

# The Economic Impact of the U.S. Biopharmaceutical Industry:

2022 National and State Estimates

May 2024



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# Executive Summary

**The innovative and critical nature of the U.S. biopharmaceutical industry with its significant societal and economic value has long been a key driver of the nation's economic growth and contributor to state and regional economies. As this study documents, every U.S. state, the District of Columbia, and Puerto Rico has some level of industry employment leading to regional economic activity.**

The biopharmaceutical industry is a major driver of innovation and economic growth both within the U.S. and globally. The industry's growth and resilience lead to jobs for significant numbers of highly skilled, highly productive, and highly paid workers across the country. Sustaining this important driver of the U.S. economy is a set of robust and long-standing pro-innovation policies that include strong intellectual property protections, a well-functioning and evidence-based regulatory system, support for research and development, and other policies that recognize both the societal and economic impacts of medical innovation.

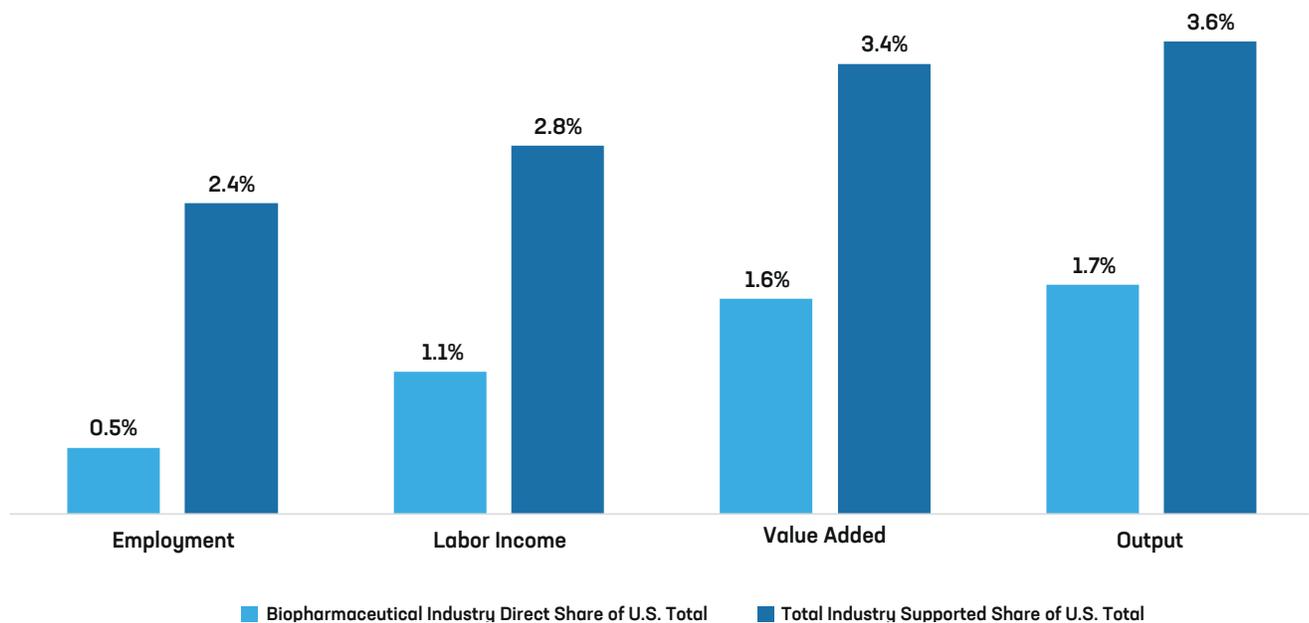
The Pharmaceutical Research and Manufacturers of America (PhRMA) engaged TEconomy Partners, LLC, to develop an independent estimate of the economic contributions of the U.S. biopharmaceutical industry and its closely integrated supply chain in 2022. The analysis includes estimates for the United States, each of the 50 states, the District of Columbia, and Puerto Rico. *A full methodology is included in Appendix A.*

Key findings from this examination of the broad biopharmaceutical value-chain include the following:

- The U.S. biopharmaceutical industry directly employed more than one million workers in 2022, and with its substantial employment multiplier of 4.69, the industry supports more than 3.8 million additional U.S. jobs for a total employment impact of more than 4.9 million jobs supported across the U.S. economy.
- The industry has been able to weather economic downturns, demonstrated by solid 30.8 percent growth since 2015, providing important stability to both the production of life saving medicines and to the U.S. and regional economies in which it operates.
- With average annual wages and benefits in 2022 of more than \$157,000 per worker –over \$60,000 more than the average U.S. manufacturing job, and more than twice the U.S. average across all industries—biopharmaceutical industry jobs are both high-wage and high-quality.
- The research and productive nature of the U.S. biopharmaceutical industry generates a productivity level of more than \$402,000 per employee in 2022—more than twice that of the U.S. average manufacturing worker and more than three times the average U.S. worker.

- A notable characteristic of the U.S. biopharmaceutical industry's workforce is the reliance on highly skilled, occupationally diverse workforce as the industry employs more than 100,000 workers in each of four occupational categories: Management (163,085), Life, Physical, and Social Science (146,274), Production (140,707), and Business and Financial Operations (102,786).
- The U.S. biopharmaceutical industry exceeded \$800 billion in direct output in 2022, and with the ripple effect of this production throughout the U.S. economy, supported an additional \$850 billion in output through its suppliers and other sectors of the economy, for a total of more than \$1.65 trillion. This combined, total output impact represents 3.6 percent of all U.S. output.
- Through its research, production, and overall operations, the U.S. biopharmaceutical industry directly accounts for 1.6 percent of U.S. GDP (i.e., its "value added"). Including the economic activity driven in other sectors of the economy the industry generates and supports more than \$880 billion in value added within the economy, or 3.4 percent of U.S. GDP.

## Biopharmaceutical Industry's Contributions to the U.S. Economy



Source: TEconomy data, calculations and analysis; IMPLAN U.S. model.

# Introduction: The Innovative Biopharmaceutical Industry

Among U.S. industries, the biopharmaceutical industry is defined by and stands out as a leader in research and innovation. Nowhere was this more apparent than in the last few years as the nation's biopharmaceutical industry members worked to develop critical vaccines, therapies, and diagnostic capabilities related to the COVID-19 pandemic. However, these capabilities did not develop overnight in response to pandemic but were the reflection of a unique industry driven by innovation that has been investing in this ability for many years.

With its high levels of investment in R&D, multi-sectoral structure, significant employment, and broad occupational requirements, the U.S. biopharmaceutical industry brings significant employment and economic impacts to every state in the nation. To measure the size and extent of the U.S. biopharmaceutical industry, PhRMA engaged TEconomy Partners, LLC, to develop an independent estimate of the size of the U.S. biopharmaceutical industry and its total economic impacts on the U.S. and individual state economies (including the District of Columbia and Puerto Rico).

This report provides estimates of the total number of biopharmaceutical industry jobs in the U.S. in 2022—the most recent year for which complete employment data are available. This effort also develops and provides economic impact measures of the U.S. biopharmaceutical industry, including total economic output, wages and benefits, and taxes. These measures capture the direct economic impacts of the biopharmaceutical industry, the indirect economic impacts on other sectors of the economy that are supported by the biopharmaceutical industry through its broad supply chain, and the induced economic activities of its workforce.

## Biopharmaceuticals—A Leader in Research and Innovation

The biopharmaceutical industry is a major component of the U.S. innovation-driven industrial base, which also includes industries such as aerospace, motor vehicles, semiconductors, and others. Analyzing the most recent NSF business R&D survey results (2021 data) and additional estimations performed by TEconomy (estimating 2022 data) provides insights into the position of the biopharmaceutical industry's R&D activities in comparison to overall U.S. medical and health R&D investment and overall U.S. industrial R&D.

The domestic biopharmaceutical industry is a leader in overall U.S. industrial R&D activities and investment.<sup>1</sup>

- The U.S. biopharmaceutical industry accounts for 17.6 percent of all domestic U.S. business R&D performance in 2021.
- The biopharmaceutical industry, estimated to include 193,000 domestic R&D employees in 2021, has more R&D workers than any U.S. industry, including the aerospace/navigational instruments manufacturing (96,000), automotive/motor vehicles manufacturing (108,000), and semiconductor manufacturing industries (93,000).
- In 2021, the U.S. biopharmaceutical industry performs 46% of all industry-performed basic research, 22% of all industry-performed applied research, and 15% of all industry-performed development.
- In 2021, the U.S. federal government funded 1.2 percent of domestic biopharmaceutical R&D, compared to 47.3 percent for the aerospace industry.
- The U.S. biopharmaceutical industry invests 81.2 percent of its global R&D spending in the U.S., a higher share than other U.S. industries such as motor vehicles (79.7 percent) and semiconductors (74.2 percent).
- The U.S. biopharmaceutical industry devotes 25.9 percent of its total domestic employment to R&D functions, 2.87 times larger than the U.S. all industry average.

The biopharmaceutical industry is the leader in U.S. medical and health R&D activities and investments.

- The biopharmaceutical industry's estimated 2022 domestic R&D investment of \$141.0 billion accounts for 78.6 percent of all U.S. industry funded medical and health R&D.<sup>2</sup>

# Continued Growth of the U.S. Biopharmaceutical Industry

## Defining the U.S. Biopharmaceutical Industry

The U.S. biopharmaceutical industry is a highly complex industry that includes large, vertically integrated biopharmaceutical companies with their own research and manufacturing facilities; small and start-up research-focused companies that have not yet had a medicine approved by the Food and Drug Administration; clinical development and research organizations that provide a range of services to support drug development and manufacturing; a broad-ranging set of suppliers providing basic and high-value added inputs; and distributors who provide logistics support to deliver prescription medicines across the country and around the world. For the purposes of this analysis, all 50 states, the District of Columbia, and Puerto Rico are included in the U.S. geographic definition.

The core value-adding activities of the U.S. biopharmaceutical industry – biopharmaceutical research and development, manufacturing, and distribution—are used to define and produce estimates of the size and structure of the U.S. industry. These activities are found in U.S. federal data sources within all or parts of three “sectors” of the U.S. economy as defined by the federal government in the North American Industrial Classification System (NAICS). Employment data were developed by carefully identifying and estimating the share of each of the sectors’ employment attributable to the biopharmaceutical industry. A fourth sector, biopharmaceutical corporate offices, captures significant and identifiable standalone corporate administrative operations (e.g., headquarters, executive offices, financial, marketing, legal, etc.) not already captured in the other sectors. **Appendix A** provides the specific NAICS codes used to define the industry sector, and describes the data and methodology used to produce the U.S. and state-level employment estimates included in this report.

## Assigning Biopharmaceutical Industry Sector

“Sector” is based on the NAICS code assigned to each establishment (i.e., the business location) captured in the BLS data, and is assigned based on the predominant activity at that location. Because all jobs within an establishment are assigned to the establishment’s NAICS code, sector-based job counts may over- or under-state job functions to the extent multiple activities occur at a single establishment (e.g., co-located R&D and manufacturing). The total employment estimate is not affected, however.

In 2022, total employment in the U.S. biopharmaceutical industry for the first time exceeded one million employees, reaching 1,049,839 jobs (**Table 1**). Much of this growth can be attributed to an increase in biopharmaceutical R&D, which now becomes the largest biopharmaceutical sector with nearly 409,000 jobs and accounts for 39 percent of the total U.S. industry. Much of this growth may be linked to a continuation of the pandemic-related increases in overall biomedical R&D. Biopharmaceutical manufacturing accounts for 34

percent of total employment. Biopharmaceutical distribution accounts for nearly 24 percent of the industry’s employment at 248,374 jobs and distinct biopharmaceutical corporate offices employment accounts for just over 3 percent or 33,043 jobs in 2022.

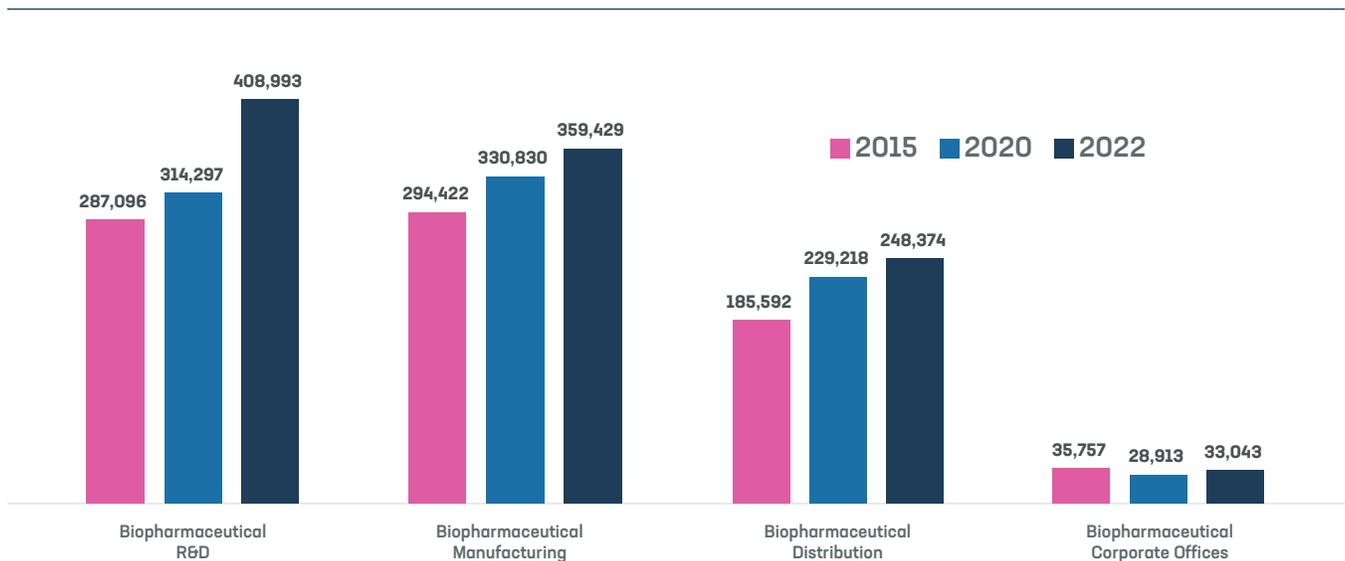
**Table 1: U.S. Biopharmaceutical Industry Employment by Sector, 2022**

Biopharmaceutical Sector	Estimated Sector Employment	Share of Total Industry Employment
Biopharmaceutical R&D	408,993	39.0%
Biopharmaceutical Manufacturing	359,429	34.2%
Biopharmaceutical Distribution	248,374	23.7%
Biopharmaceutical Corporate Offices	33,043	3.1%
<b>Total</b>	<b>1,049,839</b>	<b>100.0%</b>

**Source:** 2022 Bureau of Labor Statistics (BLS), Quarterly Census of Employment and Wages (QCEW) and Current Population Survey (CPS) Employment Data; TEconomy analysis, calculations, and estimations.

The three core biopharmaceutical sectors have shown a significant level of employment growth over the last seven years and show tremendous resilience against negative economic events (**Figure 1**). The biopharmaceutical R&D and biopharmaceutical manufacturing sectors’ employment increased substantially since 2015; R&D increased by nearly 122,000 jobs and manufacturing increased by 65,000 jobs. Though due in part to reclassification issues in 2017, the biopharmaceutical distribution sector continues to grow adding more than 19,000 jobs just since 2020. Lastly, the sector capturing distinct biopharmaceutical corporate offices’ employment varies, often in line with recent M&A activity, is up in employment since 2020, but is still below the 2015 value.

**Figure 1: Changes in Biopharmaceutical Industry Sector Employment, 2015, 2020, 2022**

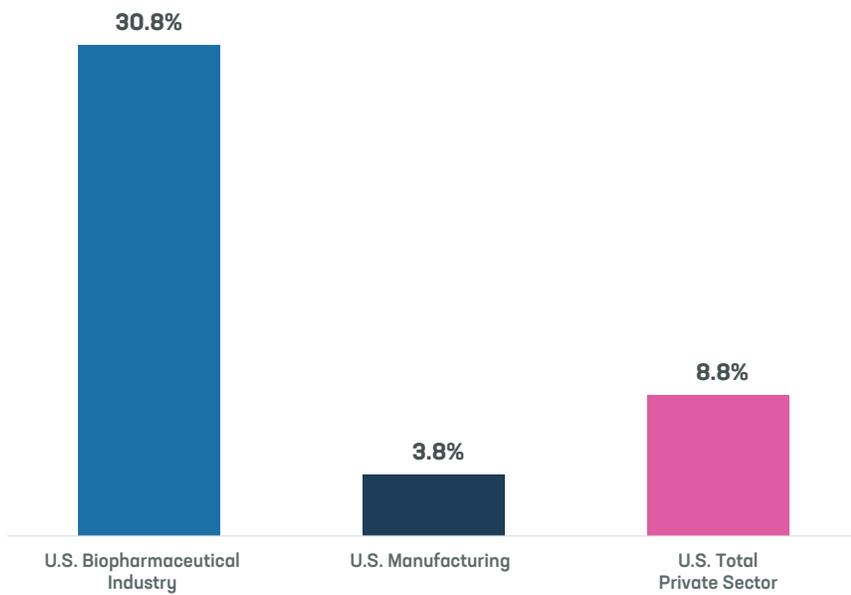


**Source:** TEconomy analysis, calculations, and estimations.

## Employment Growth in the U.S. Biopharmaceutical Industry

An important and defining characteristic of the U.S. biopharmaceutical industry has been its ability to weather economic downturns providing important stability to both the production of life saving medicines and to the U.S. and regional economies in which they operate. **Figure 2** provides a comparison among the U.S. biopharmaceutical industry, overall U.S. manufacturing, and the overall U.S. private sector employment from 2015 to 2022 reflecting the employment growth success of the U.S. biopharmaceutical industry.

**Figure 2: Comparative Industry Employment Change, 2015 - 2022**

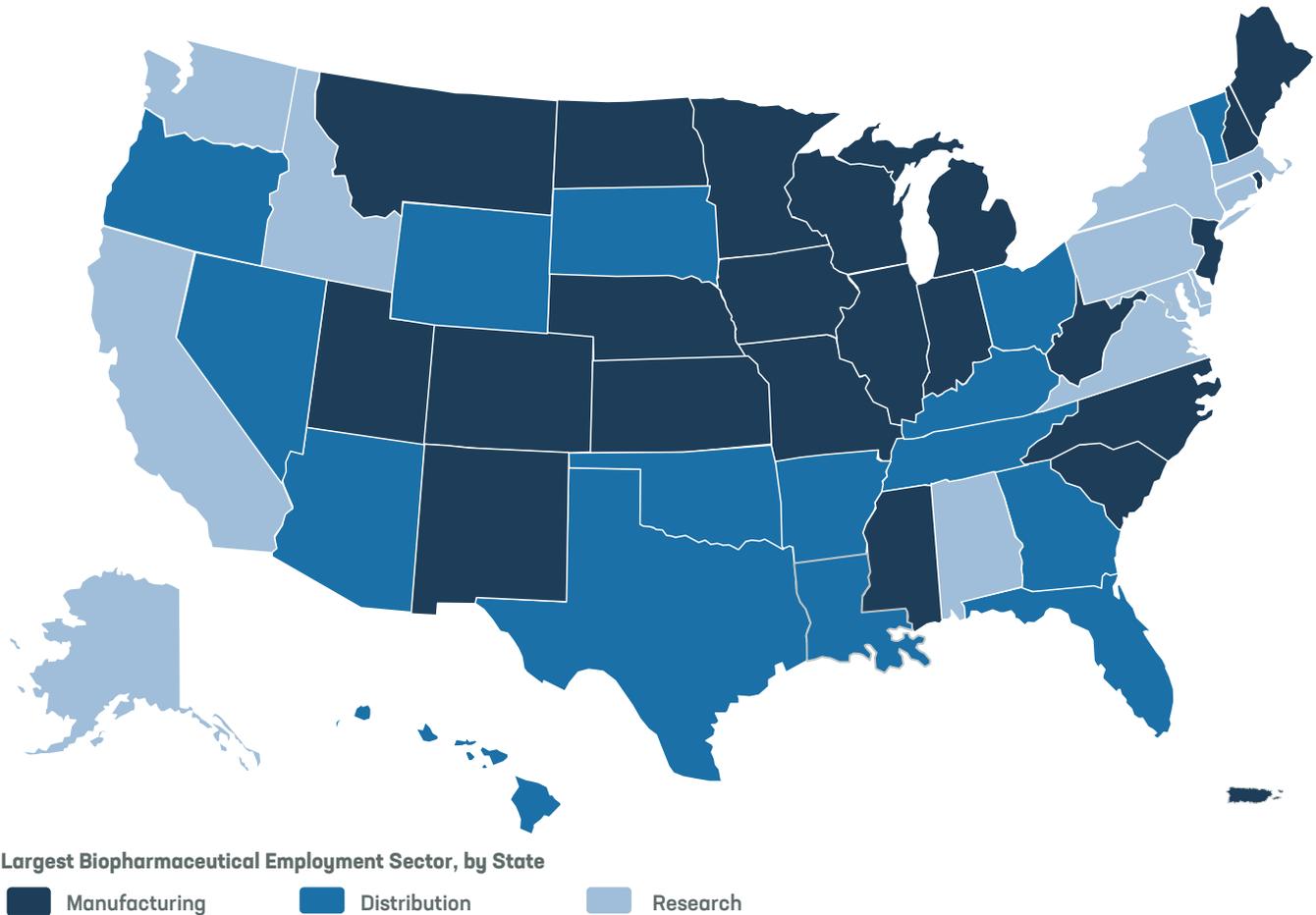


**Source:** TEconomy analysis, calculations, and estimations; BLS Data.

## Geographic Structure of the U.S. Biopharmaceutical Industry

The total size of the U.S. biopharmaceutical industry varies by state with the sectoral distribution of the industry also varying widely. While many of the leading overall states have significant employment in all four biopharmaceutical industry sectors, the largest single sector shows much geographic variation (**Figure 3**).

**Figure 3: Geographic Distribution of Largest Biopharmaceutical Industry Sector by Employment, 2022**



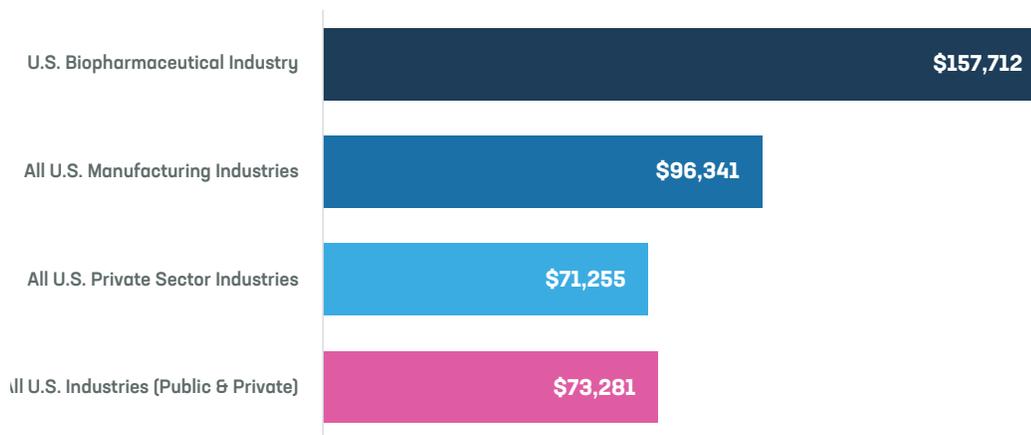
**Source:** TEconomy data, calculations and analysis.

**Note:** Employment in the Biopharmaceutical Corporate sector was not the largest sector in any state and is therefore not included in the map above.

## High-Wage and High-Quality Jobs from a High-Value Industry

The biopharmaceutical industry, whether in its R&D, manufacturing, distribution, or corporate office functions, is a generator of high-wage and high-quality jobs. For 2022 the 1.05 million U.S. biopharmaceutical industry jobs generated more than \$165 billion in personal income (including both wages and benefits or total compensation)—averaging nearly \$158,000 in annual compensation per worker (**Figure 4**). This is more than twice the national private sector average of \$71,000 and the national all employment (including public sector jobs) average of \$73,000. Furthermore, as a driver of the U.S. economy the biopharmaceutical industry average compensation is significantly higher than the U.S. manufacturing average of \$96,000—a robust indication of the high quality jobs that the biopharmaceutical industry provides to U.S. workers. This biopharmaceutical industry compensation premium has existed since at least 2015 (and likely for many years prior).

**Figure 4: Comparative Average Annual Employee Compensation, 2022**



**Source:** TEconomy estimations of 2022 Industry Employment and Total Labor Income using IMPLAN models.

This high employee compensation is made possible by the value-added nature of U.S. biopharmaceutical industry is also reflected in an extremely high productivity measure for the industry, exceeding \$402,000 in value added per worker in 2022, compared to a value-added per worker of \$188,000 for overall U.S. manufacturing and a measure of approximately \$124,000 per worker across all U.S. industries (private sector or private and public sector combined (**Figure 5**)).



**Figure 5: Comparative Average Productivity, 2022**



**Source:** TEconomy estimations of 2022 Industry Employment and Value Added using IMPLAN models.

### Occupationally Diverse Workforce

The U.S. biopharmaceutical industry relies on skilled talent across a range of occupational categories and educational levels, including those with skills, education, and training in science, technology, engineering, and math (STEM) and those with capabilities in business, management, and finance. The diverse set of jobs and occupations required by this industry can range from those requiring an advanced college degrees such as positions in R&D and senior management to jobs in skilled labor positions such as manufacturing technicians and other production, logistics, and support personnel.

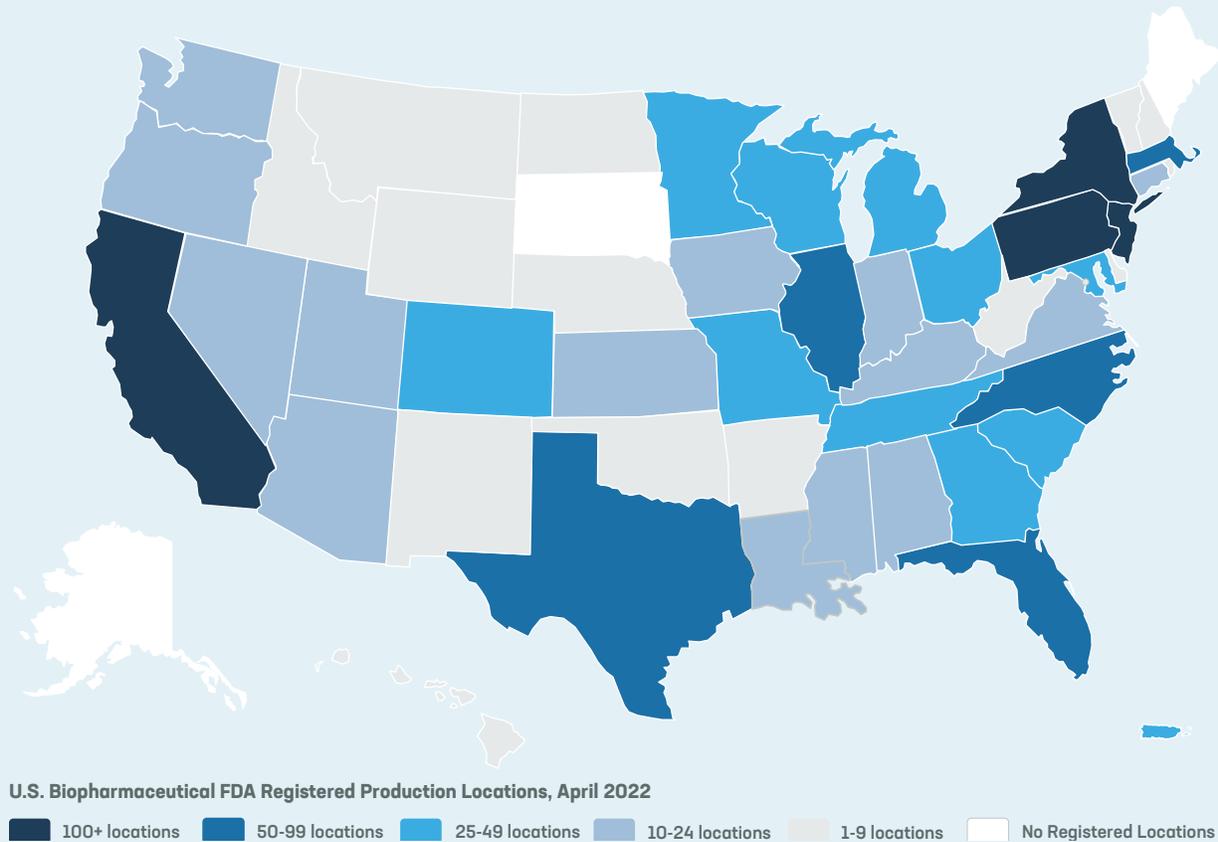
Using NAICS-specific occupational information, a composite 2022 occupational profile is developed for the overall U.S. biopharmaceutical industry based upon the occupational requirements of each of the four biopharmaceutical industry sectors. Figure 6 shows the estimated biopharmaceutical industry employment across key occupational categories and Figure 7 compares the occupational structure of the U.S. biopharmaceutical industry to overall U.S. manufacturing, and U.S. total private sector occupational employment.

### Developing the U.S. Biopharmaceutical Industry Occupational Structure

Using U.S. Bureau of Labor Statistics 2022 Occupational Employment by Industry data and the individual biopharmaceutical sector employment totals, weighted shares of U.S. occupational employment by major category are calculated for this analysis.

## FDA-Approved Biopharmaceutical Manufacturing Spans the Country

Beyond employment, another approach to examining the geographic footprint of the biopharmaceutical industry is by assessing the number of locations in each state that are manufacturing (or capable of manufacturing) one or more FDA approved drug or pharmaceutical.



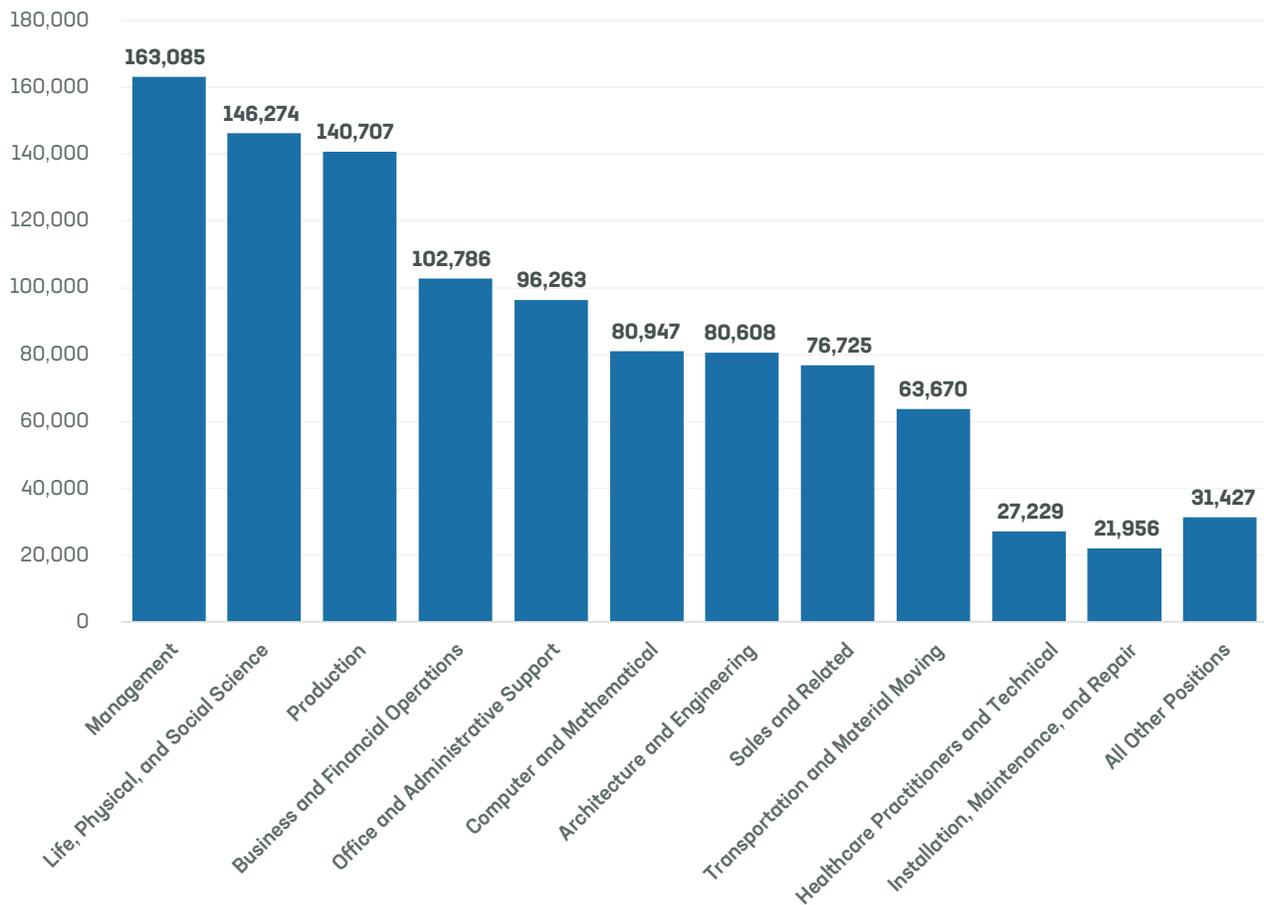
In 2022, the U.S. biopharmaceutical industry operated 1,574 facilities across the country that are manufacturing FDA-approved human-use products under current Good Manufacturing Practice regulations.

- These facilities are spread across 47 states, the District of Columbia and Puerto Rico.
- 33 states and Puerto Rico have 10 or more facilities manufacturing FDA- approved medicines.
- Four states - New Jersey, California, Pennsylvania, and New York - have 100 or more registered locations with 198, 163, 108, and 101, respectively.

**Source:** NDP Analytics, Analysis of the U.S. Food and Drug Administration's Drug Establishments Current Registration Sites, April 2022.

As shown in **Figure 6**, the biopharmaceutical industry employs more than 100,000 workers in each of four occupational categories: Management (163,085), Life, Physical, and Social Science (146,274), Production (140,707), and Business and Financial Operations (102,786).

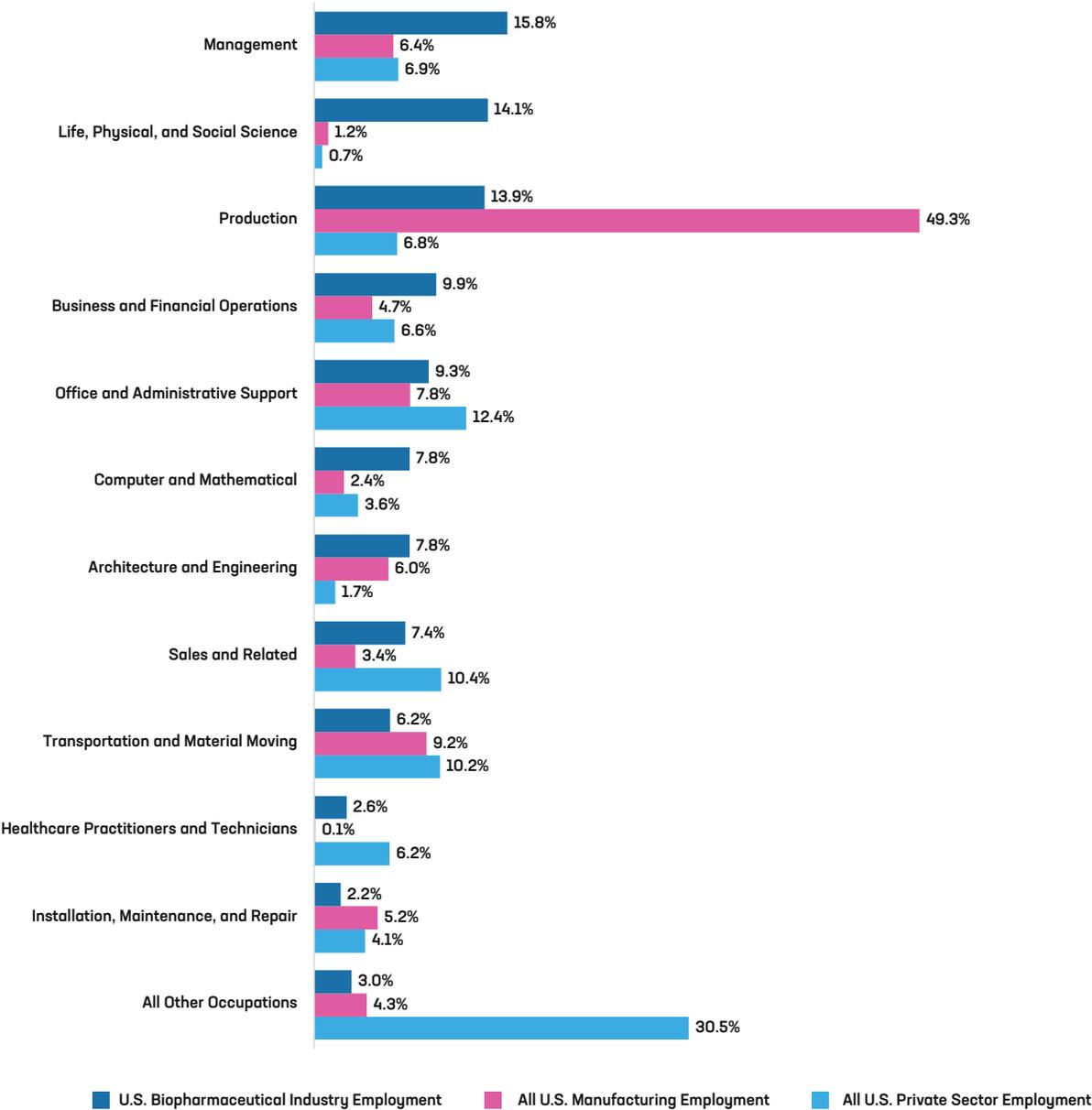
**Figure 6: U.S. Biopharmaceutical Industry Estimated Employment by Occupational Category, 2022**



Source: TEconomy estimations using U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2022

Comparatively, **Figure 7** shows that in 2022 nearly 16 percent of biopharmaceutical industry employment is classified into the management occupational category (that includes many individuals, educated and skilled in other occupations, that have moved into a managerial role). As should be expected, life, physical, and social science occupations account for a significantly higher proportion than both manufacturing and overall private sector employment reaching more than 14 percent. Production occupations, occurring primarily within the biopharmaceutical manufacturing sector, account for 14 percent of the biopharmaceutical industry's total employment. The biopharmaceutical industry also provides significant employment in other broad areas with diverse educational and skill requirements. Business, financial, and sales-related occupations are spread throughout the four subsectors and combine for more than 17 percent of the biopharmaceutical industry's total employment, while computer, math, and engineering occupations combine for nearly 16 percent. Office and administrative workers spread across the industry account for 9 percent of the workforce. Transportation and material moving occupations related to receiving supplier inputs and shipping finished products account for 6 percent of total employment.

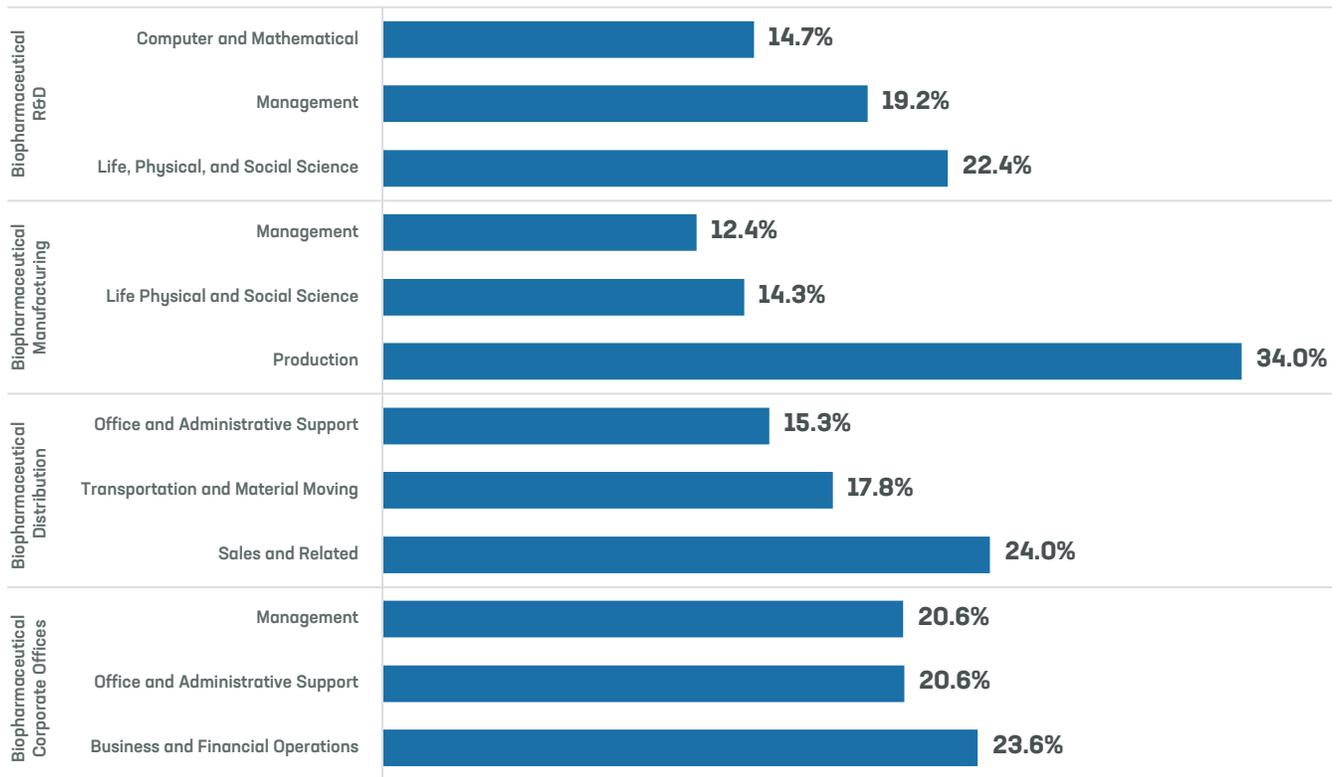
**Figure 7: Comparative Occupational Profile (Percent of Jobs), 2022**



Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2022, and TEconomy estimations. "All Other Occupations" includes Arts & Design, Construction, Healthcare Support, Legal, and more.

Figure 8 provides additional details of the key occupational groups within each of the four sectors of U.S. biopharmaceutical industry. Of note, is that the life, physical, and social science occupational categories is among the top three occupations for two biopharmaceutical industry sectors: R&D and Manufacturing. Not surprisingly, management is a key occupation across three biopharmaceutical industry sectors: R&D, manufacturing, and corporate offices.

**Figure 8: Key Occupations by U.S. Biopharmaceutical Sector (Percent of Jobs), 2022**



**Source:** U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2022, and TEconomy estimations.

From a state industry perspective, management occupations account for 15 percent or more of the state's biopharmaceutical employment in 42 states, life, physical, and social science occupations account for 15 percent or more in 11 states, and production workers account for 15 percent or more in 23 states and Puerto Rico. *Details of key occupational shares, by state, are provided in **Appendix B**.*

To provide further occupational-related details, **Table 2** shows key detailed occupations and example job titles found among recent U.S. biopharmaceutical industry job postings highlighting both the diversity of employment opportunities within the industry, but also the interconnected nature of these occupations. For example, while the management occupational group has increased in size from 2019 to 2022, this structure corresponds with growth in manager numbers across many distinct occupational groups (e.g., production, sciences, engineering) and job titles (e.g., quality control manager, oncology medical director, director process engineering). Similarly, the sales and related occupational group also shows that while considered a more “business” function, these individuals often have biomedical focus areas that typically require a scientific, technical, or engineering education and/or background.

**Table 2: U.S. Biopharmaceutical Industry: Top Five Occupations and Example Job Titles**

Occupational Group	Top Five Detailed Occupations	Example Job Titles
<b>Management</b>	General and Operations Managers	Area Business Manager, Operations Supervisor, Director of Business Operations
	Industrial Production Managers	Quality Control Manager, Manufacturing Manager, Clinical Quality Assurance Manager
	Natural Sciences Managers	Clinical Research Associate, Oncology Medical Director, Associate Director of Regulatory Affairs
	Managers, All Other	Director of Global Regulatory Affairs, Program Manager, Customer Engagement Manager
	Architectural and Engineering Managers	Director of Process Engineering, Project Engineer, Engineering Manager
<b>Business and Financial Operations</b>	Compliance Officers	Global Regulatory Affairs Manager, Regulatory Affairs Specialists, Compliance Specialist
	Accountants and Auditors	Staff Accountant, SOX Analyst, Internal Auditor
	Market Research Analysts and Marketing Specialists	Marketing Coordinator, Digital Marketing Specialist, Business Development Associate
	Human Resources Specialists	Recruiter, Human Resources Business Partner, Talent Acquisition Specialist
	Logisticians	Supply Chain Analyst, Production Planner, Logistics Analyst
<b>Computer and Mathematical</b>	Software Developers	Principal Software Engineer, Software Developer, DevOps Engineers
	Computer Systems Analysts	Business Systems Analyst, Data Team Lead, Health System Specialist
	Computer User Support Specialists	IT Support Specialist, Field Support Technician, Help Desk Technician
	Data Scientists	Data Scientist, Clinical Data Manager, Machine Learning Engineer
	Computer Occupations, All Other	Systems Engineer, Automation Engineer, Document Control Specialist

Occupational Group	Top Five Detailed Occupations	Example Job Titles
<b>Life, Physical, and Social Science</b>	Chemists	Analytical Chemist, Principal Scientist, Quality Control Chemist
	Biological Technicians	Research Associate, Microbiology Technician, Process Development Associate
	Biochemists and Biophysicists	Biochemist, Toxicologist, Formulation Scientist
	Chemical Technicians	Research Associate, Quality Control Chemist, Product Development Associate
	Medical Scientists, Except Epidemiologists	Medical Science Liaison, Principal Scientist, Director of Clinical Pharmacology
<b>Architecture and Engineering</b>	Industrial Engineers	Validation Engineer, Quality Engineer, Packaging Engineer
	Industrial Engineering Technologists/Technicians	Pharmaceutical Manufacturing Technician, Maintenance Technician, Manufacturing Support Technician
	Mechanical Engineers	Mechanical Engineer, Reliability Engineer, Principal Engineer
	Chemical Engineers	Process Engineer, Process Development Scientist, Director of Toxicology
	Bioengineers and Biomedical Engineers	Process Engineer, Lead Data Engineer, Biomedical Engineer
<b>Healthcare Practitioners and Technical</b>	Pharmacy Technicians	Pharmacy Technician, Filling Technician, Nuclear Pharmacy Technician
	Pharmacists	Pharmacovigilance Specialist, Neuroscience Sales Specialist, Cardiovascular Sales Specialist
	Registered Nurses	Vaccine Specialists, Field Educators, Clinical Nurse Consultants
	Health Information Technologists and Medical Registrars	Health Specialist, IT Specialist, Technical Product Analyst
	Nuclear Medicine Technologists	Nuclear Medicine Technologists, Radiation Safety Specialist, Field Medic

Occupational Group	Top Five Detailed Occupations	Example Job Titles
<b>Sales and Related</b>	Sales Representatives, Technical/Scientific Products	Pharmaceutical Sales Representative, Medical Liaison, District Manager
	Sales Representatives, Except Technical/Scientific Products	Key Account Manager, Account Executive, Specialty Sales Representative
	First-Line Supervisors of Non-Retail Sales Workers	Digital Enterprise Architect, Channel Leader, Director of Distribution Strategy
	Sales Representatives of Services	Neuroscience Sales Specialist, Diagnostic Sales Consultant, Cardiovascular Sales Specialist
	Sales Engineers	Product Support Engineer, Marketing Analytics Analysts, Pharmaceutical Engineer
<b>Office and Administrative Support</b>	Customer Service Representatives	Customer Service Representative, Customer Care Specialist, Supply Chain Representative
	Shipping, Receiving, and Inventory Clerks	Receiving Associate, Shipping Clerk, Distribution Center Associate
	Production, Planning, and Expediting Clerks	Logistics Coordinator, Production Scheduler, Inventory Management Coordinator
	First-Line Supervisors of Office and Administrative Support Workers	Customer Care Manager, Customer Strategy Manager, Office Manager
	Secretaries and Administrative Assistants	Administrative Assistant, Administrative Coordinator, Commercial Excellence Manager
<b>Production</b>	Packaging and Filling Machine Operators	Packaging Technicians, Packaging Operators, Pharmaceutical Technician
	Chemical Equipment Operators and Tenders	Chemical Operators, Freeze Dry Operator, Aseptic Preparation Operator
	Inspectors, Testers, Sorters, and Weighers	Quality Assurance Specialist, Quality Control Associate, Quality Control Inspector
	First-Line Supervisors of Production Workers	Manufacturing Supervisor, Production Supervisor, Production Lead
	Mixing and Blending Machine Operators	Compounder, Blending Operator, Formulation Technician



Occupational Group	Top Five Detailed Occupations	Example Job Titles
<b>Transportation and Material Moving</b>	Freight, Stock, and Material Movers, by Hand	Warehouse Associate, Material Handler, Warehouse Shift Manager
	Packers and Packagers, by Hand	Warehouse Picker/Packer, Packager, Shipper,
	Stockers and Order Fillers	Warehouse Operator, Inventory Clerk, Inventory Control Associate
	Industrial Truck and Tractor Operators	Forklift Operator, Logistics Operator, Weight Engineer
	First-Line Supervisors of Transportation and Material Moving Workers	Warehouse Lead, Shipping and Receiving Manager, Inventory Supervisor
<b>Installation, Maintenance, and Repair</b>	Industrial Machinery Mechanics	Manufacturing Maintenance Mechanic, Plant Technician, Packaging Mechanic
	Maintenance and Repair Workers, General	Field Service Engineer, Facilities Technician, Maintenance Specialist
	First-Line Supervisors of Mechanics, Installers, and Repairers	Maintenance Manager, Facilities Supervisor, Maintenance Planner
	Maintenance Workers, Machinery	Facilities Technician, Plant Utilities Engineer, Machine Repair Journeyman
	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Facilities Mechanics, HVAC Technician, Controls Technician

Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2020, Lightcast Job Posting Data and TEconomy estimations.

# Key Driver of U.S. Innovation Economy

The U.S. biopharmaceutical industry is the world leader in the development of new small-molecule medicines, large molecule biologics, vaccines, diagnostics, and other products. While this performance provides and realizes significant benefits to U.S. citizens, it also contributes to the biopharmaceutical industry being one of the nation's most innovative industries, while driving significant contributions to the U.S. economy.

The economic impacts, or more precisely the revenue and expenditure impacts, of the U.S. biopharmaceutical industry can be estimated and measured using the well-established regional economic analysis technique of input-output (I-O) analysis. I-O analysis tracks the revenues of an industry, the related economic activity of purchases from its suppliers, and the spending of employees within the economy. For this analysis a customized IMPLAN I-O model is used to quantify and estimate the interrelationships between the U.S. biopharmaceutical industry and the remaining sectors of the U.S. economy. Additionally, state IMPLAN models are developed and used to capture economic activities at the state level. See **Appendix A** for a detailed discussion of data sources and methodology.

Economic impacts consist of three types: **direct effects** (the specific impact of biopharmaceutical industry production and revenues), **indirect effects** (the impact of biopharmaceutical industry purchases from its suppliers and from these suppliers as they purchase inputs to meet the biopharmaceutical industry's demand), and **induced effects** (the additional economic impact of the spending of biopharmaceutical industry employees and suppliers' employees in the economy that can be attributed to the biopharmaceutical industry expenditures). Taken together, these three impact effects combine to form the **total impacts** of the U.S. biopharmaceutical industry. In other words, the I-O analysis models the "ripple effect" throughout the economy that originates from direct biopharmaceutical industry revenues and expenditures, flows through industry suppliers as they buy additional inputs, and through industry and supplier workers who spend their wages.

## Definition of Impact Variables

**Employment:** The number of individuals whose employment is due, totally (direct employment) or in part (indirect or induced employment) to the economic effects of the industry.

**Labor (Personal) Income:** Salaries, wages, and the full cost of benefits including non-cash payments received by individuals in the economy. Includes employee compensation and sole proprietor income.

**Value-Added:** The difference between an industry's total output and the cost of its intermediate inputs (including labor income); sometimes referred to as the industry's "Contribution to GDP".

**Output:** The dollar value of industry production (e.g., sales or revenue).

**Personal Tax Revenue:** The dollar value of taxes generated due to the creation of personal income; includes both individual and company paid portion of social security.

## The Economic Impact of the U.S. Biopharmaceutical Industry

The U.S. biopharmaceutical industry's total output impact, often referred to as “total economic impact” totaled more than \$1.65 trillion in 2022.<sup>3</sup> This total industry impact includes \$802 billion of biopharmaceutical businesses sales (direct output effect) and \$851 billion in indirect and induced output effects. These values generate a biopharmaceutical industry output multiplier of 2.06—meaning that every \$1.00 in output produced by the biopharmaceutical industry supports an additional \$1.06 in output in other sectors of the U.S. economy (**Table 3**).

The operations and sales revenue of the biopharmaceutical industry is responsible for supporting more than 4.9 million jobs throughout the U.S. economy. These jobs consist of the nearly 1.05 million U.S. biopharmaceutical industry jobs detailed earlier in this report and the 3.8 million indirect and induced jobs supported by the industry in 2022. For every one biopharmaceutical industry job, the industry supports an additional 3.69 jobs in the U.S. economy, for a total employment multiplier of 4.69. Together, the biopharmaceutical industry employees and the workforce of its suppliers and other impacted segments of the U.S. economy received nearly \$428 billion in combined wages and benefits (also known as labor income or total compensation) in 2022.

**Table 3: Economic Impacts of the U.S. Biopharmaceutical Industry, 2022 (\$ in billions)**

Impact Type	Employment	Labor Income	Value Added	Output	State/Local Personal Tax Revenue	Federal Personal Tax Revenue
<b>Direct Effect</b>	1,049,839	\$165.57	\$422.52	\$802.28	\$5.04	\$34.01
<b>Indirect Effect</b>	1,670,395	\$122.48	\$204.60	\$395.68	\$3.43	\$25.91
<b>Induced Effect</b>	2,206,263	\$139.74	\$256.98	\$455.08	\$3.92	\$29.58
<b>Total Impacts</b>	4,926,497	\$427.80	\$884.09	\$1,653.03	\$12.40	\$89.50
<b>Multiplier</b>	4.69	2.58	2.09	2.06		

**Source:** TEconomy data, calculations and analysis; IMPLAN 2022 U.S. model.

Through this total compensation the employees and supplier employees of the biopharmaceutical industry are an important generator of federal, state, and local government tax revenues. The impact analysis estimates that incomes of biopharmaceutical industry workers and supported employees generate nearly \$102 billion in personal taxes in 2022 – more than \$12 billion in state and local tax revenues and more than \$89 billion in federal tax revenues.

The biopharmaceutical industry's direct value added of more than \$422 billion represents 1.6 percent of U.S. Gross Domestic Product (GDP) in 2022. The total impacts value added generated and supported by the industry, including supported sectors beyond the biopharmaceutical industry itself, totaled more than \$884 billion, or 3.4 percent of total U.S. GDP.<sup>4</sup>

## Economic Impacts Across the Biopharmaceutical Industry's U.S. Supply Chain

The biopharmaceutical industry requires a vast array of inputs and suppliers for research, operations, production, and distribution. The demand interrelationship with the industry's supply chain is captured within the indirect effects, as a part of the overall economic impacts.

The I-O analysis assesses the product and service input demands of the U.S. biopharmaceutical industry on every other sector in the U.S. economy and estimates the industry-specific impact for each supplier sector. Table 4 provides a detailed characterization of the major supply chain inputs (using grouped IMPLAN industry sectors for simplicity and clarity) to the U.S. biopharmaceutical industry as determined by the size of the indirect output effects. **Table 4** is ordered by the size of the supplier output or value of what that sector(s) supplies to the biopharmaceutical industry. For example, the biopharmaceutical industry purchased more than \$34 billion in real estate services (including facility leasing costs). The industry also purchased more than \$30 billion in software, computer services, and internet connectivity and hosting. From a product input perspective, various organic/inorganic chemical inputs (such as raw materials, excipients, or in some instances active pharmaceutical ingredients) accounted for nearly \$27 billion in direct production demand and likely accounts for a significant share of the nearly \$11 billion in inputs from the wholesale - other nondurable goods sector as well.

**Table 4: Supply Chain Inputs to the U.S. Biopharmaceutical Industry - Sectors, Jobs, and Sales, 2022**

Biopharmaceutical Industry Key Supplier Sectors	Supplier Jobs	Supplier Sales (\$B)
Real Estate Services	156,119	\$34.45
Software, Computer Services, and Internet	66,712	\$30.49
Organic/Inorganic Chemical Inputs	10,109	\$26.70
Insurance Services	52,306	\$24.92
Marketing, Advertising, & Public Relations Services	26,299	\$17.94
Mail, Couriers, & Express Parcel Delivery	204,377	\$15.00
Employment Services	125,139	\$14.99
Financial Services	42,089	\$13.23
Electric Power Utilities	9,397	\$13.12
Facility & Operational Services	106,137	\$11.99
Management Consulting Services	65,139	\$11.49
Legal Services	42,702	\$10.79
Wholesale - Other Nondurable Goods	27,520	\$10.79
Advertising & Public Relations Services	35,270	\$10.40
Warehousing & Storage	77,837	\$8.61
Business Support & Related Services	93,686	\$8.61

Biopharmaceutical Industry Key Supplier Sectors	Supplier Jobs	Supplier Sales (\$B)
Architectural & Engineering Services	39,948	\$8.26
Truck Transportation	31,039	\$7.03
Telecommunication Services	8,872	\$6.42
Wholesale - Commercial/Industrial Equipment	15,617	\$6.06
Printing	27,496	\$5.36
Paper/Cardboard Packaging	8,361	\$5.20
Accounting Services	27,430	\$5.09
Plastics/Plastic Packaging	7,155	\$4.84
Wholesale - Electronic Markets/Brokers	25,996	\$4.81
Laboratory Supplies & Equipment	11,276	\$3.89
Key Food-Related Inputs (e.g., starches, whey, protein, cellulose)	4,597	\$3.72
Logistics & Support Activities	30,155	\$3.57
Commercial/Industrial Equipment Repair	28,390	\$3.46
Wholesale - Other Durable Goods	7,897	\$2.92
Repair/Remodel Construction	11,061	\$2.84
Wholesale - Electric/Electronic Equipment	4,404	\$2.77
Intellectual Property Management & Licensing	1,177	\$2.66
Wholesale - Industrial Machinery, Equipment, & Supplies	7,020	\$2.46
Industrial, Processing, & Control Equipment	4,031	\$2.26
Commercial/Industrial Equipment Leasing	5,154	\$1.96
Environmental & Other Technical Services	10,724	\$1.92
Natural Gas, Water, & Other Utilities	1,299	\$1.50
Other Packaging	897	\$0.48
Communications Equipment	199	\$0.11
All Other Suppliers	209,362	\$42.56
Total Indirect (Supply Chain) Impacts	1,670,395	\$395.68

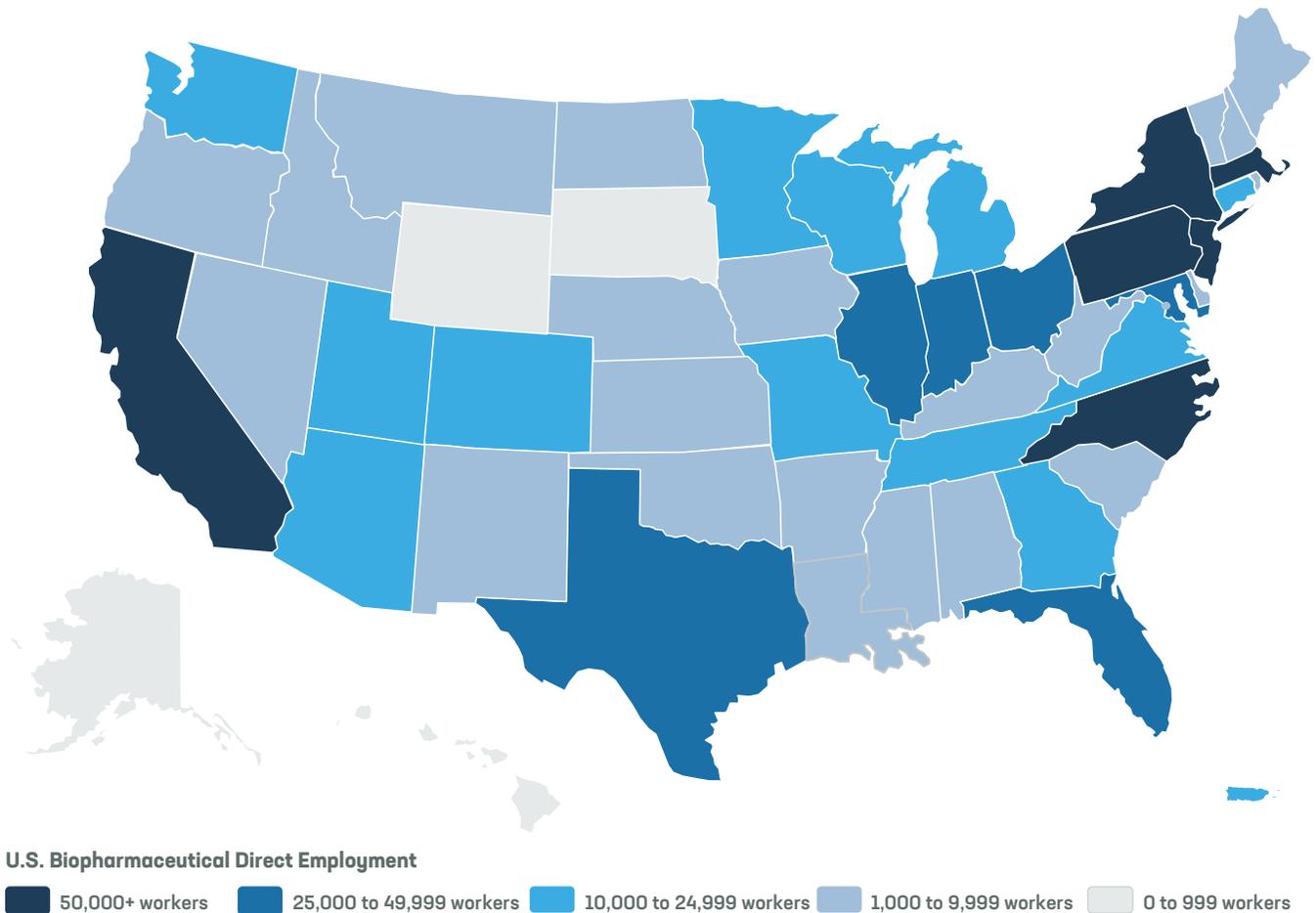
Source: TEconomy data, calculations and analysis; IMPLAN 2022 U.S. Model.

## Nationwide Employment and Impacts of the U.S. Biopharmaceutical Industry

The U.S. biopharmaceutical industry, as with most production-based industries, is concentrated in certain states with significant direct employment levels, sometimes driven by size of population, by historical centers of innovation, or natural resources. A key measure of its importance and significance, however, is **the diverse geographic representation of the U.S. biopharmaceutical industry—with every state, the District of Columbia, and Puerto Rico having some direct biopharmaceutical industry employment and experiencing some level of economic impact from the industry.**

**Figure 9** illustrates direct biopharmaceutical industry employment across all 50 states, the District of Columbia, and Puerto Rico. Six states—California, Massachusetts, New Jersey, New York, North Carolina, and Pennsylvania—each have more than 50,000 biopharmaceutical industry workers. In total, 24 states and Puerto Rico have more than 10,000 biopharmaceutical industry workers, with six more states having between 5,000 and 10,000 industry jobs.

**Figure 9: Geographic Distribution of U.S. Biopharmaceutical Industry Direct Employment, 2022**

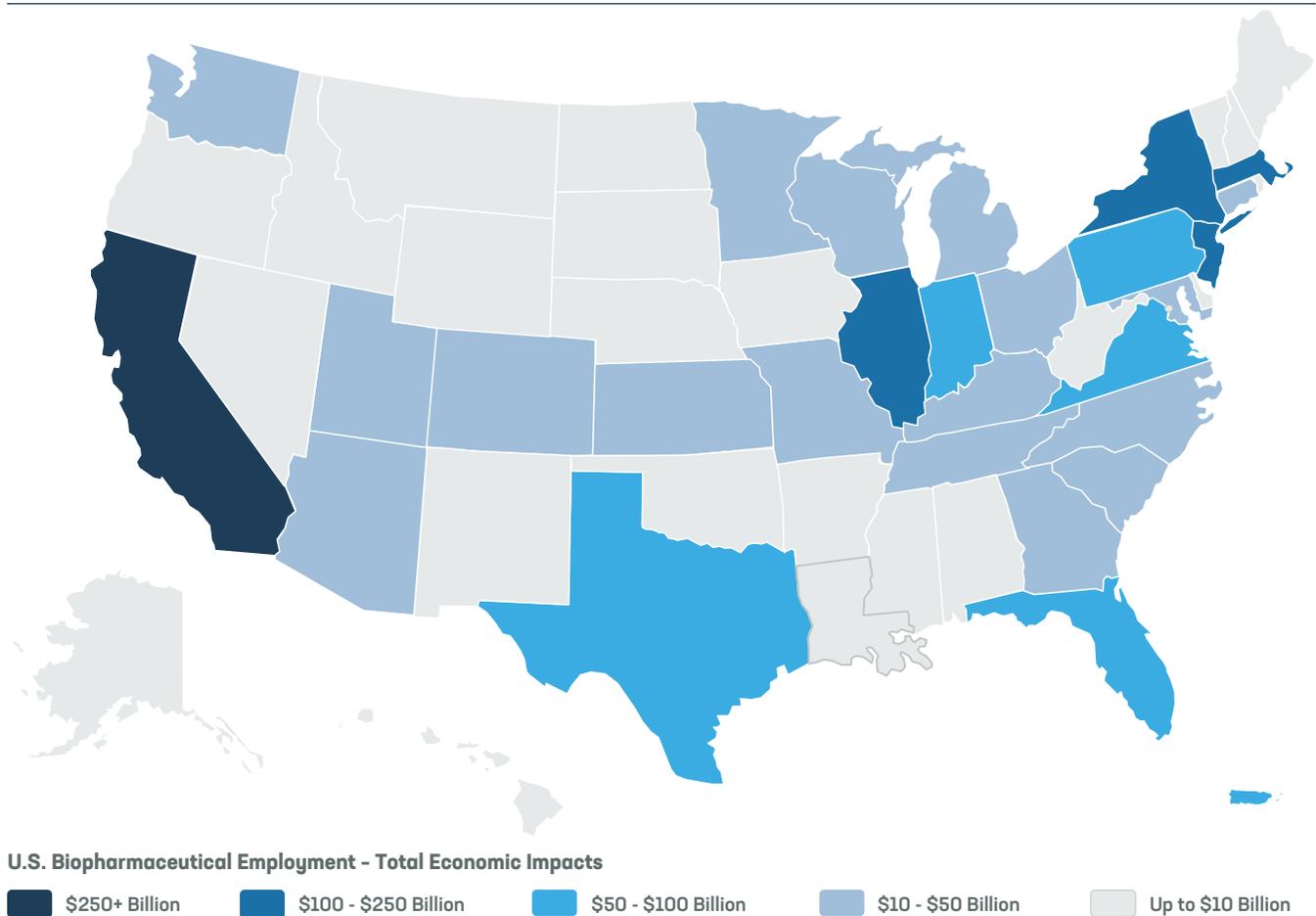


Source: TEconomy Partners data, calculations and analysis.

The distribution of the U.S. biopharmaceutical industry's total employment impacts reflects, in part, the large-scale, geographically dispersed, supply chain. For suppliers (indirect employment), there are ten states where the industry supports more than 50,000 supplier jobs, and another thirteen states and Puerto Rico with between 20,000 and 50,000 supplier jobs. Combining direct, indirect, and induced employment, the biopharmaceutical industry generates and supports more than 100,000 jobs in 13 states, with more than 250,000 jobs in eight states—California, New Jersey, Massachusetts, Texas, Florida, New York, Illinois, and Pennsylvania. Overall, 30 states and Puerto Rico each have more than 20,000 jobs generated and supported by the biopharmaceutical industry.

From a total economic impacts' perspective (direct, indirect, and induced output combined), California is by far the largest source of U.S. biopharmaceutical economic impact—accounting for more than \$275 billion, or 17 percent of the U.S. total output impacts (**Figure 10**). Additionally, nine states—New Jersey, Massachusetts, New York, Illinois, Texas, Pennsylvania, Florida, North Carolina, Indiana—and Puerto Rico, also have total biopharmaceutical industry economic impacts of \$50 billion or more. Fully 48 states, and Puerto Rico, exceed \$1 billion in total U.S. biopharmaceutical industry driven economic impact. **Appendix B** provides employment and economic impact estimates by state.

**Figure 10: Geographic Distribution of U.S. Biopharmaceutical Industry Total Economic Impacts, 2022**



**Source:** TEconomy data, calculations and analysis; IMPLAN 2022 U.S., 50 States, District of Columbia, and Puerto Rico Models.

# Discussion

The strength and innovative nature of the U.S. biopharmaceutical industry and the innovation-based policies that have supported the industry have resulted in the nation being the global leader in biopharmaceutical innovation and production. This industry consists of extensive research, manufacturing, and distribution infrastructure and employment and generates and supports significant impacts on economies across the country.

## Sizeable and Growing Employment

- Direct employment of nearly 1.05 million workers and a substantial employment multiplier of 4.69, the U.S. biopharmaceutical industry supports more than 3.88 million additional U.S. jobs for a total employment impact of nearly 4.93 million jobs in 2022, an increase of 16.2 percent since 2020.
- The U.S. biopharmaceutical industry outpaced U.S. manufacturing and the overall U.S. private sector in employment growth over the 2015-2022 period – demonstrating a combination of growth, stability, and economic resilience that makes the industry a key driver of the U.S. economy.

## High-Wage, High-Quality, and High Productivity Jobs

- This average U.S. biopharmaceutical job had a total compensation level of nearly \$158,000 per year in 2022—over \$60,000 more than the average U.S. manufacturing job, and more than twice the U.S. average across all employment—biopharmaceutical industry jobs are both high-wage and high-quality.
- From an overall productivity perspective, the combined sectors of the U.S. biopharmaceutical industry, generates a productivity level of more than \$402,000 per employee—more than twice that of the U.S. average manufacturing worker and more than three the average U.S. worker.
- In 2022, the U.S. biopharmaceutical industry employed more than 100,000 workers in each of four occupational categories: Management (163,085), Life, Physical, and Social Science (146,274), Production (140,707), and Business and Financial Operations (102,786).

## Important Driver of Innovation and Economic Impacts

- The U.S. biopharmaceutical industry exceeds \$800 billion in direct output in 2022, and with the ripple effect of this production throughout the U.S. economy, supports an additional \$850 billion in output through its suppliers and other sectors of the economy. This combined, total output impact represents 3.6 percent of total U.S. output.



- Through its research, production, and overall operations, value added from the U.S. biopharmaceutical industry directly contributes 1.6 percent of U.S. GDP and including indirect and induced effects supports more than \$880 billion in value added, or 3.4 percent of U.S. GDP.

The nation's biopharmaceutical industry is a major driver of innovation and economic growth both within the U.S. and globally. The industry's growth and resilience lead to jobs for significant numbers of highly skilled, highly productive, and highly paid workers across the country. But this unique industry and its substantial workforce cannot be taken for granted. To sustain this important driver of the U.S. economy, the U.S. biopharmaceutical industry must be supported by robust innovation policies starting with strong intellectual property protections, a well-functioning and evidence-based regulatory system, support for research and development, and other policies that recognize both the societal and economic impacts of medical innovation.

# Appendix A: Methodology

The following narrative provides an overview of the approach used to develop the 2022 biopharmaceutical industry employment and economic impact estimates at the national and state levels. This approach is similar to that used by TEconomy Partners for prior studies for PhRMA.

## Data Sources

Estimates of biopharmaceutical industry employment were derived by combining several widely used public and private data sources.

**2022 Quarterly Census of Employment and Wages:** Employment data for all relevant components of the biopharmaceutical industry were obtained from the U.S. Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) for 2022. QCEW establishment, employment, and wage data is captured by each state as part of corporate unemployment insurance data collection efforts performed by their Labor Market Information (LMI) office and coordinated with and reported nationally to the BLS. QCEW employment data are categorized into industry sectors and subsectors using the North American Industrial Classification System (NAICS), which is the standard used by Federal statistical agencies to classify business establishments.

A single company in the biopharmaceutical industry may have many establishments (locations) throughout the U.S., and each of that company's establishments can be classified into different NAICS categories. For example, a biopharmaceutical company with three establishments may have a manufacturing facility in one location, an R&D facility in another location, and corporate offices in a third location. At the same time, companies often have these functions co-located, for example R&D and manufacturing in the same location. In these instances, the establishment is generally assigned to the NAICS category associated with the primary activity at that location.

U.S. and state-level (including the District of Columbia and Puerto Rico) biopharmaceutical industry employment is estimated by aggregating employment across all establishments belonging to the biopharmaceutical industry based on their NAICS classification, with refinements, using the approach described later in this Appendix.

**2022 Current Population Survey:** The BLS Current Population Survey (CPS) is a national-level survey that estimates the total employment spectrum of the U.S. including public and private sector wage and salary employees, corporate and self-employed workers, and unpaid family workers. While the QCEW data captures nearly all industry employment (approximately 98 percent of all U.S. jobs), it does not capture sole proprietors, consultants, contract employees, representatives, and other “non-corporate” or “self-employed” private sector employment. CPS data were used to adjust the QCEW data upwards to estimate the full spectrum of biopharmaceutical industry employment.

**2017 Economic Census:** Every five years the U.S. Census Bureau performs the national economic census to examine the detailed economic activities of U.S. industry. While the 2022 Economic Census is the most recent effort, detailed data has not been released. Therefore, data derived from the 2017 Economic Census is used again for this analysis of the U.S. biopharmaceutical industry. These data are collected at the NAICS code



level across a set of North American Product Classification System (NAPCS) codes. Some broader NAICS codes include a combination of biopharmaceutical industry jobs and non-biopharmaceutical industry jobs. To determine the share of these sectors attributable to the biopharmaceutical industry, U.S. and state-level data from U.S. Economic Census were used to estimate the biopharmaceutical-relevant economic activity within these NAICS codes.

**Corporate Headquarter Employment Data:** With specific corporate sites to work from, individual biopharmaceutical-related headquarters locations were examined using data from Dun & Bradstreet and LinkedIn to better understand their employment structure. For those establishments that appeared to be dedicated to management activities only, additional work was performed including examination of corporate websites for additional location and employment information for these administrative locations. Based upon this analysis, employment was estimated for a set of key establishments for inclusion as part of the overall biopharmaceutical industry in a separate Biopharmaceutical Corporate Office sector. While every attempt is made to specifically identify these corporate and administrative locations, the number and employment values used in this analysis are likely conservative in nature.

**2022 IMPLAN Models:** The wider economic impact of the biopharmaceutical industry was estimated using the well-established regional economic analysis technique of input-output analysis (I-O), using custom I-O models from IMPLAN. The I-O analysis produces estimates of the economic impacts of the biopharmaceutical industry on output in the U.S. economy, on jobs, personal income, and federal, state, and local taxes.

The IMPLAN models' data matrices track the flow of commodities to industries from producers and institutional consumers within the nation or within individual states. The data also model consumption activities by workers, owners of capital, and imports. The inter-industry trade flows built into the model permit estimating the impacts of one sector on all other sectors with which it interacts within the specified geography. The 2022 models are the most current available at the time of this analysis. Impact results are generated and reported in 2022 dollars.

## The Structure of the U.S. Biopharmaceutical Industry

The biopharmaceutical industry's wide range of activities is spread across a set of different NAICS codes reflecting its presence within the U.S. economy. For purposes of this analysis, these NAICS codes are grouped into four industry subsectors: biopharmaceutical manufacturing, biopharmaceutical distribution, biopharmaceutical R&D, and biopharmaceutical corporate offices (**Table A1**).

**Table A1: 2022 NAICS Structure Relevant to Biopharmaceutical Industry**

<b>Biopharmaceutical Manufacturing</b>
325411 Medicinal and botanical manufacturing
325412 Pharmaceutical preparation manufacturing
325413 In vitro diagnostic substance manufacturing
325414 Biological product (except diagnostic) manufacturing
<b>Biopharmaceutical Distribution</b>
424210 Drugs and druggists' sundries merchant wholesalers*
<b>Biopharmaceutical R&amp;D</b>
541713 R&D in nanotechnology (including nanobiotechnology)*
541714 R&D in biotechnology (except nanobiotechnology)
541715 R&D in the physical, engineering, and life sciences (except nanotech and biotech)*
<b>Biopharmaceutical Corporate Offices</b>
551114 Corporate, subsidiary, and regional managing offices*

\*Indicate NAICS codes that include both biopharmaceutical and non-biopharmaceutical employment, and therefore require additional refinement and specification.

### Biopharmaceutical Manufacturing

Biopharmaceutical manufacturing is defined to include 100 percent of the employment within the four six-digit industries within the encompassing NAICS 3254. While a very small portion of the manufacturing activity of companies falling into these codes may be for products not considered drugs or pharmaceuticals, the intent of these codes is to capture the manufacturers of medicines, vaccines, diagnostics, and related biopharmaceuticals.

## Biopharmaceutical Distribution

The increasing importance of firms involved in the logistics and distribution of biopharmaceutical products, both in managing large and complex supply chains and as a source for industry innovation is acknowledged through their inclusion in this value-chain approach to estimating the size and impacts of the biopharmaceutical industry.

To succinctly specify the biopharmaceutical industry-related employment estimate from NAICS 424210 (Drugs and druggists' sundries merchant wholesalers), estimates are made of the size of these non-biopharmaceutical activities (e.g., "druggist sundries", miscellaneous medical supplies and equipment, and other retail consumer product distribution) using data from the 2017 Economic Census. The resulting estimate of U.S. biopharmaceutical distribution employment represents 94.2 percent of this six-digit NAICS employment. This common factor is then applied to each state's NAICS 424210 employment value.

## Biopharmaceutical R&D

The nature of biopharmaceutical R&D as a key and critical component of the U.S. scientific R&D and a pipeline for innovation and new discoveries for the entire U.S. biopharmaceutical industry. Unfortunately, the current 2022 NAICS code structure, like previous structures, captures biopharmaceutical R&D across all four six-digit industries under the encompassing NAICS 5417. While, as discussed previously, the 2017 Economic Census "product coding" schema called the North American Product Classification System (NAPCS) allowed for responding firms to classify the activities and products they produce, these data are limited in terms of public availability, especially at the state level.

Furthermore, discrepancies between the Economic Census (U.S. Census) and the QCEW data (U.S. BLS) in terms of the size of the six-digit NAICS industries 541713, 541714, 541715, and 541720 required additional adjustments to the estimation process.

Combining the four components of scientific R&D services, these procedures estimate that 45 percent of the encompassing NAICS 5417 is classified as belonging to the U.S. biopharmaceutical industry. This percentage captures employment involved in distinct biotechnology activities, pharmaceutical sciences research including CRO activities, and other medical and health related R&D. R&D activities performed within locations classified as biopharmaceutical manufacturing, distribution, or corporate offices are not captured within Biopharmaceutical R&D but are captured within the employment estimates for those distinct sectors.

## Biopharmaceutical Corporate Offices

A characteristic at the core of the NAICS classification scheme is to allow for the classification of individual establishments based upon the functions occurring within a particular establishment. As with all large, multinational industries such as automotive and aerospace, a meaningful share of biopharmaceutical industry employment is captured within Management of Companies and Enterprises (NAICS 5511). To assess the level of this biopharmaceutical industry employment a special estimation effort is required to assess these locations' impacts. With specific corporate information to work from, individual biopharmaceutical-related sites are identified as biopharmaceutical "headquarters". These address specific sites were examined to ascertain whether any significant manufacturing or R&D activities were occurring within these establishments that would expect these locations to be classified by public sector data collection agencies as either NAICS 3254 - Pharmaceutical and medicine manufacturing; or NAICS 5417 - Scientific research and development (R&D) services.

For those establishments that appeared to be dedicated to administrative and management activities only, additional work was performed including examination of corporate websites for additional location information to determine if this employment would most likely be classified in NAICS 5511 by public sector data collection agencies. Based upon this analysis, employment was estimated for 30 key establishments and locations, for inclusion as part of the overall biopharmaceutical industry. Headquarters employment for key firms in the biopharmaceutical distribution sector is also estimated in this fashion, consistent with the value chain approach used in this report to estimate the size of the biopharmaceutical industry. Of the total 2022 employment in U.S. establishments that are classified as corporate offices, this approach leads to a conservative estimate that 1.37 percent should be considered biopharmaceutical industry employment.

It is important to recognize that the employment within these four defined biopharmaceutical sectors is based on establishment-level data collection where a single NAICS code is assigned to the establishment (i.e., the physical business location). The specific NAICS code is determined by the predominant or primary business activity occurring within the location and is typically determined by factors such as relative share of production costs, revenue, value of shipments, and in some instances employment. Since within the BLS QCEW data all jobs within an establishment are assigned to the establishment's single NAICS code, sector-based job counts may over- or under-state actual employment by function to the extent multiple activities occur at a single establishment (e.g., collocated R&D and manufacturing). The total employment estimate is not affected, however.

## Additional Refinements

For three of the four biopharmaceutical sectors - biopharmaceutical manufacturing, biopharmaceutical distribution, and biopharmaceutical R&D - CPS data are used to adjust the employment estimates to reflect the inclusion of self-employed workers. The CPS provides an estimate of the ratio of "self-employed" workers to the number of "private sector wage and salary workers" or corporate employment for each biopharmaceutical sector's grouping of NAICS codes. This share ranges from 0.4 percent in biopharmaceutical manufacturing to 2.1 percent in biopharmaceutical distribution in 2022. This share ratio is applied to the QCEW-based biopharmaceutical sector employment to arrive at a final biopharmaceutical sector employment estimate. Biopharmaceutical corporate office employment is not adjusted in a similar fashion as because CPS survey respondents identify their employment based upon more traditional industry sectors (e.g., process consultants would identify with the biopharmaceutical manufacturing sector, not the biopharmaceutical corporate offices sector).

## Final Biopharmaceutical Industry and Sector Employment Estimates

A summary of the NAICS-based employment for the components of the biopharmaceutical industry is provided in Table A2. The data entries show the estimated share of employment within that sector (four-digit NAICS code) that is attributed to the biopharmaceutical industry, the 2022 employment estimate, and the subsector's share of total biopharmaceutical industry employment.

**Table A2: U.S. Biopharmaceutical Industry Ssector Estimates, 2022**

Biopharmaceutical Sector	NAICS Codes (4 Digit)	Total NAICS Employment	Biopharma Share of Sector	Biopharma-Related Sector Employment	Share of Total Biopharma Employment
Biopharmaceutical Manufacturing	3254 Pharmaceutical and medicine manufacturing	361,015	100.00%	359,429	34.24%
Biopharmaceutical Distribution	4242 Drug and druggist sundries wholesale	263,726	94.18%	248,374	23.66%
Biopharmaceutical R&D	5417 Scientific research and development (R&D)	900,699	45.41%	408,993	38.96%
Biopharmaceutical Corporate Offices	5511 Management of companies and enterprises	2,411,281	1.37%	33,043	3.15%
<b>Total U.S. Biopharmaceutical Industry</b>			<b>1,049,839</b>	<b>100.0%</b>	

**Source:** TEconomy Partners analysis, calculations and estimations using 2022 BLS QCEW and CPS Employment Data for all 50 States, the District of Columbia, and Puerto Rico.

## Total Economic Impact of the Biopharmaceutical Industry

The economic impact of the biopharmaceutical industry was estimated using the well-established economic analysis technique of input-output analysis (I-O), using custom I-O models from IMPLAN for each state, the District of Columbia, and Puerto Rico, as well as a U.S. national model. The IMPLAN models' data matrices track the flow of commodities to industries from producers and institutional consumers within the specific region. The data also model consumption activities by workers, owners of capital, and imports. The inter-industry trade flows built into the models permit estimating the impacts of one sector on all other sectors with which it interacts.

The biopharmaceutical industry sector employment estimates described above serve as the inputs to drive the resulting impacts within the U.S. and individual state I-O models. The models, using the additional data embedded within the IMPLAN models, convert these employment estimates into localized income and expenditures. The estimation of ripple effect of these expenditures (including the spending of worker wages) generates the impact measures reported in this report. These measures include the direct, indirect, and induced job creation, associated personal incomes, business value added and output, and associated personal income tax generation to federal, state and local taxing authorities.

# Appendix B

## State-Level Estimates

**Table B1. U.S. and State Employment: Direct, Indirect, and Induced Effects and Total Impacts, 2020**

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
<b>U.S. Total (incl. District of Columbia &amp; Puerto Rico)</b>	<b>1,049,839</b>	<b>1,670,395</b>	<b>2,206,263</b>	<b>4,926,497</b>	<b>4.69</b>
Alabama	4,168	7,481	6,296	17,945	4.31
Alaska	370	276	335	981	2.65
Arizona	13,260	38,282	33,211	84,753	6.39
Arkansas	2,838	7,889	5,452	16,179	5.70
California	174,153	230,839	373,360	778,351	4.47
Colorado	14,703	31,610	32,904	79,217	5.39
Connecticut	12,445	15,491	23,289	51,225	4.12
Delaware	4,267	2,243	2,088	8,597	2.01
District of Columbia	3,809	2,794	1,756	8,359	2.19
Florida	42,829	136,231	119,538	298,598	6.97
Georgia	12,750	31,736	31,535	76,021	5.96
Hawaii	938	1,942	1,544	4,424	4.72
Idaho	2,560	4,331	3,888	10,778	4.21
Illinois	44,863	81,808	137,037	263,709	5.88
Indiana	30,586	36,830	65,876	133,291	4.36
Iowa	6,722	7,292	9,311	23,325	3.47
Kansas	7,989	12,577	14,205	34,771	4.35
Kentucky	7,359	18,624	14,529	40,512	5.51
Louisiana	3,020	8,105	6,900	18,025	5.97
Maine	6,689	11,019	12,512	30,220	4.52
Maryland	33,423	31,440	48,800	113,664	3.40
Massachusetts	92,733	83,340	176,961	353,035	3.81
Michigan	18,574	39,139	44,790	102,503	5.52
Minnesota	13,220	22,076	31,624	66,920	5.06
Mississippi	2,477	5,226	3,751	11,454	4.62
Missouri	17,141	34,305	34,620	86,066	5.02
Montana	1,394	1,742	1,848	4,985	3.58
Nebraska	4,490	7,036	7,832	19,358	4.31
Nevada	3,718	8,911	6,639	19,268	5.18
New Hampshire	3,854	5,294	6,809	15,956	4.14

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
New Jersey	75,833	108,558	172,334	356,725	4.70
New Mexico	2,745	2,935	2,899	8,579	3.13
New York	71,598	99,454	116,217	287,270	4.01
North Carolina	56,183	61,950	108,355	226,487	4.03
North Dakota	1,056	902	1,588	3,547	3.36
Ohio	26,069	53,568	56,460	136,097	5.22
Oklahoma	3,363	9,210	6,361	18,934	5.63
Oregon	5,072	12,580	11,029	28,681	5.65
Pennsylvania	56,086	69,860	136,405	262,350	4.68
Rhode Island	2,424	4,346	4,887	11,658	4.81
South Carolina	9,959	17,732	14,956	42,647	4.28
South Dakota	870	1,505	1,405	3,780	4.35
Tennessee	15,528	38,722	35,428	89,678	5.78
Texas	49,165	124,149	136,314	309,628	6.30
Utah	16,508	33,928	31,038	81,474	4.94
Vermont	1,339	2,528	2,183	6,050	4.52
Virginia	11,481	23,348	20,712	55,541	4.84
Washington	21,984	25,575	33,563	81,122	3.69
West Virginia	3,264	5,490	5,000	13,754	4.21
Wisconsin	13,821	20,684	24,878	59,383	4.30
Wyoming	264	392	193	849	3.22
Puerto Rico	17,885	27,067	24,818	69,770	3.90

Source: TEconomy Partners data, calculations and analysis; IMPLAN U.S. and state models.

**Table B2. U.S. and State Output: Direct, Indirect, and Induced Effects and Total Impacts, 2020**

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
<b>U.S. Total (incl. District of Columbia &amp; Puerto Rico)</b>	<b>\$802,276.9</b>	<b>\$395,679.0</b>	<b>\$455,076.4</b>	<b>\$1,653,032.3</b>	<b>2.06</b>
Alabama	\$2,648.4	\$1,467.5	\$1,174.7	\$5,290.6	2.00
Alaska	\$120.6	\$64.3	\$66.6	\$251.5	2.09
Arizona	\$8,606.9	\$8,127.8	\$6,775.1	\$23,509.8	2.73
Arkansas	\$2,197.4	\$1,594.6	\$1,002.6	\$4,794.6	2.18
California	\$131,916.1	\$60,849.7	\$84,098.9	\$276,864.8	2.10
Colorado	\$9,100.5	\$7,353.1	\$6,919.8	\$23,373.4	2.57
Connecticut	\$8,805.6	\$3,549.4	\$4,828.9	\$17,183.9	1.95
Delaware	\$2,240.8	\$196.9	\$362.6	\$2,800.3	1.25
District of Columbia	\$1,617.2	\$832.7	\$393.2	\$2,843.1	1.76
Florida	\$30,707.8	\$28,144.6	\$23,808.4	\$82,660.9	2.69
Georgia	\$8,834.0	\$7,025.9	\$6,262.6	\$22,122.6	2.50
Hawaii	\$482.8	\$432.9	\$323.5	\$1,239.2	2.57
Idaho	\$1,226.3	\$881.4	\$735.6	\$2,843.3	2.32
Illinois	\$51,842.5	\$20,849.5	\$28,384.1	\$101,076.1	1.95
Indiana	\$39,576.4	\$8,616.8	\$12,520.4	\$60,713.6	1.53
Iowa	\$5,290.3	\$1,627.5	\$1,698.7	\$8,616.5	1.63
Kansas	\$5,715.8	\$2,832.9	\$2,755.5	\$11,304.3	1.98
Kentucky	\$5,674.9	\$3,795.6	\$2,731.3	\$12,201.8	2.15
Louisiana	\$2,322.2	\$1,577.9	\$1,253.9	\$5,154.0	2.22
Maine	\$4,086.8	\$2,449.1	\$2,431.0	\$8,966.9	2.19
Maryland	\$17,699.5	\$7,454.2	\$9,804.9	\$34,958.6	1.98
Massachusetts	\$49,430.7	\$22,386.8	\$38,248.3	\$110,065.7	2.23
Michigan	\$16,049.8	\$9,037.3	\$8,786.8	\$33,873.9	2.11
Minnesota	\$8,087.9	\$5,548.4	\$6,538.4	\$20,174.7	2.49
Mississippi	\$1,747.0	\$968.4	\$658.8	\$3,374.2	1.93
Missouri	\$12,188.8	\$7,722.0	\$6,658.4	\$26,569.2	2.18
Montana	\$731.3	\$354.8	\$333.1	\$1,419.3	1.94
Nebraska	\$4,015.3	\$1,625.4	\$1,501.7	\$7,142.3	1.78
Nevada	\$2,270.7	\$1,891.7	\$1,357.2	\$5,519.6	2.43
New Hampshire	\$2,548.5	\$1,262.6	\$1,414.7	\$5,225.9	2.05
New Jersey	\$58,938.7	\$25,860.2	\$36,078.4	\$120,877.3	2.05
New Mexico	\$1,519.4	\$603.1	\$535.8	\$2,658.3	1.75
New York	\$50,673.8	\$26,512.6	\$25,830.6	\$103,017.0	2.03
North Carolina	\$40,515.3	\$18,623.0	\$21,047.3	\$80,185.5	1.98
North Dakota	\$534.0	\$216.0	\$294.3	\$1,044.2	1.96
Ohio	\$17,997.3	\$10,807.3	\$10,785.9	\$39,590.5	2.20
Oklahoma	\$2,509.8	\$1,706.5	\$1,214.5	\$5,430.7	2.16

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
Oregon	\$3,329.9	\$2,712.3	\$2,181.7	\$8,224.0	2.47
Pennsylvania	\$42,422.8	\$16,266.0	\$26,531.6	\$85,220.4	2.01
Rhode Island	\$2,132.0	\$1,004.6	\$941.7	\$4,078.3	1.91
South Carolina	\$7,545.5	\$3,835.8	\$2,818.6	\$14,199.9	1.88
South Dakota	\$476.5	\$319.3	\$263.8	\$1,059.6	2.22
Tennessee	\$9,985.1	\$8,466.0	\$7,197.0	\$25,648.1	2.57
Texas	\$39,271.4	\$27,936.4	\$27,777.8	\$94,985.6	2.42
Utah	\$9,707.1	\$7,567.0	\$6,330.4	\$23,604.5	2.43
Vermont	\$829.0	\$561.7	\$415.2	\$1,806.0	2.18
Virginia	\$6,930.1	\$5,323.7	\$4,151.0	\$16,404.8	2.37
Washington	\$11,582.2	\$7,039.0	\$8,087.9	\$26,709.1	2.31
West Virginia	\$2,731.5	\$1,066.3	\$889.5	\$4,687.3	1.72
Wisconsin	\$8,719.1	\$4,743.8	\$4,824.5	\$18,287.3	2.10
Wyoming	\$157.9	\$76.7	\$34.5	\$269.1	1.70
Puerto Rico	\$45,985.8	\$3,909.7	\$3,015.0	\$52,910.5	1.15

Source: TEconomy Partners data, calculations and analysis; IMPLAN U.S. and state models.

**Table B3. U.S. and State Occupational Share Estimates, 2020**

State	Management	Life, Physical, and Social Science	Production	Business and Financial Operations	Office and Administrative Support	Computer and Mathematical	Architecture and Engineering	Sales and Related	Transportation and Material Moving	Healthcare Practitioners and Technical	Installation, Maintenance, and Repair	All Other Occupational Categories
U.S. Total (incl. District of Columbia & Puerto Rico)	16%	14%	14%	10%	9%	8%	8%	7%	6%	3%	2%	3%
Alabama	15%	14%	14%	9%	9%	7%	7%	9%	7%	3%	2%	3%
Alaska	18%	19%	4%	11%	8%	12%	12%	6%	4%	3%	1%	3%
Arizona	15%	10%	15%	9%	11%	5%	5%	12%	10%	3%	2%	3%
Arkansas	15%	8%	10%	9%	12%	5%	4%	16%	12%	4%	2%	3%
California	17%	16%	11%	10%	9%	9%	9%	6%	5%	3%	2%	3%
Colorado	15%	13%	15%	9%	10%	7%	7%	9%	7%	3%	2%	3%
Connecticut	16%	12%	11%	12%	11%	8%	7%	8%	6%	3%	2%	4%
Delaware	18%	9%	7%	15%	14%	10%	6%	7%	5%	3%	2%	5%
District of Columbia	18%	20%	3%	11%	7%	13%	13%	4%	3%	3%	1%	4%
Florida	15%	11%	12%	9%	11%	6%	6%	13%	10%	3%	2%	3%
Georgia	15%	13%	13%	9%	10%	7%	7%	10%	8%	3%	2%	3%
Hawaii	16%	11%	5%	10%	11%	7%	7%	14%	10%	4%	1%	3%
Idaho	17%	15%	8%	10%	9%	9%	9%	8%	6%	3%	2%	3%

State	Management	Life, Physical, and Social Science	Production	Business and Financial Operations	Office and Administrative Support	Computer and Mathematical	Architecture and Engineering	Sales and Related	Transportation and Material Moving	Healthcare Practitioners and Technical	Installation, Maintenance, and Repair	All Other Occupational Categories
Illinois	14%	12%	19%	9%	10%	5%	6%	8%	8%	3%	3%	3%
Indiana	14%	13%	26%	9%	9%	5%	6%	5%	6%	2%	3%	3%
Iowa	14%	14%	22%	9%	9%	6%	6%	6%	6%	2%	3%	3%
Kansas	15%	14%	18%	9%	9%	6%	7%	7%	7%	2%	3%	3%
Kentucky	15%	9%	12%	9%	12%	5%	5%	14%	11%	4%	2%	3%
Louisiana	15%	7%	11%	9%	13%	4%	3%	17%	13%	4%	2%	3%
Maine	15%	14%	19%	9%	9%	6%	7%	7%	7%	2%	3%	3%
Maryland	17%	19%	12%	10%	7%	10%	11%	3%	3%	2%	2%	3%
Massachusetts	18%	19%	6%	11%	8%	12%	12%	4%	3%	3%	1%	4%
Michigan	14%	13%	22%	9%	9%	5%	6%	8%	8%	2%	3%	3%
Minnesota	15%	14%	15%	9%	9%	7%	8%	8%	7%	3%	2%	3%
Mississippi	14%	11%	18%	9%	11%	5%	5%	11%	9%	3%	3%	3%
Missouri	15%	13%	16%	9%	9%	6%	7%	9%	7%	3%	2%	3%
Montana	15%	14%	19%	9%	9%	6%	7%	7%	7%	2%	3%	3%
Nebraska	14%	13%	20%	9%	9%	5%	6%	8%	8%	2%	3%	3%
Nevada	15%	12%	14%	9%	10%	6%	6%	11%	9%	3%	2%	3%
New Hampshire	15%	14%	18%	9%	9%	6%	7%	7%	7%	2%	3%	3%
New Jersey	16%	12%	15%	11%	10%	7%	7%	7%	6%	3%	2%	3%
New Mexico	15%	15%	18%	9%	9%	7%	8%	6%	6%	2%	3%	3%
New York	16%	14%	14%	10%	10%	7%	7%	8%	7%	3%	2%	3%
North Carolina	16%	15%	16%	10%	9%	8%	8%	5%	5%	2%	2%	3%
North Dakota	15%	15%	19%	9%	8%	7%	8%	6%	6%	2%	3%	3%
Ohio	16%	10%	11%	11%	12%	7%	6%	11%	9%	3%	2%	3%
Oklahoma	15%	9%	13%	9%	11%	5%	5%	14%	11%	4%	2%	3%
Oregon	15%	11%	12%	9%	11%	6%	6%	13%	10%	3%	2%	3%
Pennsylvania	16%	15%	14%	10%	9%	8%	9%	6%	5%	2%	2%	3%
Rhode Island	14%	13%	21%	9%	9%	5%	6%	7%	7%	2%	3%	3%
South Carolina	14%	14%	23%	9%	9%	5%	6%	6%	6%	2%	3%	3%
South Dakota	16%	12%	6%	10%	11%	8%	7%	13%	9%	4%	1%	3%
Tennessee	16%	12%	9%	10%	11%	7%	7%	12%	9%	4%	2%	3%
Texas	15%	11%	13%	9%	11%	6%	6%	12%	9%	3%	2%	3%
Utah	15%	14%	19%	9%	9%	6%	7%	7%	6%	2%	3%	3%
Vermont	15%	10%	14%	9%	11%	5%	5%	13%	10%	3%	2%	3%
Virginia	16%	14%	11%	10%	10%	8%	8%	9%	7%	3%	2%	3%
Washington	17%	18%	8%	10%	8%	11%	11%	6%	4%	3%	2%	3%
West Virginia	14%	12%	19%	9%	10%	5%	6%	10%	8%	3%	3%	3%
Wisconsin	15%	14%	18%	9%	9%	7%	7%	7%	6%	2%	3%	3%
Wyoming	15%	12%	12%	9%	10%	7%	6%	11%	9%	3%	2%	3%
Puerto Rico	13%	12%	28%	8%	9%	3%	5%	7%	7%	2%	3%	2%

Source: U.S. Bureau of Labor Statistics 2020 Occupational Employment Survey data; TEconomy Partners data, calculations, and analysis.

# Endnotes

- 1 National Center for Science and Engineering Statistics, National Science Foundation, Business Enterprise Research and Development Survey, 2021; TEconomy Partners analysis. For these comparative data the biopharmaceutical industry is captured using a combination of the pharmaceutical manufacturing and biotechnology NAICS codes. Domestic includes the combination of U.S. and Puerto Rico and U.S. operations of foreign-based biopharmaceutical firms.
- 2 TEconomy analysis and estimates using National Center for Science and Engineering Statistics, National Science Foundation, Business Enterprise Research and Development Survey, 2021 and Corporate SEC 10-K filings for more than 70 leading U.S. biomedical product and R&D corporations.
- 3 2022 is the most current year available for the IMPLAN I-O data and models.
- 4 Total U.S. output and value-added as estimated by the 2022 U.S. IMPLAN model. Note: value-added corresponds most closely to U.S. GDP.





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