and ensure compliance with rigorous quality and regulatory standards.

Evidence from Facilities and Regional Labor Markets

Plant-level staffing patterns and job postings both point to sustained demand for skilled production and support workers.

- In biologics and fill-finish facilities, a majority of roles are concentrated in production operations, quality control and assurance, and technical support functions.
- Recent job postings show persistent demand for quality assurance and control roles, medical technicians, production workers, production technicians, and industrial maintenance technicians.
- These patterns confirm that biopharmaceutical manufacturing's day-to-day labor market is defined not only by scientists and managers, but equally by sustained hiring needs for skilled production, quality, technician, and maintenance roles that keep facilities operating safely and reliably.

Industry-led Workforce Solutions

Leading biopharmaceutical companies are not only expanding facilities but also investing directly in workforce solutions to meet growing talent needs.

- Companies are supporting apprenticeships, boot camps, stackable credential pathways, and employer-aligned training programs with community colleges and universities.
- Several common design features and best practices emerge across these initiatives, including paid work-based learning, co-located training facilities, stackable flexible credentials, and, at times, the use of regional or multi-employer consortia.
- At the same time, employers are assisting trainees with tuition support, career coaching, and job placement to expand participation and employee retention.
- Together, these efforts demonstrate that workforce skilling is an essential complement to capital investment and a cornerstone of sustaining U.S. leadership in biopharmaceutical manufacturing.

Crucially, the biopharmaceutical industry is not treating this rising labor demand as a challenge for others to solve. Across the case studies highlighted in this report, companies are acting as co-investors in developing new workforce pipelines, working with community colleges, universities, workforce boards, and community-based organizations to design and fund training that aligns directly with modern plant requirements. Sustaining and scaling this momentum will require continued commitment from industry, policymakers, and education and workforce systems. Federal and state leaders have a strategic opportunity to treat biopharmaceutical manufacturing as critical infrastructure on par with semiconductors and clean energy by supporting permitting, infrastructure, and talent initiatives that encourage continued facility expansion in the United States.

I. Introduction

The innovative biopharmaceutical industry is committing to the United States through a new and unprecedented wave of investment activities, with plans to invest $500 billion to accelerate R&D, enhance and expand manufacturing, and create skilled, high-quality jobs throughout the country.[3]

Driven by industry growth and expansion, strategic reshoring and onshoring, resilient supply chain objectives, facility modernization, and commitments to maintaining American leadership in the life sciences, numerous biopharmaceutical companies have recently announced dozens of new multibillion-dollar investments in U.S. production, R&D facilities, and other infrastructure. The commitments include new, expanded, and modernized facility investments across nearly half of all U.S. states.

The biopharmaceutical industry's historic wave of new operational investments in the U.S. is not limited to construction and infrastructure or new automation equipment. To see these commitments succeed requires investing in the American worker for upskilling, reskilling, and strategic talent development—and biopharmaceutical companies are playing a major role in this capacity for both the new and existing workforce.

This report aims to highlight examples of industry-led and supported workforce training efforts to meet the growing demand.

The biopharmaceutical industry is an advanced manufacturing powerhouse. New and expanded U.S. manufacturing operations are designed to enable production of both existing and emerging product lines as well as to accelerate development of new life-saving therapies. This includes, importantly, major investments to manufacture medicines for clinical research pipelines, to be administered in early- through later-stage clinical trials, a critical phase of the innovation continuum to deliver new therapies, vaccines, and other treatments to patients.

3 Drew Voytal, "Manufacturing U.S. jobs and breakthroughs," PhRMA website blog, October 2025. See: https://phrma.org/blog/manufacturing-u-s-jobs-and-breakthroughs.

Modern biopharmaceutical production environments are rapidly evolving, requiring significant investments in plants and equipment with major implications for workforce and talent demand and skills. Industry production is shifting from traditional batch-oriented plants to highly digitized, flexible, and data-driven operations aligned with Industry 4.0 principles.[4] These include smart, connected facilities, leveraging AI and advanced analytics, automation and robotics, and moving toward continuous manufacturing and modular production capabilities. This evolution is reshaping workforce and skill needs, requiring a digitally fluent biopharmaceutical manufacturing workforce comfortable with data systems, analytical tools, and an ability to manage and troubleshoot automated systems. Skilled technician roles are increasingly "hybrid" in nature, blending mechanical knowledge with IT, new AI-driven process controls, and data interpretation.

New operational investments, therefore, are not stopping with construction and infrastructure or new automation equipment. To see these commitments succeed requires investing in the American manufacturing worker for upskilling, reskilling, and related strategic talent development—and biopharmaceutical companies are playing a major role in this capacity for both the new and incumbent workforce. The industry is partnering with academic institutions and training partners in new and innovative approaches to focused, targeted, and rapid skills development for flexible, industry-recognized credentials. This report aims to highlight examples of these industry-led and supported workforce training efforts.

4 Industry 4.0 refers to the fourth industrial revolution, an ongoing shift toward highly digital, connected, and automated manufacturing operations and systems.

Biopharmaceutical Manufacturing Investments Highlight Growth, Momentum, but Also the Industry's Response to Meeting the Talent Imperative

The industry's historic recent investments include a primary emphasis on new and expanded manufacturing operations. The investments highlight the emphasis companies are placing on meeting the demand for biologics, complex medicines derived from living systems such as cells, bacteria, or biological processes, rather than chemical synthesis. They include and reflect rising global demand for monoclonal antibodies for immunotherapies and other treatments, vaccines, cell and gene therapies for rare genetic diseases and advanced cancers, and recombinant proteins such as insulin and growth factors for metabolic and endocrine disorders. This biomanufacturing focus drives needs for new production infrastructure.

The industry's investments represent billions in new and expanded U.S. manufacturing facilities. While not all announcements include estimates of projected new job creation, many do, with thousands of new permanent jobs expected to be generated directly in biopharmaceutical manufacturing operations, in roles such as:

- Process engineering and site operations management
- Technical scientific and manufacturing roles such as chemists and bioprocess specialists
- Facility operations and maintenance roles tied to machinery operation, advanced automation, and other production infrastructure
- Lab technicians
- Quality assurance and quality control
- Packaging, material handling, and other logistics and distribution functions

These roles reflect the biopharmaceutical industry's outsized deployment of highly skilled "STEM" professionals, where the industry's manufacturing operations employ more than four times the STEM workforce relative to the nation's overall private sector.[5] They also reflect the scores of skilled production and technician roles necessary to produce modern medicines, areas of significantly rising demand and strategic importance that coincide with these new transformative investments. These dynamics highlight access to skilled talent and quality academic institutions, along with business climate, strategic locations, and robust life sciences ecosystems as leading priorities in site selection factors for biopharmaceutical manufacturing facilities.

5 TEConomy Partners, LLC, "The Biopharmaceutical Industry's Sustained Commitment to Enhancing the Nation's STEM Education and Workforce," 2024.

Biopharmaceutical manufacturing investments will enable the industry to continue to deliver medicines to patients via more reliable domestic supply chains while also employing Americans, including in newly created jobs, at an even greater scale. Each investment results in significant economic ripple or "multiplier effects", generating and supporting tens of thousands of new construction jobs in skilled trades across the country, as well as support for supply chains, logistics, business services, retail, and numerous other sectors. According to Pharmaceutical Research and Manufacturers of America's (PhRMA)—the trade association representing the nation's leading biopharmaceutical research companies—tracking of recent announcements and commitments among its members, the half-trillion dollars in investment are expected to generate an estimated $1.2 trillion in the nation's economy and create more than 100,000 jobs—including 25,000 in biopharmaceutical facilities and operations.[6]

The size and scale of these historic investments and their associated long-term commitments to America's workforce and talent warrant an assessment of the types of investment and partnerships underway. As with the industry's well-documented support for U.S. STEM education,[7] there is a compelling story to be told regarding the industry's historic investments in the American worker—including in the important context of reskilling and upskilling the incumbent workforce.

This report is organized across the following sections:

- **Setting the Context:** The Biopharmaceutical Production Workforce Today
- **Highlighting the Opportunity for U.S.-Based Biopharmaceutical Manufacturing:** Impacts on the National Manufacturing Base from Industry Expansion
- **Meeting the Demand for Skilled U.S. Manufacturing Talent:** Biopharmaceutical Industry Leaders Partner, Invest in New Training and Education Programs
- **Conclusion**

6 Stephen Ubl, "Historic biopharmaceutical investments: A prescription for America's future," PhRMA website blog, September 2025. See: https://phrma.org/blog/historic-biopharmaceutical-investments-a-prescription-for-america-s-future.

7 TEConomy Partners, LLC, "The Biopharmaceutical Industry's Sustained Commitment to Enhancing the Nation's STEM Education and Workforce," 2024.

II. Setting the Context: The Biopharmaceutical Production Workforce Today

Biopharmaceutical manufacturing is one of the United States' most dynamic advanced manufacturing industries, anchoring supply chains for biologics, vaccines, and small molecule therapies while creating tens of thousands of high paying production, technical, and skilled trades jobs each year.

Over the last decade, employment in pharmaceutical and medicine manufacturing has grown far faster than both the overall private sector and the broader manufacturing base, and projections to 2034 indicate that this growth will be sustained and increasingly driven by a need for technical and skills-based roles.

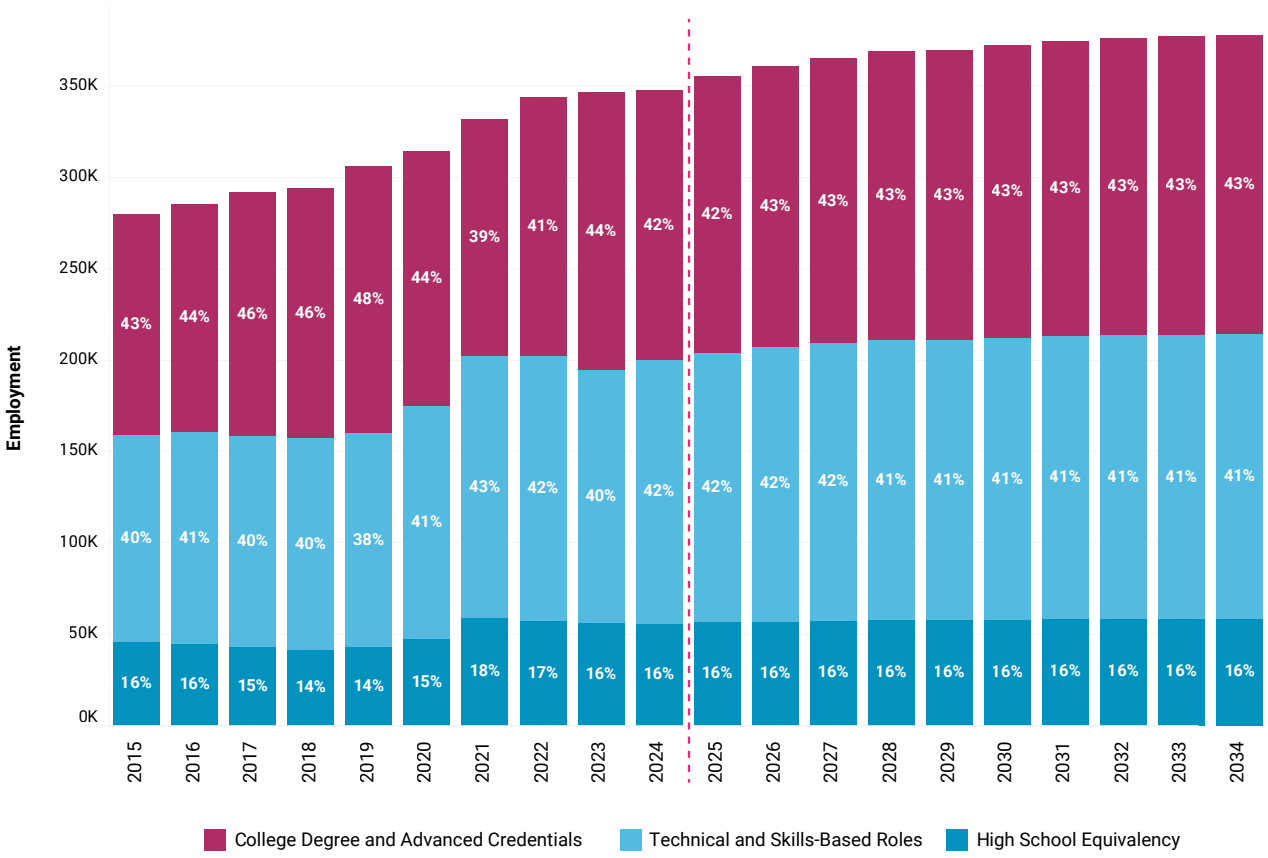
Employment in pharmaceutical and medicine manufacturing grew 24% between 2015 and 2024, more than twice as fast as overall private sector employment and nearly six times as fast as employment in all manufacturing, underscoring the sector's role as a structural growth engine rather than a niche component of the economy.

An Expanding Domestic Biopharmaceutical Manufacturing Base

Biopharmaceutical manufacturing—including the production of biologic drugs, vaccines, cell and gene therapies, and other complex modalities—remains a core component of America's domestic manufacturing platform. Industry employment reached 348,000 jobs in 2024 and is projected to exceed 377,000 jobs by 2034, an increase of about 8.5%—more than twice the projected growth rate for total manufacturing employment over the same period (Figure 1). Employment in pharmaceutical and medicine manufacturing grew 24% between 2015 and 2024, more than twice as fast as overall private sector employment and nearly six times as fast as employment in all manufacturing, underscoring the sector's role as a structural growth engine rather than a niche component of the economy.[8]

8 Employment in all manufacturing industries in the U.S. grew by 4% over this period while the overall private sector grew by 11% (Source: TEConomy analysis of Lightcast 2026.1).

Figure 1: Recent and Projected Future Employment Trends in the U.S. Biopharmaceutical Manufacturing Industry by Entry-Level Education Requirements



Note: Biopharmaceutical manufacturing industry employment is defined as including detailed industry sectors under NAICS 3254, Pharmaceutical and Medicine Manufacturing.

Source: TEConomy analysis of Lightcast data (Datarun 2025.4).

This sustained growth reflects a combination of onshoring and reshoring of critical production, rapid expansion in biologics and sterile products capacity, and large-scale capital investment by U.S. and global biopharmaceutical firms in U.S. operations. At the facility level, these trends translate into sizable cohorts of production operators, process technicians, and maintenance specialists who run and support highly automated lines for formulation, filling, and packaging—roles that are distinct from, but tightly integrated with, those of scientists and engineers. Announced and recently opened biologics and fill-finish[9] plants in North Carolina, Indiana, Ohio, and other states broadly describe hiring needs that span manufacturing associates and technicians, sterile fill-finish technicians, packaging operators, quality control and quality assurance technicians, utilities and facilities mechanics, and automation/controls technicians, often emphasizing current Good Manufacturing Practice (cGMP)[10] familiarity, problem-solving skills, and comfort with computerized production systems over four-year degrees.

9 Fill-finish plants are pharmaceutical manufacturing facilities that aseptically fill sterile drug products into final containers, then seal, inspect, label, and package it for distribution. Unlike a biologics plant, which typically produces or purifies the active biological drug substance itself, a fill-finish plant focuses on the final sterile packaging step.

10 cGMP represents the minimum set of regulations and requirements, overseen by the U.S. Food and Drug Administration (FDA) for the methods, facilities, and controls used in manufacturing, processing, and packaging of a drug product, ensuring its safety for use and alignment with its ingredient and strength claims. For more information, see: https://www.fda.gov/drugs/pharmaceutical-quality-resources/current-good-manufacturing-practice-cgmp-regulations.

As these plants come online, the traditional "operator" role is evolving into a more advanced process technician job that blends equipment setup and troubleshooting with real-time monitoring of complex biologic processes, data capture in electronic batch records, and collaboration with engineering and quality teams to resolve any issues with ongoing uptime of manufacturing processes or final quality of products. Job postings for new and expanding facilities routinely seek technicians who can lead or execute aseptic filling steps, perform in-process quality checks, adjust parameters on programmable logic controllers, and carry out preventive maintenance aimed at maximizing overall equipment effectiveness. Notably, these positions are often accessible with community college credentials, industry recognized certificates, or prior industrial experience rather than a traditional bachelor's degree. In this way, the same forces that are driving renewed domestic investment in biopharmaceutical manufacturing are simultaneously generating strong, sustained demand for a wide range of skilled and technical roles that sit at the heart of the sector's day-to-day manufacturing capability.

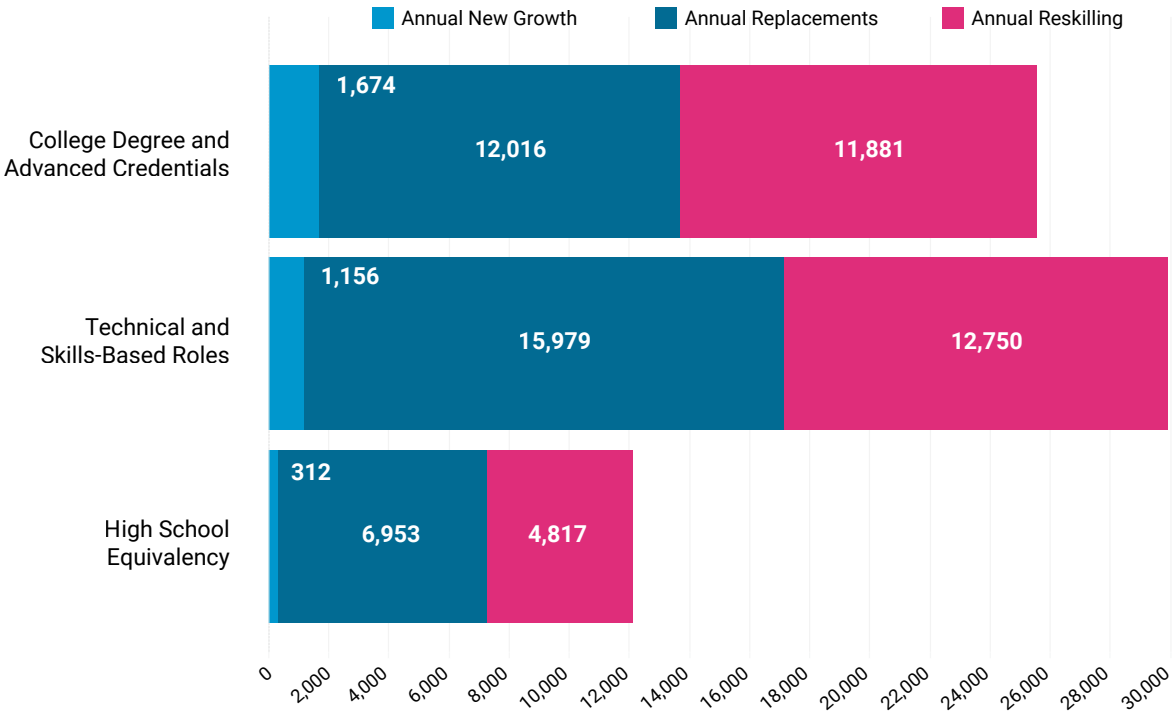
Announced and recently opened biologics and fill-finish plants broadly describe hiring needs that span manufacturing associates and technicians, sterile fill-finish technicians, packaging operators, quality control and quality assurance technicians, utilities and facilities mechanics, and automation/controls technicians.

Demand Across All Skill Levels, Led by Technical and Skills-Based Jobs

Within the industry, employment data show that technical and skills-based roles constitute a large and growing share of the sector's workforce. In 2024, 42% of the total biopharmaceutical manufacturing sector's employment falls into technical and skills-based roles which require some type of credential, certification, or experiential or skills-based training, up to and including associate's degrees, but typically less than a four-year degree. This compares with 43% in jobs requiring college degrees and advanced credentials, and 16% in roles accessible with only high school equivalency. That distribution of entry-level requirements for the industry is projected to remain remarkably stable through 2034, meaning that technical and skills-based roles will continue to account for about two fifths of all biopharmaceutical manufacturing jobs over the next decade as new facilities and expansions come online.

National employment projections also highlight that technical and skills-based roles are anticipated to generate the highest combined demand for talent pipelines across the three major skills tiers (Figure 2). Between 2025 and 2034, biopharmaceutical manufacturing employers are expected to need nearly 30,000 hires or reskilled workers each year across all skill levels, with technical and skills-based roles accounting for a larger share of this demand than either college degree roles or jobs requiring only high school equivalency. Specifically, technical and skills-based roles are projected to require more than 1,100 new positions annually, nearly 16,000 replacement hires for workers retiring or otherwise leaving the workforce, and roughly 12,750 workers reskilled each year over the decade to remain relevant in their current roles.

Figure 2: Average Annual Projected Demand for Jobs in the Biopharmaceutical Manufacturing Industry by Major Skills Tier, 2025-2034

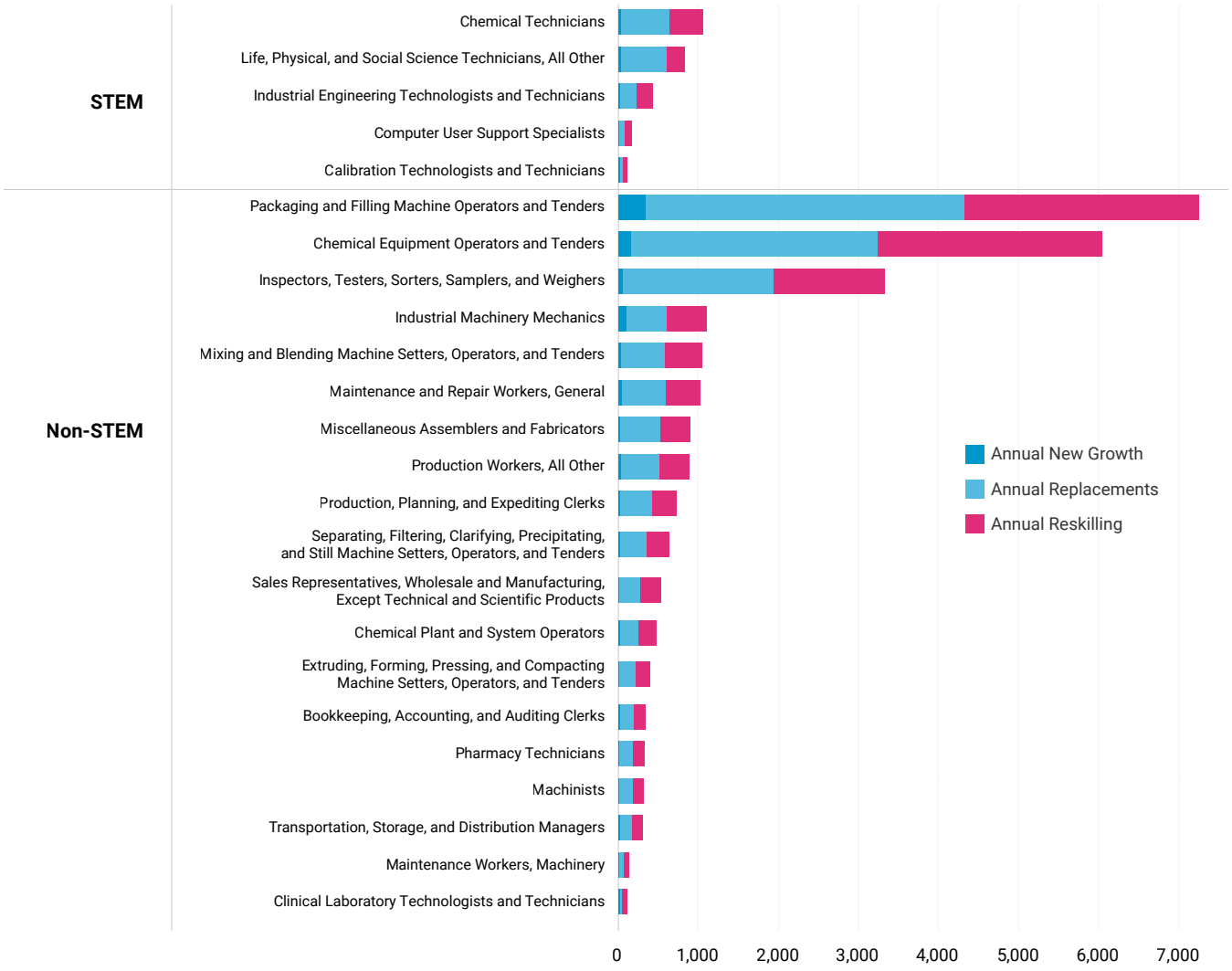


Source: TEConomy analysis of Lightcast data (Datarun 2025.4).

By comparison, college degree and advanced credential roles show slightly higher demand from growth of the industry, while high school equivalent roles such as entry-level material handlers or basic support functions represent a smaller portion of overall employment demand. These patterns again underscore that the sector's labor market pressures are concentrated not only in advanced STEM occupations but also in mid-skill technical roles that keep production lines running, maintain complex equipment, and ensure compliance with rigorous quality and regulatory standards.

Within the technical skills tier, several production and maintenance occupations stand out as especially in demand. Packaging and filling machine operators and tenders, chemical equipment operators and tenders, and inspectors, testers, sorters, samplers, and weighers together represent the single largest block of projected annual workforce needs in biopharmaceutical manufacturing when combining new job growth, replacement demand to backfill employees leaving the workforce, and ongoing reskilling and upskilling of workers to align with modern job requirements (Figure 3). Each of these occupations is expected to require thousands of hires and reskilled workers per year between 2025 and 2034, driven by the expansion of sterile fill-finish operations, continuous manufacturing[11] lines, and quality control practices. These are hands-on, plant floor jobs that rely on strong technical and problem solving skills and are increasingly driven by talent with industry recognized credentials, apprenticeships, or on-the-job training.

Figure 3: Average Annual Growth Projections for Technical and Skills-Based Roles within the Biopharmaceutical Manufacturing Industry, 2025-2034



Source: TEConomy analysis of Lightcast data (Datarun 2025.4).

11 Continuous manufacturing is an integrated drug-production process in which materials flow continuously through manufacturing steps rather than being processed in discrete batches.

Evidence From Recent Job Postings Reinforce the Demand Signals for Skilled Production and Support Workers

Recent job postings data reinforces the demand signals for skilled production and technical support workers alongside other major labor categories in biopharmaceutical manufacturing. Over the 2021 through 2025 period, core commercial and leadership roles as well as STEM professionals and scientists in general research roles remain major industry needs (Table 1). Yet quality assurance and control roles rank nearly as high with nearly 2,000 monthly postings, reflecting the centrality of quality functions in cGMP environments and confirming that quality specialists and quality control analysts are among the most sought after technical hires. Many quality specialist and quality assurance and control technician postings specify associate degrees, certificates, or equivalent experience rather than requiring a four-year degree, underscoring that a significant share of this quality demand is for skilled technical, non-degree roles. Similarly, more than 1,100 average monthly postings for medical technicians highlight the importance of skilled technician labor segments to the industry. In many cases, medical technician positions in laboratory support, phlebotomy, or diagnostic operations are accessible with targeted certificates or associates level training, indicating that biopharmaceutical employers are an important source of skills-based jobs beyond production floor activity.

Industry job postings patterns confirm that while demand for scientists, managers, and data specialists remains strong, biopharmaceutical manufacturing's day-to-day labor market is equally defined by sustained hiring needs for skilled production, quality, technician, and maintenance roles that keep facilities operating safely and reliably.

Within explicitly production oriented categories, job postings data show a substantial and persistent need for skilled operators, technicians, and maintenance personnel. Across pharmaceutical manufacturers, general production roles generate an average of 761 unique monthly postings, production technicians account for 729 postings, and production supervisors add another 476, together signaling a robust demand for workers who can run and oversee manufacturing lines. Industrial maintenance technicians, essential for maintaining uptime of highly automated plants, also account for 254 monthly postings, and logistics and supply chain roles account for a further 290 postings per month that support material flows into and out of manufacturing sites. Taken together, these patterns confirm that while demand for scientists, managers, and data specialists remains strong, biopharmaceutical manufacturing's day-to-day labor market is equally defined by sustained hiring needs for skilled production, quality, technician, and maintenance roles that keep facilities operating safely and reliably.

Table 1: Leading Scientific and Technical Job Categories from Job Postings Activity within U.S. Pharmaceutical Manufacturing Industry Sectors, 2021-2025

Job Category	Average Unique Monthly Job Postings from Pharmaceutical Manufacturers, Jan. 2021 – Dec. 2025
Scientists - General Research	2,023
Quality Assurance & Control	1,986
Data Scientists	1,464
Technicians - Medical	1,123
Regulatory Affairs	1,087
Medical Science Liaisons	871
Medical Directors	866
Production - General	761
Production - Technicians	729
Nursing	712
Engineers - General	512
Production - Supervisors	476
Engineers - Industrial	454
Scientists - Medical - General & Hospitalists	316
Logisticians & Supply Chain	290
Scientists - Chemists	261
Industrial Maintenance Techs	254

Source: TEConomy analysis of Lightcast Job Posting Analytics data (Datarun 2025.4).

Federal and industry leaders increasingly recognize biopharmaceutical manufacturing as critical infrastructure for both national security and economic resilience. The pandemic era disruptions to global supply chains, coupled with geopolitical risks, have accelerated plans by major manufacturers to “reshore” production of active pharmaceutical ingredients, sterile injectables, and other strategic products back to U.S. sites. As a result, new and expanded facilities are being built not only in traditional biopharmaceutical hubs but also in smaller metros and rural regions, where they serve as anchor employers and catalysts for broader advanced manufacturing ecosystems.

III. Highlighting the Opportunity for U.S.-Based Biopharmaceutical Manufacturing: Impacts on the National Manufacturing Base from Industry Expansion

In the context of the broader U.S. manufacturing base, the biopharmaceutical industry represents a high value, strategically important part of the U.S. economy that converts scientific discovery into reliable, large-scale production of medicines, vaccines, and advanced therapies.

Because it links upstream R&D to downstream distribution and patient care, the sector supports dense networks of suppliers, logistics providers, construction trades, and specialized service firms, creating outsized economic spillovers in the regions where facilities are located. National studies estimate that biopharmaceutical activity supports millions of jobs across the country and generates total economic impacts more than double the value of direct industry output, reflecting the capital-intensive nature of modern plants and the high productivity of their workforces. Crucially, this is not only an innovation story; it is a "good jobs" story, with average wages in biopharmaceutical manufacturing substantially exceeding typical U.S. manufacturing pay and offering clear advancement pathways for workers who begin in technical and production roles.

Within this strategic sector, new and expanding facilities consistently seek manufacturing technicians, process operators, quality technicians, maintenance and automation specialists, and other hands-on roles that keep highly regulated, automated plants running safely and efficiently. These positions offer competitive wages, benefits, and opportunities to progress into lead technician, supervisor, or specialist roles as workers gain experience and skills. Taken together, these trends underscore biopharmaceutical manufacturing's role as a cornerstone of America's domestic manufacturing base—one that creates high value products essential to public health while providing large numbers of stable, middle skills and non-degree career opportunities in communities across the country.

New Facilities Will Continue to Generate Demand for Skilled Production and Technician Workforce

Across recent biopharmaceutical manufacturing announcements, a consistent picture emerges of substantial, sustained demand for skilled and technical production labor, with workforce needs varying systematically by facility type but always anchored by large cohorts of technicians, operators, and quality assurance staff. Large biologics drug substance (Active Pharmaceutical Ingredient or "API") plants—typically billion dollar plus investments—routinely project 400 to 650 permanent jobs, while mid-sized biologics facilities in the $400 million to $1 billion range project 200 to 400 jobs per site. Fill-finish and sterile drug product facilities operate at smaller scales but still commonly account for 50 to 200 permanent positions, and in some cases (such as major drug product hubs) reach 500 jobs or more when embedded in larger campuses. Considered together, these projects represent thousands of new advanced manufacturing positions nationally and an analysis of national examples shows that a majority of these roles are in skilled technical and production occupations.

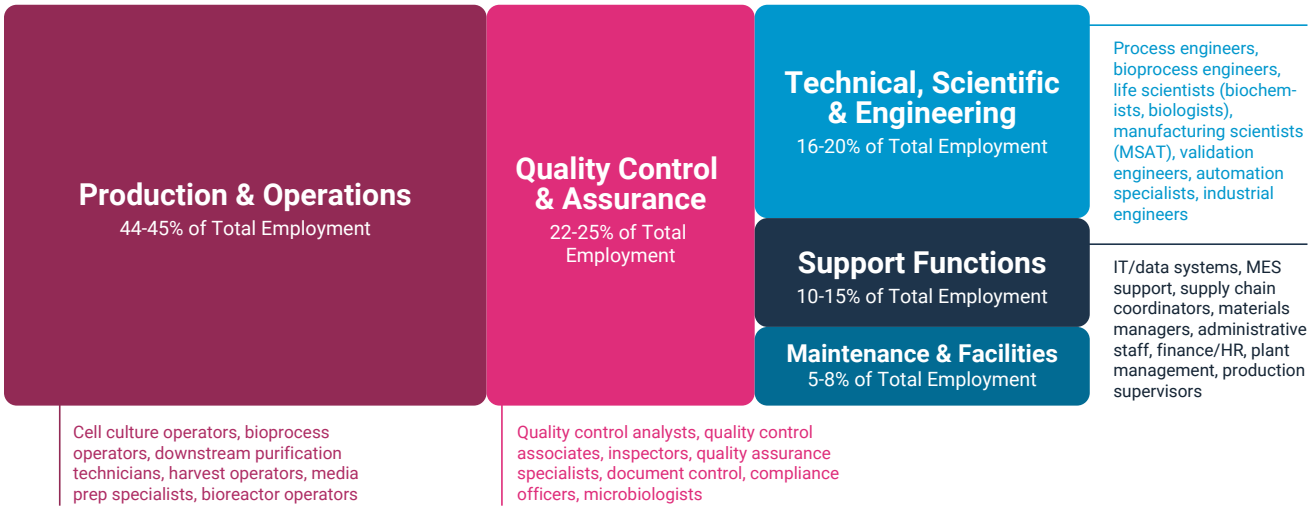
Examining employment profiles for "typical" facilities based on workforce descriptions from real operations can help clarify what this means at the plant level. For a hypothetical representative 500 employee biologics API facility:

- Approximately 220 to 225 workers, about 44% of total staff, are likely to serve as production and operations personnel who run upstream cell culture and fermentation, downstream purification, formulation, and associated material handling.
- An additional 110 to 125 workers (22% to 25%) would be expected to be dedicated to quality control and quality assurance, reflecting the especially stringent regulatory regime for biologics and the documented industry norm of 3.5 to 5 quality assurance and control staff for every 10 plant personnel.
- Technical, scientific, and engineering roles would account for about 80 to 100 employees (16% to 20%).
- Maintenance and facilities positions add an additional 25 to 40 workers (5% to 8%).
- Support functions such as IT, supply chain, and administration make up 50 to 75 jobs (10% to 15%).

At a site level, more than half of the workforce in this representative large biologics facility is concentrated in hands-on production and quality roles, with technicians, operators, and quality associates forming the core of day-to-day operations even as scientists and engineers provide critical process and systems leadership.

Given the roles described above, it is estimated that approximately 75 to 100 workers (15% to 20%) would hold graduate degrees, 150 to 175 (30% to 35%) would hold a bachelor's degree, and an additional 150 to 175 (30% to 35%) would have associate degrees or industry certificates. The remaining 100 to 125 workers (about one in five employees) would enter with a high school diploma or GED and receive specialized on-the-job or short-cycle training.

Figure 4: Workforce Profile for a Hypothetical Representative Large 500-Employee Biologics API Facility Based on Meta-Analysis of Pharmaceutical Manufacturing Industry Sites and Studies

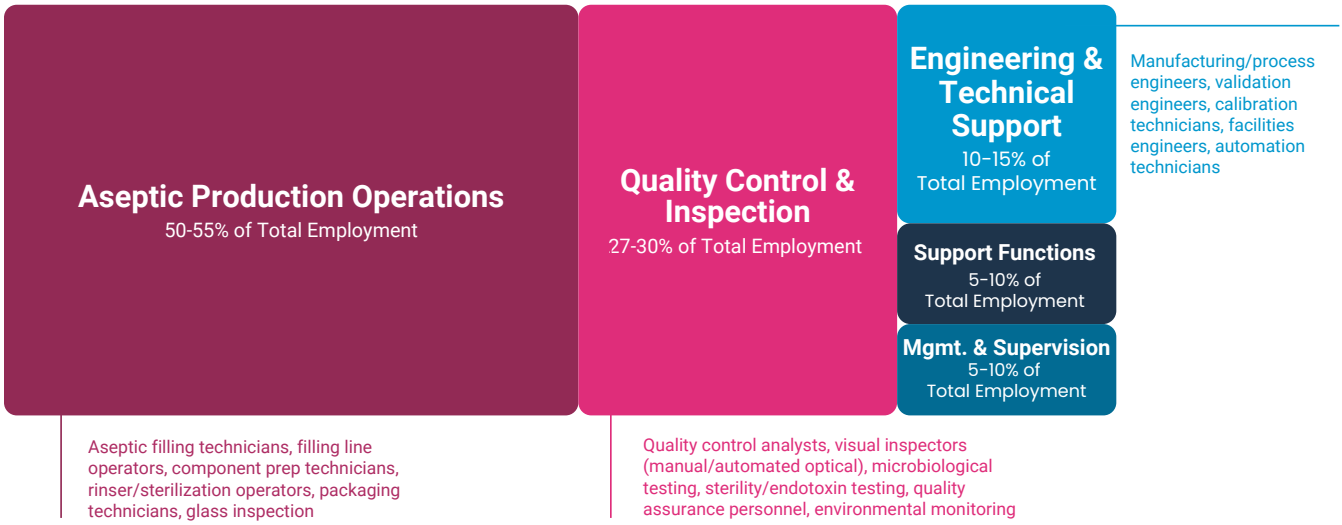


Source: TEConomy analysis of Lightcast national staffing patterns and job postings data (Datarun 2025.4), meta analysis of press releases regarding new and expanding facilities from PhRMA member companies; North Carolina Biotechnology Center/NCLifeSci, Window on the Workplace 2023: Workforce Training Needs for NC's Biopharmaceutical Manufacturing Industry, December 2023; BioPlan Associates, 22nd Annual Report and Survey of Biopharmaceutical Manufacturing Capacity and Production, April 2025; Fellows et al., "Benchmarking the Quality Practices of Global Pharmaceutical Manufacturing to Advance Supply Chain Resilience," AAPS Journal, Vol. 24, No. 6, October 2022 (FDA/D&B/University of St. Gallen), Pharmaceutical Online / FDA 483 Trends Analysis for Sterile Drug Manufacturers, 2024; Green et al., "Recommendations for Workforce Development in Regenerative Medicine Biomanufacturing," Stem Cells Translational Medicine, Vol. 10, No. 10, October 2021; Liu et al., "The Influence of the Number of Employees on the Quality Management of Pharmaceutical Production," Scientific Research Publishing, 2019; BioProcess International, "Predictive Modeling of Talent Efficiency in Biopharmaceutical Organizations," October 2025; Arling et al., "Creating Effective Biopharmaceutical QA/QC Organizations," BioPharm International, 2002 (reprinted 2014).

The “typical” workforce profile for a hypothetical representative 100 employee fill-finish facility underscores an even more pronounced dependence on technical production labor. About 50 to 55 positions (50% to 55% of total employment) are likely to be aseptic production operators and technicians who manage sterile filling lines, component preparation, and packaging. Quality control and inspection roles—including visual inspectors, microbiology and analytical lab staff, and quality assurance specialists—could be expected to account for an additional 27 to 30 positions (27% to 30%), driven by the high volume of unit level inspection and sterility testing required before release. The remaining 20 to 25 jobs are split among engineering and technical support (10% to 15%), frontline management and supervision (5% to 10%), and other support functions (5% to 10%). Evidence from recent case studies reinforces these ratios and shows that expansion of sterile operations primarily translates into additional operators and inspectors rather than a large increase in research roles.

In fill-finish facilities, the educational distribution shifts further toward skills-based roles: only 5 to 10 employees (5% to 10%) are expected to hold advanced degrees and 20 to 30 (20% to 30%) a bachelor’s, while 25 to 35 workers (25% to 35%) would be expected to hold associate degrees or certificates, and 35 to 45 (35% to 45%) would be sourced from high school educated operators and technicians. This aligns with wage and program data from North Carolina and other states showing entry-level biopharmaceutical manufacturing operators earning significant starting wages with credentials such as BioWork certificates or two-year degrees, and with case evidence from other sterile manufacturing employers whose production staff are predominantly high school graduates with specialized technical training.

Figure 5: Workforce Profile for a Hypothetical Representative Mid-Size 100-Employee Fill-Finish Facility Based on Meta-Analysis of Pharmaceutical Manufacturing Industry Sites and Studies



Source: TEConomy analysis of Lightcast national staffing patterns and job postings data (Datarun 2025.4), meta analysis of press releases regarding new and expanding facilities from PhRMA member companies; Fellows et al., "Benchmarking the Quality Practices of Global Pharmaceutical Manufacturing to Advance Supply Chain Resilience," AAPS Journal, Vol. 24, No. 6, October 2022 (FDA/D&B/University of St. Gallen), Pharmaceutical Online / FDA 483 Trends Analysis for Sterile Drug Manufacturers, 2024; Green et al., "Recommendations for Workforce Development in Regenerative Medicine Biomanufacturing," Stem Cells Translational Medicine, Vol. 10, No. 10, October 2021; Liu et al., "The Influence of the Number of Employees on the Quality Management of Pharmaceutical Production," Scientific Research Publishing, 2019; BioProcess International, "Predictive Modeling of Talent Efficiency in Biopharmaceutical Organizations," October 2025; Arling et al., "Creating Effective Biopharmaceutical QA/QC Organizations," BioPharm International, 2002 (reprinted 2014).

Viewed across the pipeline of new and expansion projects, these findings underscore how every major biopharmaceutical manufacturing announcement translates into robust demand for skilled technical and production labor. Scaling these employment shares across the dozens of large- and mid-sized projects documented in recent years—many in emerging regions without deep legacy pipelines—highlights why biopharmaceutical manufacturers, workforce boards, and policymakers are investing so heavily in apprenticeships, boot camps, and applied technical programs.

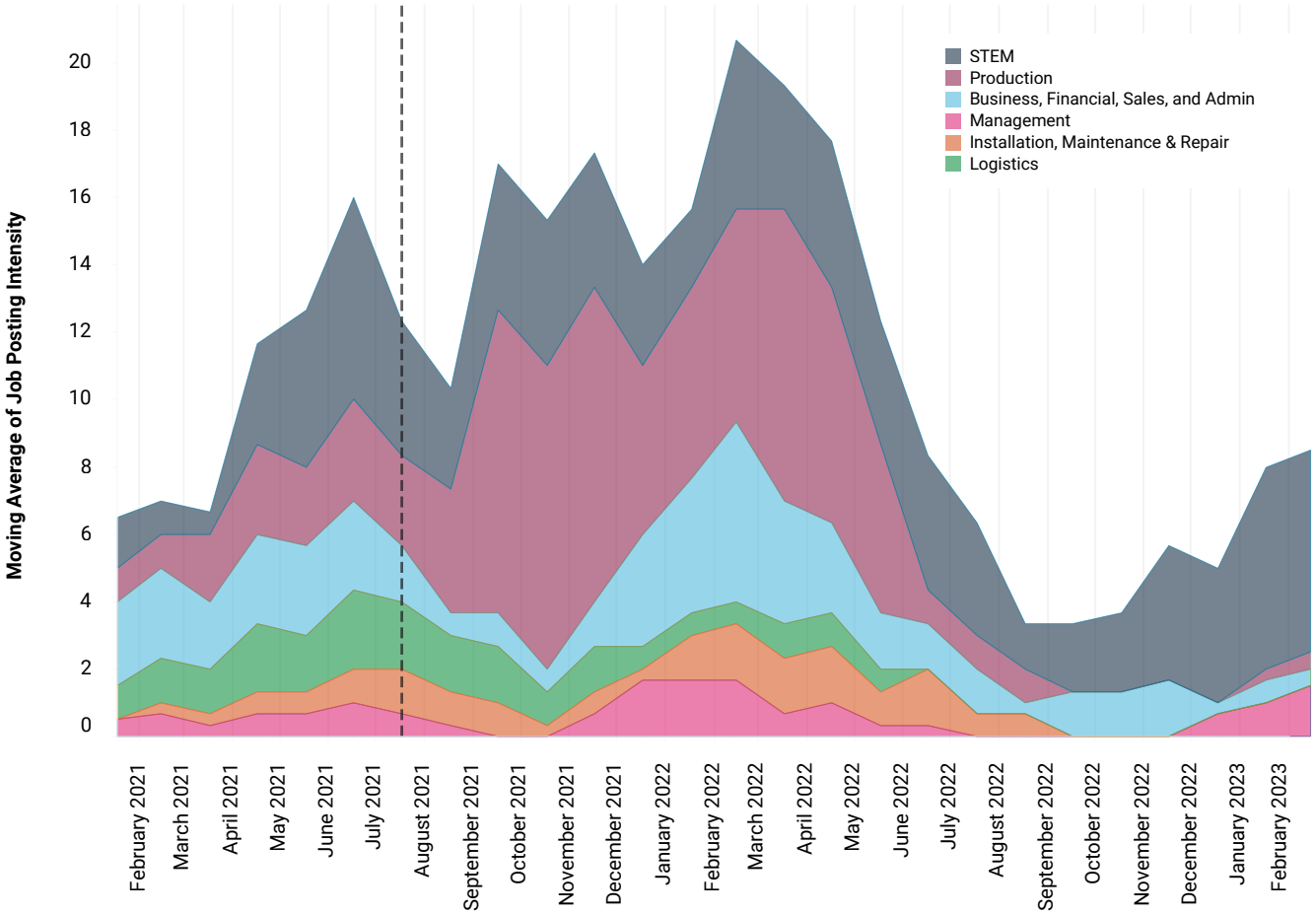
Recent Examples Underscore the Intensity of Hiring for Technical and Skills-Based Roles Driven by New, Expanded Biopharmaceutical Industry Sites

Recent examples provide compelling case studies for the intense labor demand generated by new biopharmaceutical manufacturing facility activity. One lens through which this "real-time" demand can be observed is job postings activity tied directly to the anticipated expansion before and immediately after the period in which it first becomes fully operational. As new facilities move from construction into commissioning, companies must rapidly build out full shift teams of operators, technicians, and maintenance staff, prompting a concentrated burst of recruiting activity. Job postings often spike in the months just before startup as employers race to hire and train enough workers to support validation runs, regulatory inspections, and initial production campaigns. A second wave can follow immediately after operations begin, as firms refine staffing models, add additional lines or shifts, and backfill roles once early hires advance into lead or supervisory positions.

The hiring patterns around recent flagship projects demonstrate how new and expanded facilities trigger these concentrated waves of recruitment, in particular for skilled production and technical roles.

A pattern appears in job posting intensity for MilliporeSigma's single use assembly facility in Danvers, Massachusetts, where expansion to support bioreactor bag and sterile tubing production has driven surges in demand for assemblers, production technicians, and industrial maintenance staff (Figure 6). These roles anchor a critical upstream segment of the biopharmaceutical manufacturing supply chain, ensuring reliable supply of single use systems to drug substance facilities, and expansion in Danvers aligns with broader industry shifts toward flexible, single use bioprocessing platforms which will create significant opportunities for new biopharmaceutical manufacturing jobs driven by credentialing and skills-based training. In anticipation of these growth cycles, MilliporeSigma and regional partners have worked with community colleges and vocational schools in the North Shore and Greater Boston area to expand advanced manufacturing and bioprocess technician programs, creating pathways into long-term facility employment for learners with certificates and associate degrees.

Figure 6: Intensity of Job Postings Activity by Major Role Type During Expansion of MilliporeSigma Single Use Assembly Facility in Danvers, MA



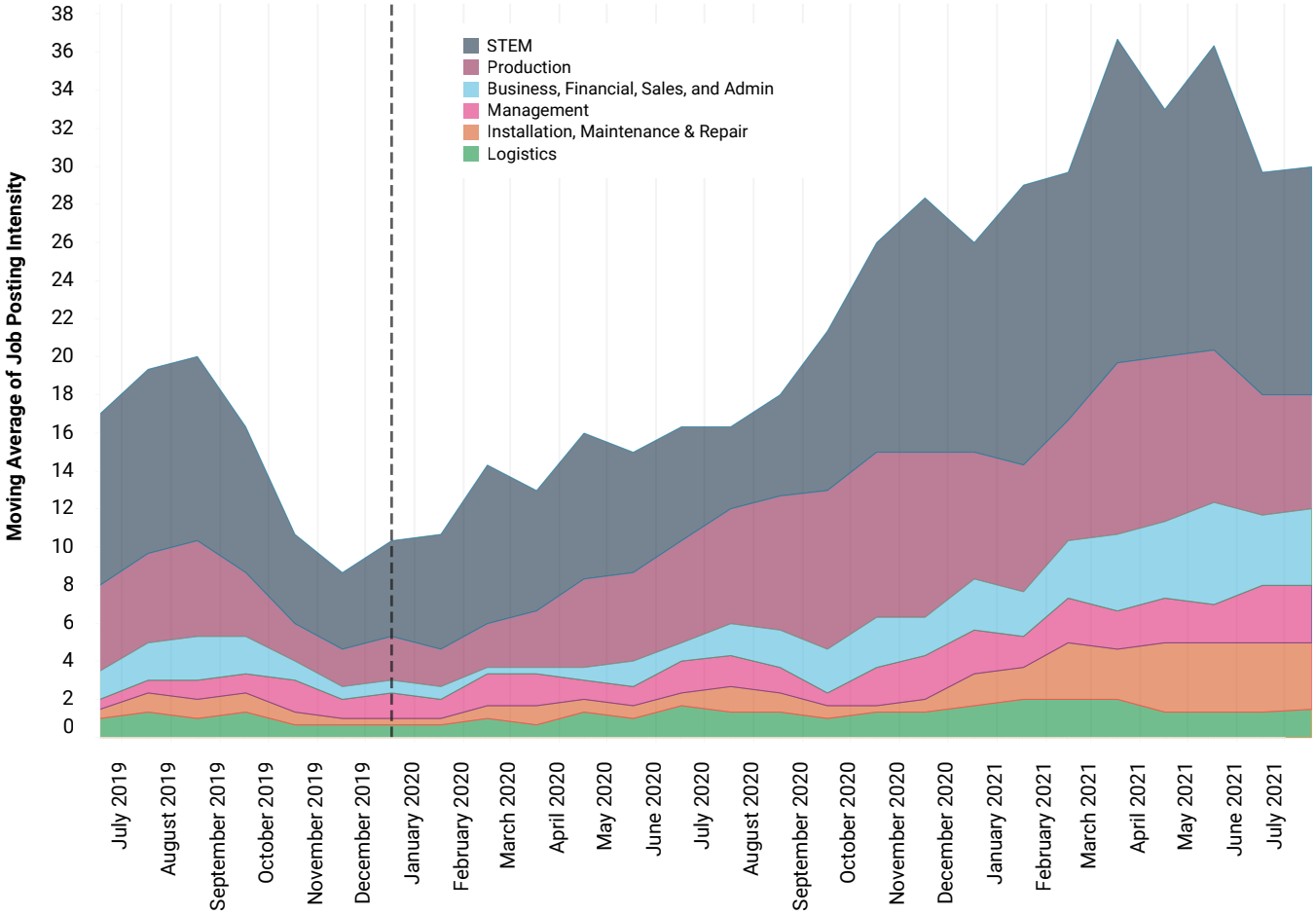
Note: Job posting intensity represents a smoothed moving average of unique postings activity attributed to the employer and geography where the facility site is located; Dotted line represents approximate date expansion first became operational.

Source: TEConomy analysis of Lightcast Job Posting Analytics data (Datarun 2025.4).

Novo Nordisk's multibillion-dollar API manufacturing buildout in Clayton, North Carolina also exhibits the same trajectory (Figure 7). As GLP-1 production has come online, postings for production technicians, utility operators, and maintenance mechanics have risen ahead of each major operational milestone, reflecting the need to staff production lines and support functions with well trained technicians. In parallel, the company has invested heavily in upstream talent pipelines, partnering with Johnston Community College, Durham Technical Community College, and local school districts to expand the BioWork certificate[12] into high schools and adult programs so that graduates can step directly into process technician and manufacturing associate roles at the Clayton campus. These initiatives ensure that hiring surges tied to each expansion phase are supported by a ready pool of locally trained workers who can access well-paying roles.

12 Offered through North Carolina community colleges, the BioWork program is a short-term (10-12 week) training credential that prepares learners for entry-level process technician roles in pharmaceutical, biotechnology, or chemical manufacturing, with emphasis on cGMP, safety, process control, documentation, and contamination control.

Figure 7: Intensity of Job Postings Activity by Major Role Type During New Facility Expansion of Novo Nordisk API Manufacturing Facility in Clayton, NC



Note: Job posting intensity represents a smoothed moving average of unique postings activity attributed to the employer and geography where the facility site is located; dotted line represents approximate date expansion first became operational.

Source: TEConomy analysis of Lightcast Job Posting Analytics data (Datarun 2025.4).

These hiring surges are typically not temporary for skilled production and manufacturing worker cohorts; once facilities reach steady state operations, they translate into durable advanced manufacturing employment and expanded domestic capacity. MilliporeSigma's Danvers site continues to supply single use systems globally, and Novo Nordisk's Research Triangle region campus is now a cornerstone of the company's U.S. obesity drug production network, each supported by large, ongoing cohorts of technicians, operators, and maintenance workers whose jobs are sustained over the long term by the initial capital investments.

Expansion of Biopharmaceutical Facilities Create Construction and Supplier Impacts that Further Support Skilled Workforce Growth

Since early 2025, U.S. and foreign headquartered biopharmaceutical industry firms have announced a dramatic level of investment in new manufacturing capacity in the United States. This new manufacturing capacity will lead to thousands of new biopharmaceutical industry jobs. However, important for nearer term national, state, and regional economic and employment impacts are the thousands of construction workers that will be put to work over these next five years to build out these new facilities.

Based on historical federal data, capital investment regarding new manufacturing facilities, on average, leads to approximately 48% of the investment dollars going toward actual facility construction with the remaining going toward capital investment and other purchases needed to outfit the new facility with manufacturing and other operational equipment.[13] Applying this percentage to the estimated $375+ billion in recently announced investments associated with manufacturing-focused biopharmaceutical industry facilities, still realize more than $185 billion in actual facility construction costs.

Using construction multipliers developed by TEConomy[14] (using IMPLAN's most recent U.S. input-output model), this level of direct construction investment leads to approximately 160,000 construction jobs per year for five years or nearly 800,000 construction jobs-years.

New pharmaceutical manufacturing facilities and expansions create strong demand for skilled construction workers, including electricians, pipefitters, welders, HVAC technicians, and equipment installers. These jobs are often more specialized than standard industry roles because pharmaceutical sites must be built to exacting standards for cleanroom performance, contamination control, utilities, and regulatory compliance.

Beyond construction impacts, a growing biopharmaceutical manufacturing industry also supports upstream business growth for key supplier industries across positions such as machinists, printing press operators, plastics fabricators, and other hands-on trades that do not require a college degree whose employment levels are buoyed directly by the sector's capital and operating spending.

13 Established in TEConomy Partners, LLC, "The Use of Economic Impact Multipliers to Assess Employment, Economic Activity, and Policy Implications of New Investments in Biopharmaceutical Industry Facilities," internal Issue Brief for PhRMA, 2025.

14 Ibid.

Assuming these jobs match the typical occupational profile for non-residential (i.e., commercial) construction workers, these manufacturing facility investments will likely generate annual positions for approximately 60,000 construction trades workers, 15,000 construction managers, and nearly 6,500 architecture and engineering jobs, among the 160,000 annual construction jobs.

Significantly, the overall manufacturing facility investment supports not only the annual employment of these 160,000 construction workers, but also due to indirect and induced effects (suppliers and worker wage spending) generates and supports an additional 209,000 annual jobs, with an overall five-year total economic impact of $450 billion (or 2.42 times the $185 billion actual construction investment over the five years).

Beyond construction impacts, a growing biopharmaceutical manufacturing industry also supports upstream business growth for key supplier industries which provide materials, finished products, and services that enable manufacturing site operations. As shown in Table 2 below, pharmaceutical manufacturing activity indirectly supports demand for skilled production and technician roles in supplier industries, generating additional impact across the U.S. workforce.

In the leading supplier industries alone, direct pharmaceutical manufacturing output supports more than 9,200 jobs in commercial printing with an estimated 4,840 of those positions in skilled production roles tied to activities such as packaging insert printing, labeling, and other regulated print materials required for compliant distribution of medicines. Plastics plumbing fixture manufacturers who produce specialized piping, clean-in-place components, and fluid-handling systems used in bioprocessing suites have an estimated 6,633 indirect jobs supported by current pharmaceutical manufacturing roles, of which 3,903 are skilled production positions. Ethyl alcohol manufacturing and miscellaneous chemical products together account for more than 5,300 indirect jobs, with roughly 2,250 skilled production roles supporting inputs such as solvents, excipients, and cleaning agents that are critical for cGMP operations.

Table 2: Estimated Skilled Production Jobs Within Leading Upstream Supplier Industries Supported by the Biopharmaceutical Manufacturing Industry

Pharmaceutical Manufacturing Supplier Industry Sector	Indirect Employment Impacts	Estimated Skilled Production Roles Supported	Examples of Use of Supplier Products in Pharmaceutical Manufacturing Operations
Commercial Printing (except Screen and Books)	9,248	4,840	cGMP labels, folding cartons, patient leaflets, serialization codes, batch records, cleanroom signage
Plastics Plumbing Fixture Manufacturing	6,633	3,903	Cleanroom valves, fittings, drains, shower heads for aseptic suites, WFI loops, CIP/SIP systems
Ethyl Alcohol Manufacturing	3,866	1,643	Pharma-grade ethanol for disinfection, solvent use, topical ingredients, sterile wipes
Corrugated and Solid Fiber Box Manufacturing	3,590	1,931	Custom shipping boxes for raw materials, finished product pallets
Polystyrene Foam Product Manufacturing	2,166	1,274	EPS coolers and molded inserts for cold-chain shipping of products
All Other Miscellaneous Chemical Product and Preparation Manufacturing	1,434	609	Specialized cleaners, buffer additives, lubricants, sporicidal disinfectants for sanitation and CIP
Machine Shops	1,065	717	Custom vessels, filtration housings, sampling ports, adapter fittings; repair of process and validation tooling
Petrochemical Manufacturing	933	396	Feedstocks for pharma-grade polymers in single-use bags, tubing, closures, filter housings
Plastics Bag and Pouch Manufacturing	890	524	Single-use bioprocess bags, WFI/formulation bags, sterile barrier pouches for components and filters
Plastics Material and Resin Manufacturing	722	307	Pharma-grade resins for tubing, bottles, reservoirs, single-use system components
Plastics Bottle Manufacturing	647	381	Sterile bottles for oral solids, eye drops, bulk sampling; amber and child-resistant variants
Metal Crown, Closure, and Other Metal Stamping (except Automotive)	594	344	Aluminum overseals, crimp caps, vial closures, stopper rings for injectable fill-finish
Perishable Prepared Food Manufacturing	585	265	Validated nutrient media, cell-culture supplements, gelatin excipients (capsule shells)
Paper Bag and Coated and Treated Paper Manufacturing	530	285	Low-particle shed coated paper for garment bags, component wrapping, moisture-resistant case liners; antimicrobial treatments

Source: IMPLAN, TEConomy analysis of Lightcast data (Datarun 2025.4).

Importantly, the jobs highlighted above are not generic office roles; they are machinists, printing press operators, plastics fabricators, and other hands-on trades that do not require a college degree whose employment levels are buoyed directly by the sector's capital and operating spending. These impacts further highlight how pharmaceutical manufacturing demand ripples through chemical, packaging, and precision metalworking supply chains, reinforcing a broad base of advanced manufacturing employment. Taken together, these upstream effects underscore that each new or expanded pharmaceutical manufacturing site anchors not only its own plant-floor workforce, but also a wide constellation of middle-skill, technically intensive jobs across supplier industries that form a critical part of the nation's advanced manufacturing ecosystem.

IV. Meeting the Demand for Skilled U.S. Manufacturing Talent: Biopharmaceutical Industry Leaders Partner, Invest in New Training and Education Programs

The major investments in new and expanding biopharmaceutical production operations throughout the United States represent an exciting opportunity for enhanced domestic manufacturing and job creation, but also a challenge—namely, meeting the significant demand for a blend of skilled manufacturing talent. In addition to investing in new plants, advanced equipment, and expanding production lines, leading biopharmaceutical firms are investing significant resources and focused efforts to educate and train the American worker for modern biopharmaceutical manufacturing roles—including in the important context of reskilling and upskilling the incumbent workforce and expanding on-ramps to industry career opportunities.

This study has identified several examples of these efforts among PhRMA member companies via an online scan and research and by conducting interviews with employers regarding specific programs or initiatives. **Several types of programs and design characteristics emerge as common or best practice for these newly initiated workforce skilling efforts and examples are cited that illustrate these highly intentional design frameworks (Table 3). The example programs are then highlighted later in this section with brief overviews or vignettes.**

Table 3: Types of Programs Implemented, Key Design Characteristics and Approaches Utilized in New U.S. Biopharmaceutical Manufacturing Talent and Skill Development

Program Type & Key Design Features	Description & Benefits	Biopharmaceutical Industry Examples Profiled in this Report
Apprenticeship programs	Apprenticeship programs have emerged in recent years in the biopharmaceutical industry as employers see numerous advantages to structured, paid work programs that combine: on-the-job learning under supervision; classroom or college credit coursework; and industry mentorship and assessment, often utilizing senior employees in these key capacities. Apprentices earn while they learn, gaining both academic credentials and real work experience—reducing barriers to entry and accelerating readiness and this approach is clearly preferred now by many industry employers.	Amgen's Central Ohio Apprenticeship Program with Columbus State; BioMechatronics Apprenticeship (Eli Lilly and Company, CSL Seqirus, and others); Novo Nordisk Industrial Maintenance Apprenticeship.
Co-locating training facilities and industry labs	Co-locating training facilities and industry labs is a key design feature of several programs, with local partners setting up training labs or centers embedded within or adjacent to industry sites. This reduces the training-to-employment gap by exposing learners to realistic equipment and workflows.	Biogen's CoLab for BioWork certificate delivery; Life Sciences Training Center at Durham Tech enabled by Novo Nordisk investments.
Stackable credentials and modular pathways	Stackable credentials and modular pathways, where instead of pursuing a single, long degree program, pathways are structured as micro-credentials such as badges and certifications; short certificates are stackable toward degrees or higher-level certifications; and flexible entry and exit points are enabled for learners at different stages of their respective education or careers. This brings value by increasing flexibility, broadening access to trainee pools, and allowing for incremental progress toward higher credentials.	Biotechnology certificates at Durham Tech and Virginia Center for Advanced Pharmaceutical Manufacturing Consortium layered credential approach.
Utilizing regional and multi-employer consortia	Utilizing regional and multi-employer consortia rather than siloed efforts by individual companies training in isolation. Consortia can leverage shared resources, standardized industry-recognized competencies, greater scaling of trainees, and consistent workforce pipelines across employers.	NC Life Sciences Apprenticeship Consortium; Virginia Center for Advanced Pharmaceutical Manufacturing Consortium (12+ companies with higher-ed partners).
Employer-aligned academic programs	Employer-aligned academic programs integrate industry input directly into community college and university curricula so that education and training are informed and designed with employers. Applied degree programs in areas such as biotechnology, bioprocessing, and advanced manufacturing typically reflect this alignment.	Programs created in partnership with regional employers such as AstraZeneca, Eli Lilly and Company, and Merck with Virginia's academic consortium organized for the APM Center.

Note: The examples presented in this table have been identified via online scans and research and are not intended to represent an exhaustive or complete census of these programs nationally.

Source: TEConomy assessment of PhRMA member training programs, initiatives, and support.

These models and approaches break traditional boundaries between education and employment by embedding learning into industry practice, leveraging collaborative frameworks, and designing flexible pathways that meet both learner needs and evolving manufacturing demands. The result is faster, more accessible workforce development capable of supporting rapid growth in advanced biopharmaceutical manufacturing.

While several core principles and design frameworks of these programs are summarized in Table 3, additional overarching attributes or key characteristics seen across these programs include:

- **Industry-education co-design:** employers co-create curriculum with colleges and universities to align training with real jobs, utilizing feedback loops for ensuring consistent industry relevancy.
- **Combining hands-on with classroom learning:** cGMP labs, simulators, apprenticeships, and real manufacturing exposure accelerate trainee readiness.
- **Access and trainee support systems:** assistance with tuition support, career coaching, and job placement expand participation and employee retention.

Biopharmaceutical manufacturers are supporting these efforts in several ways, including:

- **Awarding scholarships and otherwise covering education and training expenses** for trainees and learners.
- **Donating training spaces and industry-grade equipment and technology** to educational partners to enable relevant training and learning experiences.
- **Hiring** apprentices for apprenticeship programs, paying competitive salaries and providing benefits while trainees learn.
- **Providing significant funding donations for educational and training infrastructure**, including new dedicated life sciences buildings, labs, and workforce training facilities.

Examples of New Biopharmaceutical Manufacturing Workforce Training and Education Programs and Initiatives

This section highlights illustrative examples and case studies of new or recent manufacturing training programs implemented by leading biopharmaceutical companies, typically in partnership with local institutions or other training partners. These examples have been identified via online scans and research and are not intended to represent an exhaustive or complete census of these programs nationally. The programs highlighted herein are, however, representative of the types of initiatives being implemented across the industry as the major investments in new and expanding production operations are begun and completed. Several companies granted small group interviews to support a more detailed profile of their respective programs and the specific design attributes and activities underway as well as initial impacts they are realizing.

Advanced Manufacturing Talent Pipelines through Industry-Led Apprenticeships: Eli Lilly and Company & BioMechatronics Apprenticeship Program (North Carolina)

Lilly is a leading industry partner in North Carolina's BioMechatronics Apprenticeship Program, a first-in-the-nation workforce training model designed to prepare advanced maintenance and automation technicians for high-demand roles in biopharmaceutical manufacturing. The program is delivered through Wake Technical Community College at its Beltline Education Center in Raleigh and is structured as a formal registered apprenticeship pathway that directly aligns education with biopharmaceutical production environments.

Developed in collaboration with CSL Seqirus, FUJIFILM Biotechnologies, and Lilly, the BioMechatronics program integrates bioprocessing, industrial automation, robotics, instrumentation, electrical systems, and advanced manufacturing maintenance into a single applied training framework. Apprentices receive both classroom instruction and paid, work-based learning inside active production facilities, creating technicians capable of supporting highly automated, continuous biomanufacturing operations—a significant and steady area of strong demand for talent in modern advanced manufacturing operations.

For Lilly, the program represents a strategic workforce investment aligned with the company's expanding advanced manufacturing footprint and long-term demand for mechatronics skilled technical talent specific to highly automated biopharmaceutical manufacturing. Rather than relying solely on traditional engineering or technician pipelines, the apprenticeship model builds a customized talent stream trained specifically for regulated pharmaceutical manufacturing environments, quality systems, and modern bioproduction infrastructure.

Launched in 2025, the program's inaugural cohort included nine apprentices hired as company employees (with Lilly hiring six) while learning and training across a "hybrid" curriculum including a set of accelerated non-degree courses spanning mechanical and electrical engineering disciplines, motor controls, pneumatics, programmable logic controllers or "PLCs", all to maintain and repair increasingly "smart" biopharmaceutical manufacturing equipment. These areas of focus are combined with life sciences-specific training in aseptic processing, cGMP operational environments, writing and revising Standard Operating Procedures (SOPs), and cleanroom gowning. As a prerequisite, each individual entering the program has already completed North Carolina's BioWork certification program, offered at regional community colleges.

Apprentices earn industry-recognized, stackable certificate credentials awarded by the Smart Automation Certification Alliance or "SACA" in four areas—electrical systems, motor control systems, pneumatic systems, and mechanical power systems, in addition to college credit.

The program spans an eight-month period, with the biopharmaceutical companies covering the education and training costs, and after which apprentices shift into their full-time role as Maintenance Technicians. Lilly supports these newly minted Technicians on the job by pairing them with "peer mentors"—senior level engineering and automation technicians who help to gauge their competencies and capabilities as they progress into their new roles.

The initiative is embedded within the **North Carolina Life Sciences Apprenticeship Consortium**, a coordinated industry network led by the North Carolina Biotechnology Center (NCBiotech). The Consortium includes 12 major biopharmaceutical industry employers working collectively with community colleges, universities, and nonprofit partners to align training systems with real-time industry workforce demand. NCBiotech functions as a key intermediary identifying strategic areas of common need with respect to workforce and talent and working to ease the path to a cooperative training model.

The Apprenticeship Consortium model provides shared infrastructure for:

- Curriculum alignment across companies and training institutions.
- Standardized occupational pathways in biomanufacturing operations.
- Talent pipeline visibility for students and jobseekers.
- Scalable workforce development across multiple employers and regions.

The BioMechatronics Apprenticeship Program demonstrates how Lilly and its industry partners are moving beyond traditional workforce models toward co-designed, apprenticeship-based talent systems—creating resilient, future-ready pipelines for advanced biopharmaceutical manufacturing while strengthening regional life sciences ecosystems. Lilly, experiencing successful outcomes with the program, is considering implementing a similar program and approach at other U.S. manufacturing sites.

Amgen New Albany's Apprenticeship and Bootcamp Programs with Columbus State Community College (Ohio)

Amgen's newly built, most digitally advanced assembly and packaging facility in New Albany, Ohio, is paired with investments in training pipelines that strengthen operations while supporting the local workforce and community. The nearly 300,000-square-foot plant in New Albany's International Business Park performs final stage assembly, labeling, and packaging of injectable medicines, linking Amgen's global R&D and drug substance operations to U.S. distribution. Opened in 2024 with an initial investment of $474 million, which later grew to at least $822 million, the site is equipped with automated guided vehicles, automated storage and retrieval systems, and extensive digital monitoring, making it one of the most automation-intensive pharmaceutical packaging operations in the country.

From the outset, Amgen recognized that Central Ohio lacked a ready-made biopharmaceutical manufacturing workforce sufficient to meet its hiring needs. During construction and operational readiness planning, site leaders concluded that they would need to create a dedicated curriculum and training pathway that could prepare new hires for cGMP production in time for the plant's 2023–2024 startup. This need led to a formal partnership with Columbus State Community College, with Amgen providing the process knowledge and competency expectations

and the college serving as the instructional partner. The collaboration was also supported by regional organizations including JobsOhio and Ohio Life Sciences, which helped promote the program and link it to broader efforts to build a Central Ohio life sciences workforce.

The partners ultimately developed a two-track model that combines a short-cycle cGMP Bootcamp with a longer apprenticeship program. The cGMP Bootcamp, now part of Columbus State's Biotechnology and Pharma Manufacturing Bootcamp offerings, delivers foundational instruction in biomanufacturing processes, FDA regulatory requirements, quality documentation, basic automation, applied math, digital systems, and workplace skills.

It operates as an intensive, no-tuition certificate program—supported in part by a $250,000 Ohio Life Sciences workforce grant—that is open to career changers, recent high school graduates, and others from the broader community, not just existing Columbus State students. The curriculum blends classroom sessions and lab-based instruction over several weeks, providing participants with an understanding of cGMP expectations, equipment cleaning and readiness procedures, and the basics of working in a regulated manufacturing environment before they set foot on the production floor.

Building on this foundation, Amgen and Columbus State created an 18-month manufacturing apprenticeship that integrates six months of intensive coursework with a year of mentored, on-the-job training at Amgen's New Albany facility. The classroom phase, delivered through Columbus State's workforce and Manufacturing Extension Partnership (MEP) structures, includes approximately 160 hours of noncredit training and 16 credit hours covering electrical systems, mechanical drives, pneumatic systems, troubleshooting, preventive maintenance, and operation of highly automated packaging lines.

Apprentices then transition to Amgen's site, where they complete a structured progression of internal certifications tied to specific equipment and processes, mentored by experienced operators and technicians and evaluated through performance-based assessments and exams.

Over time, apprentices move from basic access and safety training to independent operation of automated lines, including responsibilities for equipment setup, changeovers, routine maintenance tasks, and cGMP documentation. A defining feature of the New Albany program is its employment model. Apprentices are hired as full-time Amgen employees from the day they begin coursework at Columbus State, receiving pay and benefits. This structure has allowed Amgen to draw candidates who could not afford to stop working to attend college or unpaid training, including workers transitioning from automotive, food processing, and other manufacturing sectors. The program thus broadens access to pharmaceutical manufacturing careers while still meeting stringent cGMP and technical standards through its carefully sequenced curriculum and internal certification system.

Curriculum development itself illustrates the depth of Amgen's contribution. Site leadership, engineers, and operations staff met with Columbus State faculty and a facilitating consultant over a series of workshops to map out the skills and competencies required for a fully digital, data-connected packaging operation. Amgen staff then participated in biweekly design sessions to refine course content, problem sets, and lab exercises, reviewing and approving final modules before launch. While the curriculum is grounded in Amgen's specific processes, it was deliberately structured so that other pharmaceutical and advanced manufacturing employers could also use it, making it a regional training asset rather than a single company program. Columbus State's subsequent launch of a New Albany-based Accelerated Training Center in 2024, serving multiple employers in the business park, reflects how this model is being institutionalized as shared infrastructure for the local

life sciences and advanced manufacturing ecosystem. The inaugural apprenticeship cohort completed the program during the 2024–2025 academic year, with the program serving as a pathway to full-time careers at Amgen Ohio.

As the facility scales toward further expansion, investment in workforce development is ongoing. Columbus State continues to lead the cGMP Bootcamp, with Amgen and JobsOhio collaborating to refine and streamline the program for new hires needing additional reinforcement of GMP standards. The company has also begun replicating elements of the apprenticeship model at other U.S. sites.

AstraZeneca, Lilly, and Merck: Virginia Center for Advanced Pharmaceutical Manufacturing

The Virginia Center for Advanced Pharmaceutical Manufacturing (VCAPM) is a groundbreaking, industry-led workforce initiative backed by AstraZeneca, Lilly, and Merck in partnership with the Virginia Innovation Partnership Corporation, Virginia's higher-education system, and community colleges to create the nation's largest training hub for advanced pharmaceutical manufacturing. The consortium has committed up to $120 million in private investment to develop this workforce development center, designed to deliver stackable credentials, hands-on cGMP-simulated training, and degree pathways aligned with industry needs.

Located across the Richmond-Petersburg-Charlottesville Virginia region—a U.S. EDA–designated tech hub for advanced pharmaceutical manufacturing—the Center is expected to train 2,000 to 2,500 highly skilled professionals each year, reinforcing regional talent capacity as multiple new manufacturing facilities come online. The collaboration aims to integrate classroom, laboratory, apprenticeship, and employer-led learning to support U.S. supply chain strength and expand access to high-quality biopharmaceutical careers.

Recently announced and based on new investments, the VCAPM represents a forward-looking initiative highlighting a new large-scale collaborative center training approach.

Industry–Education Partnerships in Biomanufacturing Workforce Development: Biogen & Durham Technical Community College BioWork Program (North Carolina)

Biogen has long maintained and grown a significant manufacturing presence in North Carolina, and in recent years, the company has formed a unique on-site partnership with Durham Technical Community College (Durham Tech) for biomanufacturing workforce training. In 2024, Biogen and Durham Tech launched a strategic partnership to expand access to high-quality biomanufacturing education in North Carolina's Research Triangle region. The collaboration delivers Durham Tech's BioWork Certificate Program at Biogen's Community Lab (CoLab) facility in Research Triangle Park, embedding workforce training directly within an active biopharmaceutical production environment.

The program is designed to create clear, accelerated pathways into biomanufacturing careers by combining classroom instruction with immersive, hands-on laboratory training, and full-time employment with Biogen. Students develop foundational competencies in bioprocessing, biotechnology operations, and pharmaceutical manufacturing, gaining exposure to modern equipment, current industry technologies, and real-world production environments. The curriculum focuses on preparing entry-level process technicians or "Manufacturing Associates", as Biogen refers to the trainee-employees, capable of supporting operations in biotechnology and pharmaceutical lab and manufacturing settings. At the same time, trainees also receive human resources-led training as part of the certificate program, focused on resume building, interviewing and networking skills.

This partnership is supported by Biogen in several ways. The Biogen Foundation awarded $10,000 to strengthen delivery of the BioWork program through Durham Tech and to support student scholarships. Biogen provides training space and industry-grade equipment for training via the CoLab facility and has donated $250,000 to the new Life Sciences Center on Durham Tech's campus. The company provides input on relevant industry curriculum and continuous feedback to the college via a dedicated Durham Tech career professional. The investment and support reflect a growing industry trend toward direct corporate engagement in workforce pipelines—moving beyond traditional academic partnerships to co-located training models that reduce onboarding time, align curricula with employer needs, and improve job readiness at program completion.

The program's first cohort of nine trainees entered in the Fall of 2024 and have completed the program, followed by two additional cohorts in 2025. Among the first two cohorts, Biogen representatives point to at least six trainees that are currently working at Biogen—a roughly 50% placement rate. With the initial success of the program, three more cohorts are planned for 2026. The BioWork certificate credential is widely recognized by industry and portable for other biomanufacturing career opportunities.

In addition to technical training, this industry-education partnership model emphasizes economic mobility and workforce access. The BioWork program is structured to serve individuals without prior biopharmaceutical industry experience, offering a rapid on-ramp into high-demand manufacturing roles. By situating training inside Biogen's facility, the partnership provides learners with early exposure to industry culture, quality systems, and regulated manufacturing environments—key differentiators in employability and retention.

The model has strategic value in several respects, including:

- Employer-aligned curriculum: Training content reflects real operational needs in biomanufacturing.
- Workforce acceleration: Shortens time from training to productive employment.
- Infrastructure leverage: Uses industry facilities to expand training capacity without duplicative capital investment.
- Expanded access: Creates entry pathways for non-traditional and career-transitioning workers.
- Regional competitiveness: Strengthens the region's and state's biomanufacturing talent pipeline.

The Biogen–Durham Tech BioWork partnership illustrates how industry-embedded training programs can serve as scalable models for regional biopharmaceutical workforce development—aligning corporate talent needs, community college capacity, and philanthropic investment into a unified workforce strategy.

Novo Nordisk's Industrial Maintenance Apprenticeship and Training Infrastructure Investments in North Carolina

Novo Nordisk supports industrial maintenance and biotechnology manufacturing talent pipelines in North Carolina through a 3-year Industrial Maintenance Apprenticeship in partnership with Johnston Community College, where apprentices gain paid, on-the-job training while completing an applied engineering associate degree tied to the biomanufacturing needs of Novo Nordisk's Durham and Clayton campuses.

In 2023, the company also invested in regional training infrastructure in North Carolina, including a $6 million contribution to Durham Technical Community College to establish a Biotechnology Associate of Applied Science program and a 35,000-square-foot Life Sciences Training Center, connecting academic pathways with industry equipment and workforce expectations. These efforts are designed to ensure a skilled, expanded talent pipeline for existing and expanding manufacturing facilities in Clayton and Durham, strengthen the local bioeconomy, and integrate community college education with real-world manufacturing experience.

MassBioEd's Life Sciences Apprenticeship Program and Pfizer Andover (Massachusetts)

The Massachusetts Biotechnology Education Foundation's (MassBioEd's) Life Sciences Apprenticeship program, launched in 2021, represents one of the first apprenticeship models in the United States designed specifically for the biopharmaceutical manufacturing sector, and Pfizer's Andover, Massachusetts, site has emerged as the program's longest running and largest employer partner. Pfizer's Andover campus is a 70 acre, fully integrated biologics site employing approximately 2,000 workers across eight buildings that house clinical and commercial manufacturing suites, purification systems, R&D laboratories, and a clinical drug product facility producing complex biological therapies and vaccine components. Manufacturing Process Technicians make up one of the largest workforce segments at the site—notably, workers can advance all the way to master process technician, the highest frontline operations position, without a bachelor's degree. The site's broad mix of upstream processing, downstream purification, fill-finish, and production support operations creates continuous demand for skilled hands-on workers who understand cGMP environments, aseptic technique, cleanroom protocols, and biologics specific equipment.

Before the Apprenticeship Program, Pfizer Andover relied primarily on word of mouth, job boards, and internal referrals to fill entry-level production roles, competing with neighboring biotech employers for a limited pool of experienced candidates. The challenge was compounded by a perception gap: prospective workers with relevant hands-on skills from adjacent manufacturing sectors frequently did not apply because cGMP terminology and biotech branding signaled a highly credentialed environment they assumed was closed to them. MassBioEd's program was designed to bridge precisely this gap by creating a structured on-ramp into life sciences manufacturing for individuals who may not have seen themselves as having a pathway into the industry, including unemployed and underemployed adults, career changers, immigrants, veterans, and workers from non-life sciences backgrounds.

The apprenticeship model centers on a 15-week classroom and laboratory training phase delivered by Northeastern University as the primary educational partner, supplemented by MassBioEd's own "Business of Biotech" course and additional professional skills training. The curriculum spans foundational math and science, core biomanufacturing processes, cGMP and regulatory compliance, gowning and cleanroom procedures, aseptic technique, documentation practices, and soft skills essential for working in team-based, protocol driven production environments. Importantly, the training was developed in close collaboration with employer partners, including Pfizer, to ensure alignment with the actual competencies and production environments that apprentices will encounter on the floor. The classroom phase is followed by one full year (2,000 hours) of on-the-job training at the sponsoring employer's site, a regulatory requirement under the Commonwealth of Massachusetts Division of Apprenticeship Standards, which formally registers the program. At Pfizer, incoming apprentices go through a standard employee welcome week and are assigned to specific manufacturing areas, with a designated point of contact outside their normal management chain to provide mentorship, monitor progress, and address any additional support needs throughout the year.

MassBioEd operates as the apprenticeship sponsor and intermediary, handling recruitment, screening, candidate assessment, and coordination between educational providers, community partners, and employers. Candidates are sourced through a network of dozens of community-based organizations, job centers, and workforce agencies rather than through traditional higher education channels, deliberately reaching populations that are not on the radar of conventional

corporate talent acquisition programs. Basic screening covers math and language proficiency, attention to detail, willingness to work in hands-on manufacturing settings, and motivation to commit to a career change. Employer partners then conduct interviews and select the individuals they will bring on for on-the-job training. Pfizer began with just three apprentices in the program's inaugural year, but internal demand quickly outpaced available slots once site leaders saw the quality of apprentices on the production floor; the company has since scaled significantly and now serves as one of the lead sponsors of the program.

The financial and in kind investment is a public-private partnership—Pfizer pays a per apprentice fee that supports candidate recruitment and selection and contributes to the cost of training and a stipend paid to apprentices during the classroom phase and, additionally, supports dedicated headcount, salary, and benefits for each apprentice during their year of on-the-job training. Employer investments are augmented by Commonwealth of Massachusetts' financial support of the program. Bristol Myers Squibb joined Pfizer as a co-leadership sponsor at launch, and employer partners have since expanded to include more than 20 life sciences companies across Greater Boston and Central Massachusetts. Pfizer's leadership describes the investment as part of its core talent strategy, and the program is valued as a pipeline that delivers work-ready candidates who arrive with foundational biomanufacturing knowledge and demonstrate high commitment, resulting in a strong return on investment relative to conventional entry-level hiring.

Across all employer partners, MassBioEd is now approaching 200 apprentices over the program's first four and a half years of operation, with biomanufacturing technicians constituting the vast majority. Between 65% and 85% of participants begin the program without a bachelor's degree; the average age is 32; two thirds are people of color; more than half are female; 35% are immigrants; and, depending on the cohort, between 25% and 50% were unemployed at the time of enrollment.

For Pfizer specifically, 34 apprentices have graduated or are currently in process, 38% were unemployed before starting, half have been female, and 62% are people of color. Outcomes have been strong: across the program, over 90% of completers are offered a permanent or contract position at their host employer; and the two year retention rate stands at roughly 80%. Among Pfizer's graduated apprentices, 76% remain employed at the site. Apprentices earn an average post-program wage of $30.64, which, for those employed before the program, reflects an average wage increase of 55%, and an 80% rate of persistence in life sciences roles two years after placement. Upon completion, apprentices earn a formal certification from the Commonwealth of Massachusetts Division of Apprenticeship Standards as a biomanufacturing apprentice, and credits earned through Northeastern can be applied toward a bachelor's degree in biotechnology for those who choose to continue their education.

The biomanufacturing technician apprenticeship continues to grow with internal demand from Pfizer's Andover site now exceeding the number of apprentice slots available in any given cycle, a clear signal that the model has proven its value not only as a workforce development initiative but as a sustainable, scalable component of the pharmaceutical industry's talent infrastructure in one of the nation's densest life sciences clusters.

V. Conclusion

The wave of announced biopharmaceutical manufacturing investments documented in this report is more than a series of capital projects; it represents a durable expansion of accessible, high-wage production and technical career opportunities for American workers.

New biologics, small-molecule, fill-finish, and device facilities typically add hundreds of permanent positions per site, with a majority of those roles in skilled production, technical operations, quality, and maintenance—jobs that can often be accessed through certificates, apprenticeships, and applied associate degrees rather than exclusively through advanced STEM credentials. These expansions also generate sizable upstream employment in packaging, specialized plastics, chemicals, and precision machining industries, further multiplying the number of skills-based manufacturing jobs supported by the sector's growth.

Crucially, the biopharmaceutical industry is not treating this labor demand as a challenge for others to solve. Across the case studies highlighted here, companies are acting as co-investors in developing new workforce pipelines, working with community colleges, universities, workforce boards, and community-based organizations to design and fund training that aligns directly with modern plant requirements. Employer-sponsored apprenticeships, boot camps, and certificates give participants paid, structured on-ramps into process technician, maintenance, and quality roles, while stackable credentials and tuition assistance support continuous upskilling for incumbent workers as facilities adopt more automation, digital controls, and data rich quality systems. By co-locating training centers near plants, providing equipment and curricula, and guaranteeing pathways into full-time roles for successful completers, biopharmaceutical firms are demonstrating that they are not only job creators but also active partners in rebuilding America's advanced manufacturing workforce.

Sustaining and scaling this momentum will require continued commitment from industry, policymakers, and education and workforce systems. The same investments that are reshoring production, strengthening supply chain resilience, and modernizing facilities with digital capabilities must be matched by long-term support for regional training consortia, apprenticeship funding, and flexible credential programs that can keep pace with evolving technologies and production models. Federal and state leaders have a strategic opportunity to treat biopharmaceutical manufacturing as critical infrastructure on par with semiconductors and clean energy by supporting permitting, infrastructure, and talent initiatives that encourage continued facility expansion in the United States. With the right policies and partnerships, the industry's current pipeline of projects can serve as a foundation for a modernized American manufacturing base in which high-quality, skills-based biopharmaceutical careers are attainable for workers across varied communities and educational backgrounds.

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