An Analysis of Construction Spending in the Pharmaceutical & Biotech Industry,

2015-2020

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Presented by:





Supporting Organizations

PHARMACEUTICAL INDUSTRY LABOR-MANAGEMENT ASSOCIATION (PILMA)

http://www.pilma.org/

For nearly 20 years, the Pharmaceutical Industry Labor-Management Association has united the biopharmaceutical industry and union workers with the dual goals of fostering innovation of life-saving cures and securing high-quality union construction jobs. As the partnership has grown over the years, so has its impact. Labor and industry recognize the strength in their partnership: strong industry naturally leads to good jobs and a vibrant economy.

The pharmaceutical industry members of PILMA recognize that the most highly skilled workers are needed to construct and maintain the highest quality research and manufacturing facilities. Following each new drug trial, research facilities must be wiped clean – entire systems must be changed, surfaces must be sterilized and other equipment replaced. This requires highly skilled reliable labor that the industry can depend on to do the job right. North America's Building Trades Unions spend \$1.6 billion training their members each year. With state-of-the-art training facilities all over the country the building trades are ready to meet the needs of today and the challenges of tomorrow.

INSTITUTE FOR CONSTRUCTION ECONOMIC RESEARCH (ICERES)

http://iceres.org/

The Institute for Construction Economic Research (ICERES) is a non-profit network of academic faculty and other scholars interested in conducting, collaborating on, and facilitating academic-quality research on construction labor issues. ICERES is committed to being an independent, non-partisan voice on labor market and public policy issues affecting the construction industry with the goal of finding and disseminating pragmatic solutions to problems affecting construction owners, developers, contractors and workers.



EXECUTIVE SUMMARY

The development and manufacture of safe and effective COVID-19 vaccines—all within 12 months from the onset of the pandemic—represented a historic achievement in public health. Pharmaceutical and biotech companies in the United States were at the forefront of global efforts to develop vaccines, but they were hardly starting from scratch: the rapid development of COVID-19 vaccines was directly built upon years of innovation and research by this country's medical and scientific community. The success of COVID-19 vaccines only further cements what has long been known: the United States is a world leader in developing life-saving and life-enhancing medical breakthroughs. But global leadership by the United States has required more than the knowledge and skills of scientists: it is also the result of world-class research facilities, laboratories and manufacturing plants.

Developing state-of-the-art pharmaceutical and biotech facilities in the United States requires a number of critical elements. While state and federal governments provide support, the private sector independently invests billions of dollars annually in pharmaceutical and biotech infrastructure. But none of this money would be sufficient without skilled construction tradespeople who are capable of building and maintaining high-tech facilities that meet exacting standards. This has led to a unique partnership between the pharmaceutical and biotech industry and the skilled, experienced, and dedicated workers of America's construction labor unions.

The partnership between the pharmaceutical and biotech sector and construction unions was instrumental in retrofitting existing facilities to develop and manufacture COVID-19 vaccines. But this partnership has benefitted American communities for decades, from advancements in public health to the economic benefits for local workers, families, and communities. In addition to the economic impact of newly-constructed, high-tech medical and science facilities, the employment of union construction workers provides good jobs for thousands of local residents, including family-supporting wages, health insurance, and pension benefits. To demonstrate the economic impact of this partnership, this report analyzes the amount of privately-funded construction of research, manufacturing and distribution facilities in the pharmaceutical and biotech industry between 2015 and 2020 for 14 states (CA, CO, CT, DE, IL, MD, MA, MI, NJ, NY, OH, OR, PA and WA). These states were identified by the Pharmaceutical Industry Labor-Management Association (PILMA), a coalition of labor organizations and companies in the pharmaceutical industry with dual goals of fostering medical innovation and promoting high-quality construction jobs.

Table ES. Summary of Pharmaceutical and Biotech Industry Construction, 14 States, 2015-2020						
PROJECTS		SPENDING	UNION CONSTRUCTION LABOR			
State	No. of Projects (\$5M+)	Total Valuation (\$ million)	Total Spending (\$ million)	Total Labor Hours	Union Labor Hours (est.)	Union Wages (est.)
California	107	\$5,680.0	^{\$} 7,383.5	14,928,082	5,655,387	^{\$} 198,843,393
Colorado	9	\$360.0	^{\$} 527.7	1,067,607	199,655	\$5,434,598
Connecticut	11	^{\$} 228.0	\$435.7	890,947	292,113	^{\$} 9,718,594
Delaware	4	^{\$} 338.0	\$377.3	761,238	221,672	\$6,472,823
Illinois	11	^{\$} 1,490.0	^{\$} 1,549.4	3,127,123	1,929,249	^{\$} 71,787,348
Maryland	30	^{\$} 1,561.0	^{\$} 1,698.6	3,427,680	598,832	^{\$} 19,024,904
Massachusetts	95	\$5,877.2	\$4,902.8	9,872,787	2,803,186	^{\$} 102,456,455
Michigan	15	^{\$} 449.6	\$1,117.2	2,276,288	906,850	\$25,409,944
New Jersey	35	^{\$} 1,169.5	\$2,575.0	5,243,687	2,563,414	\$94,308,010
New York	41	\$2,076.3	\$2,932.5	5,932,976	3,090,661	^{\$} 112,469,159
Ohio	19	^{\$} 710.5	\$1,056.6	2,144,427	702,648	^{\$} 20,271,385
Oregon	5	\$360.7	\$407.6	819,316	262,175	^{\$} 9,304,598
Pennsylvania	48	\$3,000.4	\$3,587.0	7,266,056	2,749,716	\$85,488,658
Washington	17	\$345.0	\$445.1	899,817	362,665	^{\$} 13,237,288
TOTAL	447	^{\$} 23,646.2	^{\$} 28,995.9	58,658,033	22,338,223	^{\$} 774,227,156

Relying almost exclusively on data from Industrial Information Resources (IIR), a well-respected global consulting firm, this report concludes the following:

Source: Industrial Information Resources, Current Population Survey, Quarterly Census of Employment and Wages

- There were 447 major (\$5+ million) pharmaceutical and biotech projects that were privately funded and under construction at any point between 2015 and 2020 as identified by IIR for the 14 states studied. These projects represent a combined \$23.6 billion in infrastructure investment by the industry. Major pharmaceutical and biotech projects were most prevalent in Massachusetts (95 projects, \$5.9 billion) and California (107 projects, \$5.7 billion), however projects totaling over \$1 billion were identified in half of the 14 states (MA, CA, PA, NY, MD, IL, NJ). Further, there was at least \$228 million in private-sector projects active at any point between 2015 and 2020 in all 14 states analyzed.
- Major pharmaceutical and biotech R&D and manufacturing projects active between 2015 and 2020
 were heavily concentrated in major metropolitan cities and along the two coasts, including the Northeast
 Corridor (especially in Greater Boston) and in California. However, IIR data highlights that some of the
 largest construction projects planned for the next five years will be built in Michigan, Colorado and
 Washington.
- In terms of total investment, IIR estimates that the private sector of the pharmaceutical and biotech
 industry spent \$29.0 billion on infrastructure spending across the 14-state sample exclusively between
 2015 and 2020. This number also includes projects less than \$5 million and an adjustment for projects not
 identified by IIR, while only considering expenditures on major projects that occurred within this six-year
 time period (since some projects started before, or ended after, the years in question).
- Private-sector construction spending by the pharmaceutical and biotech industry increased every year across the 14-state area, starting at \$3.9 billion in 2015 and increasing to \$6.1 billion in 2020. A significant spike in private-sector investment occurred in 2019, effectively predating the COVID-19 pandemic. IIR estimates that industry construction spending will increase to \$6.5 billion in 2021 and will remain above \$5 billion annually through 2025.
- In terms of state construction environments, this report highlights that all 14 states featured at least \$377 million in private-sector pharmaceutical and biotech infrastructure spending between 2015 and 2020. This was led by California, which IIR projected to feature \$7.4 billion; meanwhile, four other states (MA, PA, NY, NJ) also had construction spending of at least \$2.5 billion over that time.
- Annual data provided by IIR reveals that nearly every state featured sharp year-over-year increases in construction spending between 2015 and 2020. Among states already featuring a substantial pharmaceutical and biotech presence, investment growth appears especially strong in Pennsylvania, New York, Massachusetts and Illinois: each state had well over \$200 million more in construction spending in 2020 than it did in 2015. On a percentage basis, the Pacific Northwest appears to be a rapidly expanding market for R&D and manufacturing with Oregon (566% increase in spending from 2015 to 2020) and Washington (249% increase) exhibiting the highest rates of growth among the 14 states identified in this study. Over the next five years, Washington and numerous other states (CO, MI, OH, CT, NJ) are projected by IIR to exhibit substantial increases in construction spending from their 2020 levels.
- Between 2015 and 2020, the pharmaceutical and biotech industry required 58.7 million labor hours from construction workers on research and manufacturing facilities across these 14 states among the 14 trades examined by IIR. Electricians, instrumentation techs, and plumbers and pipefitters accounted for over 60% of this total, however the industry also required more than 2.5 million labor hours of carpenters, millwrights, operating engineers, laborers, and ironworkers.
- Trends in construction employment mirror those of spending, as the number of construction labor hours required by the pharmaceutical and biotech industry increased annually from 2015 (8.0 million) through 2020 (12.3 million). A sharp increase in employment by the pharmaceutical and biotech sector in 2020 is especially notable given that many other industries in the United States experienced substantial declines in employment opportunities during the pandemic. Assuming a standard 2,000-hour work week, IIR data suggests that the pharmaceutical and biotech projects employed 6,157 full-time construction workers in 2020 across the 14 states featured in this study.
- A conservative, lower-bound estimate of union construction work indicates that the pharmaceutical and biotech industry required at least 22.3 million labor hours by union workers in these 14 states during this six-year period. The conservative nature of these estimates is due to statistical limitations; as outlined in this report, the full impact of the industry on union construction employment is likely to be substantially higher than the above projections.

- Multiplying this conservative estimate of union labor hours by the average union construction wage in
 each state between 2015 and 2020 leads to the conclusion that the pharmaceutical and biotech industry
 paid at least \$774 million in wages to union construction workers across these 14 states during this six
 year time period. This number likely underrepresents the economic impact of the employment of union
 workers: it does not include additional tens of millions of dollars in health insurance and pension
 contributions, nor does it factor in the indirect economic benefits to a region resulting from increased
 spending in the community (i.e., the "multiplier effect.")
- The pharmaceutical and biotech industry has helped create a financially self-sufficient pipeline of skilled labor in the construction industry. Union apprenticeship programs are largely funded by per-hour contributions by active tradespeople. Assuming conservative estimates of 22.3 million union labor hours and a contribution of \$0.30 per hour, the pharmaceutical and biotech industry was responsible for a minimum of \$6.7 million in funding for union apprenticeship programs in these 14 states between 2015 and 2020. These funds promote a pathway to the middle-class for blue-collar workers while strengthening a region's workforce development, all without a nickel of student debt or a dime of taxpayer money.

The development of safe and effective COVID-19 vaccines was a breakthrough in public health and once again revealed the United States as a global leader when it comes to science and medicine. While much of the credit goes to scientists and researchers responsible for life-saving and life-enhancing innovations, such breakthroughs are also made possible by the country's world-class research, development and manufacturing facilities. While the government supports many projects, a considerable amount of America's state-of-the-art science and medical infrastructure is the result of billions of dollars of private-sector investment and the unique partnership between the pharmaceutical and biotech industry and the highly-skilled tradespeople of America's construction unions.



AN ANALYSIS OF CONSTRUCTION SPENDING IN THE PHARMACEUTICAL & BIOTECH INDUSTRY, 2015-20

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INTRODUCTION

The coronavirus pandemic has had devastating and heart-breaking effects on millions of families, torn apart communities, and brought societies to a standstill around the world. Pandemics, unfortunately, have long been a part of the human experience. This is what has made the research, testing, and manufacture of safe and effective COVID-19 vaccines—all within 12 months from the onset of the pandemic—such an extraordinary achievement in public health. Pharmaceutical and biotech companies in the United States were at the forefront of global efforts to develop vaccines, but they were hardly starting from scratch: the rapid development of COVID-19 vaccines was directly built upon years of innovation and research by this country's medical and scientific community.

The leadership of American companies and scientists should come as no surprise, as the United States has long been renowned for the prowess of its medical community in developing life-saving and life-enhancing breakthroughs. But the success of the American pharmaceutical and biotech industry—and the development of COVID-19 vaccines in particular—has always been dependent on more than the knowledge and skills of scientists: it is also the result of world-class research facilities, laboratories and manufacturing plants.

Developing state-of-the-art pharmaceutical and biotech facilities in the United States relies on a number of critical elements. While state and federal governments provide support, the private sector independently invests billions of dollars annually in pharmaceutical and biotech infrastructure. But none of this money would be sufficient without skilled construction tradespeople who are capable of building and maintaining high-tech facilities that meet exacting standards. This has led to a unique partnership between the pharmaceutical and biotech industry and the highly-skilled construction workers of North America's Building Trades Unions.

The partnership between America's pharmaceutical and biotech industry and the construction unions has been important for industry growth for decades, but it took on new meaning during the pandemic. Skilled construction trades people were integral in retrofitting facilities—such as Pfizer's plant in Kalamazoo, Mich.—that were vital in the development and manufacture of COVID-19 vaccines. The capability of skilled tradespeople is due, in part, to the union sector's long-established—and highly effective—apprenticeship programs. These training initiatives have developed the country's most educated, skilled and experienced construction labor force, one that is capable of meeting the high-tech construction demands required of building world-class medical and science facilities on a timeline necessary to curtail a global pandemic.

Beyond its importance for public health, the long-standing partnership between the pharmaceutical and biotech industry and construction unions has also had enormous economic benefits for local workers, families, and communities. The employment of union construction workers provides good jobs for thousands of local residents, including family-supporting wages, health insurance, and pension benefits. The decision to hire union workers and contractors also sustains skilled craft worker training and apprenticeship programs, strengthening workforce development for a region while promoting a pathway to the middle class for its blue-collar workers. All of this is done without a nickel of student debt or a dime of taxpayers' money.

To demonstrate the impact that the pharmaceutical and biotech industry has on the construction labor market—and regional economies as a whole—this report will examine privately-funded construction on major research, manufacturing, and distribution projects (\$5+ million) for 14 states between 2015 and 2020 (CA, CT, CO, DE IL, MA, MD, MI, NJ, NY, OH, OR, PA and WA). The states included in this report were selected by the Pharmaceutical Industry Labor-Management Association (PILMA), a coalition of labor organizations and companies in the pharmaceutical industry with dual goals of fostering medical innovation and promoting high-quality construction jobs.

This report relies almost exclusively on data from Industrial Information Resources (IIR), a well-respected global consulting firm specializing in market data on major power, energy, and industrial infrastructure projects in the United States. This report will first identify major private-sector projects in each state and present IIR estimates of total industry construction spending and labor demand. In order to focus on private-sector investment in the infrastructure needed for pharmaceutical and biotech advancement, the projects included in this study intentionally feature a narrow focus: this study excludes government-sponsored projects, office buildings, hospitals, testing labs, and facilities producing supplements or cannabis. After detailing the included projects and overall spending in each state, this study will examine the pharmaceutical and biotech's impact on construction employment across 14 trades and union status between 2015 and 2020, including its financial support for union construction apprenticeship programs.

MAJOR CONSTRUCTION PROJECTS

In the 14 states selected for this study, Industrial Information Resources identified 447 major, privatelyfunded construction projects (\$5+ million valuations) in the pharmaceutical and biotech sector that were active at any point between 2015 and 2020.¹ Combined, these projects represent \$23.6 billion in capital investment in these 14 states over a six-year period. As outlined in Table 1, the pharmaceutical and biotech industry has made significant infrastructure investments in every state included in this study. Between 2015 and 2020, half of the states analyzed in this study experienced over \$1 billion in new construction on pharmaceutical and biotech production facilities. This was led by Massachusetts (95 projects, \$5.9 billion valuation) and California (107, \$5.7 billion) but even the state with the least amount-Connecticut—experienced \$228 million worth of private investment.

An analysis of the largest (\$100+ million) privately-funded pharmaceutical and biotech construction projects active between 2015 and 2020 reveal similar trends as above. First, investment is widespread across the country: there was at least one project of \$200+ million in eight states, with a \$100+ million project in 13 of the 14 states included in this study (excluding Washington). A vast majority of the highest-valued projects active between 2015 and 2020 were concentrated in five states: Massachusetts, California, Pennsylvania, New York and Illinois. This is reflected in Table 2, which lists all construction projects of \$300+ million active in these 14 states between 2015 and 2020. Led by a \$1.1 billion project outside of Philadelphia for the Center for Breakthrough Medicine, the 13 largest projects were located in these five states; altogether, these states accounted for 30 of the 33 largest privatesector pharmaceutical and biotech construction projects identified in this study.

Table 1. Number of Major Projects andTotal Investment Value, by State, 2015-20

State	# of Projects	Total Valuation
Massachusetts	95	\$5,877,150,000
California	107	\$5,680,000,000
Pennsylvania	48	\$3,000,400,000
New York	41	^{\$} 2,076,300,000
Maryland	30	\$1,561,000,000
Illinois	11	^{\$} 1,490,000,000
New Jersey	35	\$1,169,500,000
Ohio	19	^{\$} 710,500,000
Michigan	15	^{\$} 449,600,000
Oregon	5	\$360,700,000
Colorado	9	\$360,000,000
Washington	17	\$345,000,000
Delaware	4	\$338,000,000
Connecticut	11	\$228,000,000
TOTAL	447	^{\$} 23,646,150,000

Source: Industrial Information Resources. Total investment value included for any major construction project (\$5+ million TIV) active between 2015 and 2020.

¹ These 447 construction projects occurred at 315 different sites, as Industrial Information Resources records distinct construction projects separately. For example, IIR reports four different construction projects at Pfizer's location in Kalamazoo, Mich., that were active between 2015 and 2020: a 2014-15 plant expansion, a 2016-17 warehouse addition, a 2016-19 plant expansion, and the 2020 COVID-19 vaccine production addition.

Table 2. Pharmaceutical and Biotech Construction Projects,\$300+ Million Construction Value, Active Between 2015 and 2020

Owner	City	State	Active	Value (in \$ million)
Center For Breakthrough Medicines King of Prussia Brownfield Multi-Phase Plasmid DNA/Vi	King of Prussia ral Vector/Cell Bank CDMO	PA	2020-22	\$1,100.0
Novartis Institutes for Biomedical Research Cambridge Vaccine and Diagnostics R&D Center Expans	Cambridge sion	MA	2012-15	\$600.0
CSL Behring LLC Bradley (Kankakee-N. Campus) Protein Biotherapeutics	Bradley Bld 33 3-Fl Fit-Out (BFX8)	IL	2018-21	\$550.0
Gilead Sciences Incorporated La Verne Grassroot Sterile Intravenous Therapeutics Pla	La Verne nt	CA	2015-17	\$500.0
Regeneron Pharmaceuticals Incorporated	Rensselaer	NY	2019-21	\$400.0
Sanofi Genzyme Corporation	Cambridge	MA	2019-21	\$400.0
Regeneron Pharmaceuticals Incorporated	Rensselaer	NY	2019-21	\$375.0
CSL Behring LLC	Bradley	IL	2019-24	\$350.0
Bristol-Myers Squibb Company	Devens	MA	2020-23	\$350.0
Merck and Company Incorporated	West Point	PA	2013-16	\$300.0
Gilead Sciences Incorporated	Foster City	CA	2016-20	\$300.0
Athenex Incorporated	Dunkirk	CA	2018-21	\$300.0
Foundation Medicine Incorporated	Boston	MA	2020-23	\$300.0
Source: Industrial Information Resources				

The amount of investment in these states is not surprising given the pharmaceutical and industry is especially concentrated in major metropolitan areas. This is best reflected by Figure 1, which demonstrates the substantial construction activity in the pharmaceutical and biotech industry in the Northeast Corridor—stretching from Washington, D.C., to Boston—between 2015 and 2020. A similar concentration appears in an analysis of California, with considerable activity in the Bay Area and Greater Los Angeles.

Although the largest private-sector construction projects were concentrated in a few states in 2015 through 2020, that is expected to change starting in 2021. IIR's database highlights that many of the largest pharmaceutical and biotech construction projects over the next five years will take place in Michigan, Colorado and Washington. This includes a \$465 million addition by Pfizer in Kalamazoo, Mich., that has already broken ground; a planned \$300 million expansion by Seagen in Bothell, Wash.; and three proposed renovation projects totaling \$450 million by Agilent Technologies in Frederick, Colo. In sum, data from IIR suggests that privatesector investment in pharmaceutical and biotech infrastructure is likely to be more geographically widespread in 2021 and beyond.



CONSTRUCTION SPENDING

The preceding analysis of major projects active at any point between 2015 and 2020 offers an incomplete analysis of private-sector construction spending on research, manufacturing and distribution infrastructure by the pharmaceutical and biotech industry during this sixyear period. First, this ignores the scores of construction projects that fell below the \$5 million threshold. The pharmaceutical and biotech industry requires extensive construction work to annually maintain, repair and overhaul existing facilities; while some of these projects exceed \$5 million, many others do not. Second, some of the projects outlined in the above analysis featured construction that started before 2015 or will finish after 2020. Finally, while IIR is widely recognized as an industry leader in construction data, it recognizes that its extensive database may not account for every possible project. As a result, the section below addresses these concerns by offering IIR's "topline" construction spending estimateswhich includes small projects, adds adjustments to account for unreported projects, and isolates spending on an annual basis—for the pharmaceutical and biotech industry for each of the 14 states included in this study.

Figure 2. Annual Construction Spending (in \$ billions), Pharmaceutical and Biotech Industry, 14 States, 2015-2020



Source: Industrial Information Resources

Overall, the pharmaceutical and biotech industry is estimated by IIR to have invested \$29.0 billion in construction costs in building, renovating and maintaining private-sector production facilities in these 14 states between 2015 and 2020.² As outlined in Figure 2, the rate of private-sector investment increased annually in this six-year period, reaching \$6.11 billion in 2020. It is compelling that the most significant spike in pharmaceutical and biotech construction occurred in 2019, effectively predating the COVID-19 pandemic. Further, the last two years has featured substantial increases in capital expenditures, rising to \$4.86 billion in 2020. This surge in private-sector investment in the United States does not appear to be temporary. Projections from Industrial Information Resources suggest that private-sector pharmaceutical and biotech construction investment will increase to \$6.51 billion in 2021 and will remain well above \$5 billion annually through 2025.³

Table 3. Annual Construction Spending (in \$ millions), Pharmaceutical and Biotech Industry, by State, 2015-20							
State	2015	2016	2017	2018	2019	2020	TOTAL
California	\$1,029.0	^{\$} 1,307.7	^{\$} 1,266.8	^{\$} 1,309.5	^{\$} 1,308.3	^{\$} 1,162.2	^{\$} 7,383.5
Massachusetts	^{\$} 776.0	^{\$} 703.1	^{\$} 739.4	^{\$} 711.6	\$907.1	^{\$} 1,065.6	\$4,902.8
Pennsylvania	^{\$} 427.3	^{\$} 533.0	^{\$} 417.8	\$481.5	^{\$} 574.9	^{\$} 1,152.4	\$3,587.0
New York	\$332.1	^{\$} 281.1	\$359.6	\$480.3	\$744.2	\$735.3	\$2,932.5
New Jersey	\$371.6	\$365.8	\$ 370.1	^{\$} 423.0	^{\$} 571.0	^{\$} 473.5	\$2,575.0
Maryland	^{\$} 184.0	^{\$} 246.2	\$339.5	\$369.5	\$236.2	\$323.2	^{\$} 1,698.6
Illinois	^{\$} 202.8	^{\$} 180.2	^{\$} 189.9	^{\$} 194.0	\$371.6	^{\$} 410.8	^{\$} 1,549.4
Michigan	^{\$} 194.7	^{\$} 148.8	^{\$} 233.5	^{\$} 173.8	^{\$} 187.2	^{\$} 179.3	^{\$} 1,117.2
Ohio	^{\$} 122.0	^{\$} 121.6	^{\$} 233.5	^{\$} 277.4	^{\$} 265.0	^{\$} 124.8	^{\$} 1,056.6
Colorado	^{\$} 48.3	\$70.5	^{\$} 136.6	^{\$} 97.3	^{\$} 103.1	^{\$} 71.9	^{\$} 527.7
Washington	^{\$} 47.2	^{\$} 47.7	^{\$} 55.7	^{\$} 42.7	\$86.9	^{\$} 165.0	^{\$} 445.1
Connecticut	^{\$} 128.1	^{\$} 63.9	^{\$} 52.7	^{\$} 62.3	^{\$} 61.0	^{\$} 67.6	^{\$} 435.7
Oregon	^{\$} 17.7	^{\$} 66.4	^{\$} 88.5	^{\$} 35.5	^{\$} 81.7	^{\$} 117.8	^{\$} 407.6
Delaware	\$40.0	\$48.9	^{\$} 28.6	\$96.3	^{\$} 102.3	^{\$} 61.2	^{\$} 377.3
TOTAL	\$ 3,920. 9	^{\$} 4,184.9	^{\$} 4,424.4	^{\$} 4,754.8	^{\$} 5,600.4	^{\$} 6,110.5	\$28,995.9

Source: Industrial Information Resources

² After receiving the data from Industrial Information Resources, it was discovered that one project in New Jersey–a \$61.5 million distribution center completed between January 2013 and March 2015—was mistakenly included in the sample despite not meeting the specifications established in this study. This project was subsequently deleted from the calculations highlighting the number of projects and the value of these major projects in Table 1. However, the data format does not allow for the simple subtraction of this project's contributions to construction spending and employment estimates; as a result, the total spending and employment projections for New Jersey for 2015 include this project and are likely slightly inflated from its actual total. It is not expected that any such inflation would be significant given that (a) the project is not among the top 100 most expensive projects in the study and (b) most of the construction spending and employment likely occurred in 2013 and 2014—outside the scope of this study—as the project was only active for three months of 2015.

³ Long-term projections by Industrial Information Resources are based, in part, on planned future construction projects in IIR's database. As a result, it is possible that five-year projections may underestimate the amount of spending that will occur in the future given that some of the projects that will be built in the latter years of this time period have yet to be proposed or announced.

To analyze these data on a state-by-state basis, Table 3 details the annual construction spending by the pharmaceutical and biotech industry on private-sector projects for the 14 states included in this study between 2015 and 2020. While generally consistent with state rankings of major project activity identified earlier, Table 3 demonstrates significant concentration of construction spending on production facilities in five states—California, Massachusetts, Pennsylvania, New York and New Jersey—which all exceeded \$2.5 billion in investment over the six years studied. Despite not having many \$200+ million capital projects active between 2015 and 2020, New Jersey's position in the top five is the result of a substantial amount of maintenance and repair expenditure (\$1.2 billion) of existing facilities in the state, third-most among the 14 states in the sample. Maintenance and repair costs also explains California's top-ranked position in Table 3, as the state's pharmaceutical and biotech industry spent \$2.1 billion on this form of construction investment between 2015 and 2020, the most of any state addressed in this study. In contrast, maintenance and repair costs were relatively lower in Massachusetts, Illinois, and Maryland, where a substantially larger proportion of private-sector investment was devoted to building new facilities, additions and expansions.⁴

The results from Table 3 also highlight that the year-overyear growth in private-sector infrastructure investment between 2015 and 2020 has benefited nearly every state analyzed in this study. Among states already featuring a substantial pharmaceutical and biotech presence, investment growth appears especially strong in Pennsylvania, New York, Massachusetts and Illinois: each state had well over \$200 million more in construction spending in 2020 than it did in 2015. But on a percentage basis, Table 3 highlights the Pacific Northwest as a rapidlyemerging market for pharmaceutical and biotech R&D and manufacturing with both Oregon (566% increase in spending from 2015 to 2020) and Washington (249% increase) exhibiting the highest rates of growth among the 14 states identified in this study. Over the next five years, Washington and other states-including Colorado, Michigan, Ohio, Connecticut, and New Jersey-are projected by IIR to exhibit substantial increases in construction spending from their 2020 levels.

CONSTRUCTION EMPLOYMENT & EARNINGS

The pharmaceutical and biotech industry invests billions of dollars annually to build and renovate the production facilities necessary to research, develop, and manufacture life-saving and life-enhancing medical treatments. In addition to the public health benefits of such privatesector investment, this infrastructure has substantial economic benefits. Not only does the industry directly employ hundreds of thousands of employees in goodpaying jobs across the country, but investment by the pharmaceutical and biotech sector also annually supports thousands of good jobs in America's construction industry.

Table 4. Construction Labor Hours Demanded, Pharmaceutical and Biotech Industry, by Trade, 2015-20

Trade	Labor Hours
Boilermaker	721,132
Carpenter	3,905,009
Electrician	18,500,137
HVAC Installers	1,355,479
Instrumentation Tech	9,759,123
Insulator	1,639,850
Ironworker	2,786,959
Laborer	3,053,034
Millwright	3,688,846
Operator	3,254,005
Painting	886,173
Plumber + Pipefitter	5,890,367
Scaffolding	1,252,550
Welder	1,965,369
TOTAL	58,658,033

Source: Industrial Information Resources

⁴ While total construction spending between 2015 and 2020 (Table 3) exceeds the value of major projects active at any point between 2015 and 2020 (Table 1) for 13 of the 14 states, this is not true for Massachusetts. This is due to two reasons. Most importantly, the five largest projects in Massachusetts—worth a combined \$1.9 billion—were either completed in 2015 or were started in late 2019 or in 2020. In other words, for these projects and many others, the actual construction spending on these projects occurred before 2015 or will occur after 2020 (i.e., outside the time frame of this study). A second issue arises in that IIR uses a statistical algorithm to estimate annual spending that considers the possibility that some projects may not be completed on time, thus potentially falling outside the time period studied in this analysis. Similar issues occur in other states, but the net effect appears strongest in Massachusetts.

As described in the preceding section, the pharmaceutical and biotech industry spent \$29.0 billion on construction between 2015 and 2020 in the 14 states analyzed in this study. As estimated by Industrial Information Resources and presented in Table 4, this equates to 58.7 million construction labor hours across 14 trades, with electricians, instrumentation techs, and plumbers and pipefitters accounting for nearly 60% of that total. Substantial employment also occurred among carpenters, millwrights, operating engineers, laborers, and ironworkers, as pharmaceutical and biotech industry construction accounted for more than 2.5 million labor hours in each of those trades across the 14 states included in this study between 2015 and 2020.



Figure 3. Annual Construction Labor Hours Demanded,

Source: Industrial Information Resources

As presented in Figure 3, the trend in annual hours across the 14 states mirrors that of construction spending between 2015 and 2020. IIR data suggest that construction employment on pharmaceutical and biotech projects has increased every year, rising from 7.96 million labor hours in 2015 to 12.31 million labor hours in 2020. The sharp increase in employment by the pharmaceutical and biotech industry in 2020 is especially notable given that many other industries in the United States experienced substantial declines in employment opportunities during the pandemic. Assuming a 2,000hour work year, the totals from 2020 suggest that the pharmaceutical and biotech sector employed 6,157 fulltime construction workers across these 14 states last year.

For perspective on these 58.7 million construction labor hours demanded between 2015 and 2020, it is important to recall that the exacting specifications of cutting-edge science and medical facilities require the employment of the construction industry's most skilled and experienced workers. As a result, the pharmaceutical and biotech industry often chooses union contractors and workers given the advantages wrought by the union sector's long-established—and highly effective—training and apprenticeship programs. The decision to hire union labor only amplifies the economic benefit of infrastructure investment for a local community. Union construction work represents a "good" job featuring family-supporting hourly wages, health and pension benefits, and a commitment to workplace safety. In sum, many of the construction jobs created by the pharmaceutical and biotech industry are not just any jobs: these are the types of middle-class jobs that have long represented the backbone of American families and communities.

While union construction workers are known to comprise a substantial portion of the 58.7 million labor hours identified in this study, isolating an exact number is complicated by the fact that Industrial Information Resources does not sufficiently distinguish between union and non-union projects or labor hours. To compensate, this study offers conservative, lower-bound estimates of the amount of union labor on pharmaceutical and biotech industry construction projects; these are presented in Table 5. These estimates are generated by multiplying the number of labor hours required in each of the 14 states between 2015 and 2020 by an estimate of the union density in each state's non-residential construction sector. The results suggest that the pharmaceutical and biotech industry required, at minimum, 22.3 million hours of union construction workers to build and renovate manufacturing facilities between 2015 and 2020.⁵

The conservative, lower-bound nature of these projections derives from the use of the statewide estimates of union density in the non-residential construction market. It is expected that union activity would be significantly more concentrated in highly technical areas of construction—such as pharmaceutical and biotech facilities—than it is in other parts of the non-residential market (e.g., big-box retail stores, low-rise office buildings). Thus, while non-residential union densities may be the best available metric to measure union involvement in each state, the results offered in Table 5 likely undercount the actual contribution of union contractors and workers to pharmaceutical and biotech construction in the 14 states included in this study.

⁵ State-wide union densities in non-residential construction are developed in two steps. First, the research site, unionstats.com, provides state-bystate annual estimates of the number of private-sector union construction workers in 2015 through 2019 via an analysis of the Census Bureau's Current Population Survey. These numbers are then divided by the total number of employees of private-sector non-residential construction employers in each year using data from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (2020 was excluded because QCEW data for that year was unavailable at the time of this report). These annual numbers are then averaged over the years available to produce an overall state union density rate. While this is the best available statistical approach in the absence of explicit residential/non-residential breakdown of union membership in construction by either the Census or BLS, it is recognized that this method implicitly assumes that union density in residential construction equals zero. Although it is well accepted that union density in residential construction is indeed minimal, any concerns that this state-level projection overinflates union rates in nonresidential construction are more than offset by the fact that construction in the pharmaceutical and biotech industry is likely to be substantially higher than the non-residential construction rate as a whole (which also includes such projects as office buildings, retail spaces, restaurants, etc.).

UNION CONSTRUCTION EARNINGS

By hiring union construction workers, the pharmaceutical and biotech industry is directly responsible for creating and promoting the types of blue-collar middleclass jobs that have long represented the backbone of many communities throughout the United States. These employment opportunities feature family-supporting wages, health insurance, retirement benefits and all the other hallmarks of a "good" job. This work not only brings economic and personal security to workers and their families, it also adds hundreds of millions of dollars to regional economies and promote high labor standards in local construction markets.

To assess the economic impact of these "good" jobs, Table 6 presents stateby-state estimates of the total wages paid to union Table 5. Total Hours and Estimated Union Hours, Pharmaceuticaland Biotech Industry Construction, by State, 2015-20

State	Total Hours	State Union %	Estimated Union Hours
California	14,928,082	37.9%	5,655,387
Colorado	1,067,607	18.7%	199,655
Connecticut	890,947	32.8%	292,113
Delaware	761,238	29.1%	221,672
Illinois	3,127,123	61.7%	1,929,249
Maryland	3,427,680	17.5%	598,832
Massachusetts	9,872,787	28.4%	2,803,186
Michigan	2,276,288	39.8%	906,850
New Jersey	5,243,687	48.9%	2,563,414
New York	5,932,976	52.1%	3,090,661
Ohio	2,144,427	32.8%	702,648
Oregon	819,316	32.0%	262,175
Pennsylvania	7,266,056	37.8%	2,749,716
Washington	899,817	40.3%	362,665
TOTAL	58,658,033		22,338,223

Source: Industrial Information Resources, Current Population Survey, Quarterly Census of Employment and Wages

construction workers while working on pharmaceutical and biotech projects between 2015 and 2020. These projections are calculated by multiplying the number of union construction hours from the previous section by the average union construction wage in each state across the six-year period of this study.⁶ The results indicate that the industry was responsible for at least \$774.2 million in union construction wages across the 14 states over the six-year period identified in this study. This was led by California, where the pharmaceutical and biotech industry was responsible for nearly \$200 million in wages to union construction workers. And there are reasons to suspect that the results in Table 6 considerably underrepresent the true economic impact. In addition to these calculations being based on conservative estimates of union labor hours (Table 5), the values offered in Table 6 do not include the hundreds of millions of dollars in health and retirement benefits paid to workers or the indirect economic benefits that derive to local communities as a result of increased spending power by these workers (i.e., the "multiplier effect").7

Table 6. Estimated Union Earnings, Pharmaceutical and Biotech Industry Construction, by State, 2015-20

State	Estimated Union Earnings
California	\$198,843,393
Colorado	\$5,434,598
Connecticut	\$9,718,594
Delaware	\$6,472,823
Illinois	\$71,787,348
Maryland	\$19,024,904
Massachusetts	\$102,456,455
Michigan	\$25,409,944
New Jersey	\$94,308,010
New York	\$112,469,159
Ohio	\$20,271,385
Oregon	\$9,304,598
Pennsylvania	\$85,488,658
Washington	\$13,237,288
TOTAL	\$774,227,156

Source: Industrial Information Resources, Current Population Survey

⁶ The average union construction wage by state was calculated via an analysis of the 2015-2020 Current Population Survey.

⁷ There are two additional methodological reasons to suspect the totals in Table 6 underrepresent the true economic impact. First, this study assumes that each hour is paid at the average rate. However, this likely ignores a considerable amount of overtime pay that would be at a higher rate of pay. Second, due to sample size issues in the Current Population Survey, this study bases its calculations on the average union wage across a state's entire construction industry. This likely underrepresents the true wage on these projects given that the results of Table 4 demonstrated that employment is especially concentrated among some of the highest-paying trades in the in the industry (e.g., electricians, plumbers).

APPRENTICESHIP PROGRAMS AND FUNDING

The economic benefits of the employment of union construction workers goes beyond good wages, health insurance coverage, and increased regional spending: it also promotes the growth and sustainability of union apprenticeship programs. These programs are among the most successful and long-standing apprenticeship systems in the United States, allowing enrollees to "earn while they learn": apprentices develop skills while working on a job site during the day and supplement their training with classroom learning in the evening. While union construction apprenticeship programs have been around for generations, their importance to America's working families and the communities in which they live is at an all-time high. As economic opportunities for blue-collar workers in other industries have deteriorated, union construction apprenticeship programs are one of the few remaining pathways to the middle class for workers without a four-year college degree. From a public policy perspective, there is no downside to supporting these workforce development programs: union construction apprenticeships provide workers with important education and training opportunities without imposing a nickel of student debt or requiring a dime of taxpayer money. Instead, programs in this sector are funded by union workers diverting a portion of their hourly compensation to support union apprenticeship training and the next generation of skilled tradespeople.

To estimate the financial impact of the pharmaceutical and biotech industry on union construction apprenticeship programs via these per-hour contributions, the data in Table 5 suggests that the sector required a minimum of 22.3 million labor hours by union workers in a 14-state area between 2015 and 2020. While worker contributions to apprenticeship programs differ across trades and locals, a conservative estimate of \$0.30 per union labor hour would suggest that infrastructure investment by the pharmaceutical and biotech industry delivered at least \$6.7 million to union apprenticeship programs in these states in this six-year period. This is a conservative estimate given that the number of union labor hours is a lower-bound projection. But this number undervalues the importance of the pharmaceutical and biotech companies to apprenticeships for another reason: the industry has been the training ground for generations of apprentices across the country, with a steady volume of employment opportunities for workers to earn a paycheck while developing their skills on the jobsite.

In essence, the partnership between the pharmaceutical and biotech industry and America's construction unions has contributed to a financially self-sufficient pipeline of skilled tradespeople who are capable of building world-class research and manufacturing facilities that are critical engines of economic growth in this country. The opportunities offered by the pharmaceutical and biotech industry strengthen a region's workforce development program by creating the construction jobs that represent the backbone of long-standing, well-regarded apprenticeship programs. In doing so, the industry is intrinsically supporting one of the few remaining pathways to the middle-class for millions of non-college educated men and women across the country: the skilled construction trades. In sum, the partnership between industry and labor has produced a virtuous cycle that simultaneously uplifts workers, regional economies, and public health around the world.



CONCLUSION

The development of safe and effective COVID-19 vaccines within 12 months was a breakthrough moment in modern medicine. These efforts were led by U.S.-based companies and scientists operating in world-class research, development and manufacturing facilities. As outlined in this study, private-sector investment in pharmaceutical and biotech infrastructure long predates the pandemic and is what helped the United States to be at the forefront of global efforts to curtail the personal and societal effects of the coronavirus. This report highlights that there were \$29.0 billion in private-sector construction between 2015 and 2020 across the 14 states identified by the Pharmaceutical Industry Labor-Management Association. This includes 447 major (\$5+ million), privately-funded construction projects active at any point in this six-year period, representing \$23.6 billion in investment in research, development, and manufacturing facilities according to data from Industrial Information Resources.

The infrastructure investments made by the pharmaceutical and biotech industry benefit—and are largely reliant on the sector's unique partnership with the highly-skilled construction workers of North America's Building Trades Unions. Building cutting-edge medical and science facilities require the most educated, skilled, and experienced construction labor force. Because of this, the pharmaceutical and biotech industry has come to rely on union workers and contractors to meet their high-tech construction standards. Reliable construction demand by the pharmaceutical and biotech industry helps keep union tradespeople employed and apprenticeship programs thriving. As outlined in this study, the sector required over 58 million labor hours in the last six years, or the equivalent of 6,157 full-time construction workers in 2020. Union workers comprised a significant portion of the labor force used to build these world-class facilities, with projections suggesting that the pharmaceutical and biotech sector required a minimum of 22 million labor hours of union construction workers across these 14 states and paid out at least \$774 million in wages. In sum, private-sector investment by the pharmaceutical and biotech industry has helped sustain the types of "good" middle-class blue-collar jobs that have long represented the economic and social backbone of families and communities across the country.

