

Economic Impact of the Biopharmaceutical Sector on New York State

Executive Summary
Report

Prepared by:
Archstone Consulting LLC
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Executive Summary

As the current economic environment takes its toll on the economy; its companies, their earnings, employment, and tax revenues; New York state should identify and support the sectors and industries that are relatively stable and offer long-term growth potential. The biopharmaceutical industry and the industries that support it - such as health care providers and construction, among others - are examples of those stable industries and are important for the future of New York.

Key Facts about the Biopharmaceutical Sector in New York State

All data from 2006 unless otherwise noted.

- **Total Employment** – The biopharmaceutical industry directly employs **55,446** people and is responsible for a total of **130,464** jobs, of which **16,885** are union jobs in New York. Of those directly employed, **13,189** work for manufacturing organizations (which includes biopharmaceutical companies that both conduct research and manufacture products), and the remaining **42,257** work for research organizations. Employment in biopharmaceutical employment grew at **1.8%** from 1996-2006, against 0.8% for all other sectors in the state. The biopharmaceutical industry is responsible for **1.2%** of total employment in New York.
- **Top Professions / Occupations** – Top occupations are Life, Physical and Social Science Occupations

(such as technicians, research assistants, and scientists), Office and Administrative Support Occupations (such as administrative assistants and office managers), and Production Occupations (such as technicians, factory managers, and assemblers).

- **Total Output** – The biopharmaceutical industry generated **\$29.1 billion** in total output, of which **\$16.0 billion** was generated from direct employment. New York State is responsible for **6.8%** of all direct biopharmaceutical output nationally.
- **Tax Revenue Generated** – The industry was responsible for **\$845.6 million** in federal and social security taxes and **\$121.0 million** in state taxes paid due to direct employment.
- **Wages Paid** – The biopharmaceutical industry paid **\$3.8 billion** in wages to direct employees in 2006
- **Clinical Trials in State** – In 2008, New York was second in the nation with **5,053** clinical trial sites in the state. Additionally, New York shows its broad medical strength with high numbers of trials being performed for all **9** conditions studied.
- **Top Regions** - The top regions in the state for total employment are **New York City, Long Island** and **Westchester**. The regions that have the best “clustering” effect are **Long Island, Rochester** and **Westchester**.

Nationally, New York ranks as one of the top states across all measures of biopharmaceutical sector performance. It has exceptional strength in its research activities, primarily due to numerous, high-quality research universities and medical centers. However, New York lags other “high performing” states in the manufacturing side of the biopharmaceutical industry, which is dominated by companies which develop and manufacture drugs. This is an important area for growth, as it is responsible for higher wages than the research side and therefore provides greater potential contribution to the state economy. Supporting the commercialization of the basic research performed in New York could lead to an increase of in-state biopharmaceutical manufacturing companies, which in turn could provide growth of employment and output for the state of New York.

From 1996 – 2006, the biopharmaceutical sector grew along all measures – direct employment, total employment, output, and new medicines brought to market. New York State moved from third in direct employment to second nationally; however, its biopharmaceutical employment growth rate lagged the national average, 3.1% to 1.8%. Yet biopharmaceutical employment growth outpaced growth in all other sectors in New York State, 1.8% compared to 0.8%. The biopharmaceutical sector in New York should be seen as a growth area with untapped potential, given the balance of research resources and growth opportunities.

Since 2006, the biopharmaceutical industry has faced increasingly difficult challenges. As one of the most research intensive industries, the cost of bringing a new drug to market has increased from \$800 million in 2002 to over \$1.2 billion as of 2007ⁱ. Yet from 1997 to 2006, the number of new chemical entities approved fell from 47 to 2ⁱⁱ. Putting additional pressure on biopharmaceutical revenue is the patent expiration of many “blockbuster” drugs and the increasing use of generics by many managed care organizations to control overall health care costs. To date, the biopharmaceutical industry has reacted to these forces primarily through cost containment activities, such as sales force reductions. Increasingly, cost containment exercises

have also included reductions in R&D programs and investments – historically the source of new biopharmaceutical products. To supplement their pipelines, larger biopharmaceutical companies are looking to acquire in-progress compounds through licensing, acquisitions, and mergers; leading to increasing consolidation in the industry. In 2009, biopharmaceutical companies may need to evaluate their current business models, improve their capability to innovate and launch products more frequently and successfully, all while managing their overall costs.

The impact for New York State’s development of biopharmaceutical clusters includes both opportunities

and threats. For example, supporting the commercialization of innovative research will help the industry replenish its product pipelines, though acquisition of such biopharmaceutical start-ups may lead to job loss.

While the biopharmaceutical industry is not immune to macroeconomic conditions, it is an industry that will continue to see demand for its research and products, especially as the population of the United States and other developed countries ages and as the middle class grows worldwide. To that end, supporting the biopharmaceutical industry is important for New York’s economic future.

Introduction

The purpose of this report is to highlight the benefits of the biopharmaceutical sector on the state of New York, both at the state level and for nine key regions. It also identifies the economic impact of various policies and investments on the employment rate and output of the biopharmaceutical sector. This report will be used by the sponsoring organizations to drive policy arguments and investment recommendations for New York. The goal is to form a coalition for growth strategies for the development of biopharmaceutical clusters.

The health care industry is one of the largest industries in the U.S. and is composed of several sectors — including, but not limited to: biopharmaceuticals, medical devices, and health care services. This study focuses on the biopharmaceutical sector, which comprises the extensive and diverse group of companies that research and manufacture medications. Biopharmaceutical companies range in size from small start-up research firms to multi-national multi-billion dollar corporations, and focus on the discovery, development, testing, production, and commercialization

of new medical treatments. For the purposes of this report, the biopharmaceutical sector includes companies in the following sub-sectors: medicinal botanical manufacturing, pharmaceutical preparation manufacturing, in-vitro diagnostic substance manufacturing, biological product manufacturing, life sciences research, and biotechnology researchⁱⁱⁱ.

The data in this report spans from 1996 – 2006, the last year for which data was available. The biopharmaceutical industry has been performing well over that time frame compared to the economy as a whole. Between 1996 and 2006 nationally, employment in the biopharmaceutical sector grew twice as fast as all other sectors combined, 3.1% versus 1.4% compound annual growth rates. Additionally, each direct biopharmaceutical job supported 3.7 other jobs in the economy in 2006, as compared to 2.2 jobs in 1996. During that same time period, the industry was responsible for numerous breakthroughs, including the FDA approval of more than 400 new medicines^{iv}.

From 1999 to 2007, compounds in the development pipeline in the U.S. grew from 1,756 to 2,742 for a compound annual growth rate of 5.7%. However, the number of new entity approvals granted annually fell over that time period, from 47 in 1997 to 27 in 2006^{vi}.

In the state of New York, biopharmaceutical employment also grew, though to a lesser extent than nationally – 1.8% compound annual growth for biopharmaceutical employment compared to 0.8% for all other sectors. In 1996, New York ranked third nationally in direct biopharmaceutical employment, behind California and New Jersey, and had risen to second place by 2006. However, New York State ranked 4th in 2006 in total biopharmaceutical employment, with New Jersey and Pennsylvania passing ahead of New York. This indicates that those two states have a greater clustering effect from direct employment than New York. However, the biopharmaceutical sector in New York should be seen as a growth area, with untapped potential given the balance of research resources and growth opportunities.

Section 1: Macroeconomic Impact of the Biopharmaceutical Sector

The biopharmaceutical sector is an important, stable industry that plays a vital role in the health of the New York state economy. This section will discuss employment and economic output from the biopharmaceutical industry

To assess the economic impact of the biopharmaceutical sector, this report looks at the sector's output. A sector's output is the value of all sales generated by companies in a sector. The total output measurement is comprised of direct, indirect, and induced components. For every one dollar of direct sector contribution to output, indirect and induced dollars are generated by companies that support the biopharmaceutical sector and its employees.^{vii}

For the purposes of this analysis, three types of employment – direct, indirect, and induced - are defined. **Direct** employment measures the number of jobs that exist within biopharmaceutical companies. **Indirect** employment accounts for the jobs that provide goods or services to biopharmaceutical companies. For example, the presence of a biopharmaceutical company in a local economy may indirectly support employment opportunities for accountants and tax professionals whose services are needed by the biopharmaceutical firm. **Induced** employment accounts for the jobs that are supported by the spending patterns of both direct and indirect employees of the biopharmaceutical sector. For

example, induced employment includes the jobs at a local day care facility that may be primarily supported by business from direct and indirect employees of a biopharmaceutical company in the community. Therefore, direct employment has a multiplicative effect that can be represented by how many indirect or induced jobs exist for every one direct job. Total employment represents the sum of all direct, indirect, and induced employment.^{viii}

For this New York report, indirect and induced employment and output are the sum of all in-state activity resulting from in-state jobs. It does not include in-state activity resulting from out-of-state direct employment (i.e., the New York indirect and induced employment resulting from a company in Pennsylvania is not counted.)

State-wide Employment Impact

The biopharmaceutical sector in NY is responsible for 55,446 direct jobs, 38,590 indirect jobs, and 36,428 induced jobs, of which 16,885 of all are union jobs. In comparison to other states in the U.S., New York ranks 2nd in direct biopharmaceutical jobs, behind California, and 4th in total employment^{ix} due to the biopharmaceutical industry; behind California, New Jersey, and Pennsylvania. On a proportional basis, the New York biopharmaceutical sector supports 122 out of every 10,000 in-

state jobs, which ranks New York only 15th on biopharmaceutical job density in the state, 16th if Puerto Rico is included. This indicates that New York State has high total biopharmaceutical employment— but that the industry is responsible for a lower proportion of state jobs than other states.

Nationally, the growth of employment in the biopharmaceutical sector has been faster than overall employment growth, as measured from 1996 – 2006. For the United States as a whole, biopharmaceutical employment grew 3.1% while all other sectors grew 1.4%. In New York, the employment growth rates were lower than the national averages, though the biopharmaceutical sector did grow more than all other sectors combined. The growth rates in New York were 1.8% for the biopharmaceutical sector and 0.8% for all other sectors combined.

The biopharmaceutical industry's direct employment consists of numerous and various occupations. The top three direct occupational groups in New York are **Life, Physical and Social Science Occupations** (such as technicians, research assistants, scientists); **Office and Administrative Support Occupations** (such as administrative assistants and office managers); and **Production Occupations** (such as technicians, factory managers, and assemblers).

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New York State Biopharmaceutical Sector Occupational Profile, 2007

Occupation	Percentage
Life, Physical, and Social Science Occupations	31.2%
Office and Administrative Support Occupations	17.1%
Production Occupations	11.5%
Education, Training, and Library Occupations	6.2%
Management Occupations	6.0%
Architecture and Engineering Occupations	5.6%
Business and Financial Operations Occupations	5.0%
Computer and Mathematical Occupations	4.6%
Healthcare Practitioner and Technical Occupations	2.2%
Installation, Maintenance, and Repair Occupations	2.2%
Transportation and Material Moving Occupations	2.0%
Building and Grounds Cleaning and Maintenance Occupations	1.4%
Community and Social Services Occupations	1.2%
Arts, Design, Entertainment, Sports, and Media Occupations	1.1%
Sales and Related Occupations	1.0%
Healthcare Support Occupations	0.7%
Protective Service Occupations	0.5%
Construction and Extraction Occupations	0.3%
Personal Care and Service Occupations	0.2%
Food Preparation and Serving Related Occupations	0.1%
Legal Occupations	0.0%

For Sales and Related Occupations, the percentage of direct employment reported through this analysis may appear lower than expected, especially in light of the large sales forces pharmaceutical companies employ. A combination of factors, from sales forces being externally contracted to direct sales jobs counted in other occupational codes, such as “education and training” or “life, physical, and social science” occupations, is likely responsible for this result.

This report estimates the occupational employment of the largest group— Life, Physical and Social Science Occupations — into its four sub-groups: Life, Physical and Social Science Technicians, Life Scientists, Physical Scientists, and Social Scientists and Related Workers.

2

Types of Life, Physical & Social Science Occupations in New York State, 2007

Occupation	Percentage
Life, Physical, and Social Science Technicians	39.5%
Life Scientists	26.3%
Physical Scientists	22.5%
Social Scientists and Related Workers	11.7%

employment for \$8.1 billion and induced employment for \$5.0 billion, for a total output of \$29.1 billion. New York ranks fourth in total output, behind California, New Jersey and Pennsylvania. The average direct output per direct biopharmaceutical employee in New York is \$288,182, compared to \$155,443 for all other sectors. In total, New York State is responsible for 6.8% of the nation’s direct biopharmaceutical output.

State-wide Economic Impact

This report measured the economic impact of the biopharmaceutical industry, using the measure of

“output” as described previously. The analysis indicates that direct employment in the biopharmaceutical industry is responsible for \$16.0 billion in economic output, indirect

Regional Impact

For this study, the top nine regional “clusters” were selected for in-depth analysis and comparison. Those regional clusters are:

- **New York City** – includes New York, Bronx, Queens, Kings, and Richmond counties. Home to several large biopharmaceutical companies such as Pfizer, Bristol-Myers Squibb, ImClone/Eli Lilly, Intra-Cellular Therapies, Enzo Biochem, and Alzheimer’s Drug Discovery Foundation, as well as smaller organizations. Includes many prominent research and medical institutions such as Rockefeller University, Columbia University, Memorial Sloan-Kettering Cancer Center, Weill Medical College, and Mount Sinai School of Medicine, among others.
- **Westchester** – includes Westchester and Rockland counties. Includes numerous biopharmaceutical company facilities, such as Barr, Novartis, Wyeth, Regeneron, Acorda Therapeutics, and Aureon Laboratories, in addition to multiple research universities.
- **Long Island** – includes Nassau and Suffolk counties. Includes OSI Pharmaceuticals and Forest Labs in addition to leading research organizations in Cold Spring Harbor Laboratories, SUNY at Stony Brook, and other academic institutions. Several smaller biopharmaceutical facilities are also located on Long Island.
- **Rochester** – includes Monroe county. Includes Vaccinex, and leading educational and research facilities such as the University of Rochester, and numerous medical facilities in the region.
- **Buffalo** – includes Niagara and Erie counties. Includes ZIOpharm, Cleveland Biosciences, and Kinex; in addition to research institutions such as the University of Buffalo Center for Excellence in Bioinformatics and Roswell Park Cancer Center.
- **Syracuse** – includes Onondaga county. Home of locations for Welch Allyn, ConMed, and Bristol-Myers Squibb. Leading educational and research facilities include (Central New York Laboratory Alliance) Central New York Biotechnology Research Center, SUNY Health Sciences Center in Syracuse and Syracuse University.
- **Ithaca** – includes Tompkins county. Vybion, Hybrid Silica and Novomer join leading research universities; led by Cornell University and Ithaca University, as well as medical centers.
- **Capital Region** – includes Albany, Schenectady, Rensselaer, and Saratoga counties. Biopharmaceutical companies include Alban Molecular Research Inc. (AMRI), AngioDynamics, and Taconic. Educational and research facilities include Rensselaer Polytechnic Institute, Albany Medical College, SUNY-Albany, and the Center for Functional Genomics.
- **Binghamton** – includes Broome county. Led by SUNY-Binghamton with both research capabilities and medical facilities.

Regional Employment Impact

The regions in the state of New York with the highest amount of employment due to biopharmaceutical sectors are New York City, Long Island, West Chester one way and the Capital District. Another measure of the “ripple effect” of employment is the amount of additional employment – indirect and induced – that is generated within a given region. The higher the number of indirect and induced jobs for each biopharmaceutical job is a measure of the extent to which a “cluster” has developed. That is to say, assuming that each biopharmaceutical job requires the same number of indirect support from the entire economy, regions that have higher amounts of indirect employment are able to fulfill the necessary support from within their own region, which this report defines as “clustering.”

Biopharmaceutical Employment in New York State, 2006

	Direct	Indirect	Induced	Total
New York State	55,446	38,590	36,428	130,464
New York City	15,862	5,371	4,798	26,031
Buffalo	4,603	3,396	2,798	10,797
Capital District	7,879	3,565	4,958	16,402
Ithaca	271	49	91	410
Long Island	10,265	9,475	6,779	26,518
Rochester	2,434	2,359	1,556	6,349
Syracuse	2,626	2,060	1,543	6,229
Westchester	6,289	5,453	5,317	17,059
Binghamton	426	116	91	634
Rest of State	4,791	6,746	8,497	20,035

While this report highlights 9 key regions within New York State, significant employment occurs throughout the state and in all counties. An example of a key employment center outside of these nine regions is Akrimax's Rouses Point facility in Clinton County; which is responsible for 600 direct employment jobs in biopharmaceutical manufacturing.

Regions in New York with the highest amount of "clustering" are Long Island, Rochester, and Westchester. The three regions with the lowest amount of clustering are New York City, Ithaca and Binghamton. A comparison of the highly clustered regions to the lower clustered ones reveals that highly clustered regions provide a greater amount of employment in wholesale

trade and pharmaceutical/medical manufacturing. That indicates that providing more services along the entire value and supply chain of the biopharmaceutical industry is a good area of focus for future development work and investment to build up biopharmaceutical clusters in many regions within New York. Additionally, highly clustered regions also report a higher proportion of employment services and management of enterprises occupations, which indicates that the region is able to provide skilled workers to support the biopharmaceutical industry.

Additional data on occupational employment by region included in the Appendix.

Regional Economic Impact

This report looks at the economic impact on output of the various regions within New York. The regions with the highest total output from direct, indirect, and induced employment correlate well to those regions with both high overall employment and high "clustering." This shows the importance of biopharmaceutical clusters on the overall New York economy.

Biopharmaceutical Output in New York State, 2006 (in U.S. \$, Millions)

	Direct	Indirect	Induced	Total
New York State	\$15,978.6	\$8,123.5	\$4,973.5	\$29,075.6
New York City	\$2,827.0	\$925.9	\$708.0	\$4,460.9
Buffalo	\$1,081.5	\$542.2	\$304.2	\$1,927.8
Capital District	\$1,350.7	\$477.0	\$566.3	\$2,394.0
Ithaca	\$37.4	\$6.2	\$8.4	\$52.0
Long Island	\$3,758.8	\$1,979.2	\$882.7	\$6,620.7
Rochester	\$916.6	\$419.9	\$170.5	\$1,507.0
Syracuse	\$722.4	\$334.7	\$172.0	\$1,229.1
Westchester	\$3,173.9	\$1,409.4	\$740.1	\$5,323.4
Binghamton	\$35.8	\$10.6	\$9.0	\$55.3
Rest of State	\$2,047.5	\$2,018.4	\$1,412.3	\$5,505.4

Biopharmaceutical Establishments in New York State

In addition to the number of jobs the biopharmaceutical sectors provides to New York, another measure of its size and scope is the number of facilities or establishments in the state. Using the Bureau of Labor Statistics' "establishment" measurements, this report calculates that the biopharmaceutical industry is directly responsible for 746 establishments in New York. Of the nine regions this report focuses on, those with the highest number of facilities are New York City and Long Island. The regions with the fewest establishments are Binghamton, Ithaca and Syracuse.

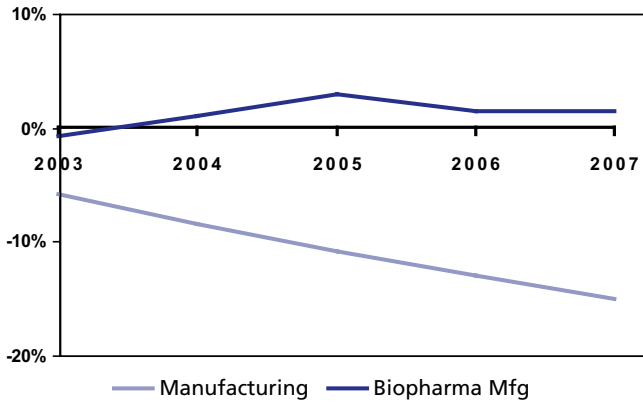
New York State Biopharmaceutical Establishments, 2006	
New York State	746
New York City	256
Buffalo	42
Capital District	52
Ithaca	14
Long Island	113
Rochester	26
Syracuse	21
Westchester	61
Binghamton	5
Rest of State	156

Impact of Biopharmaceutical Industry on Organized Labor

The biopharmaceutical industry has been a stable source of union employment in the state, especially in the direct employment in the manufacturing sector, which has been able to maintain its employment levels in biopharmaceuticals while employment has fallen for other manufacturing industries.

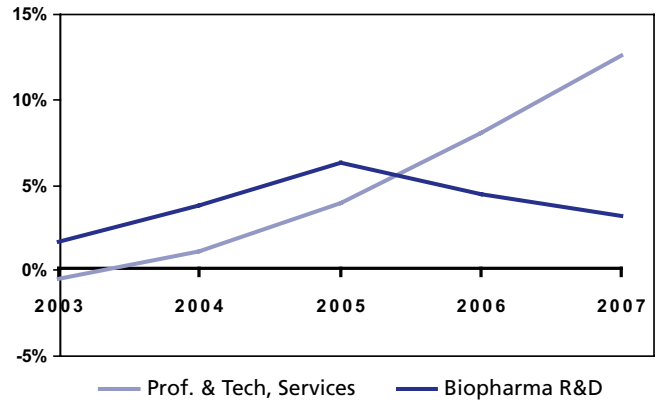
NY Manufacturing Industry Employment Trends

Employment Change 2003-2007



NY Tech Service Industry Employment Trends

Employment Change 2003-2007



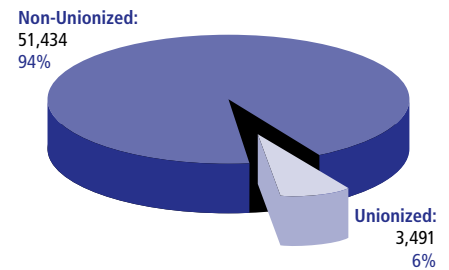
In 2007, union workers represented only 6% of direct employment, but over 13% of total employment from the biopharmaceutical sector. In total, 3,491 union workers are directly employed by the biopharmaceutical industry, while 16,885 union workers are employed in direct, indirect and induced employment. For direct employment, 766 are employed in biopharmaceutical manufacturing firms

for a 5.8% unionization rate, and 2,725 are employed in biopharmaceutical R&D organizations for a 6.5% unionization rate. Across the industry, union employment is concentrated in the construction, transportation and warehousing, health care and social assistance, and educational services occupations.

Biopharmaceutical Direct Employment & Union Coverage

2007

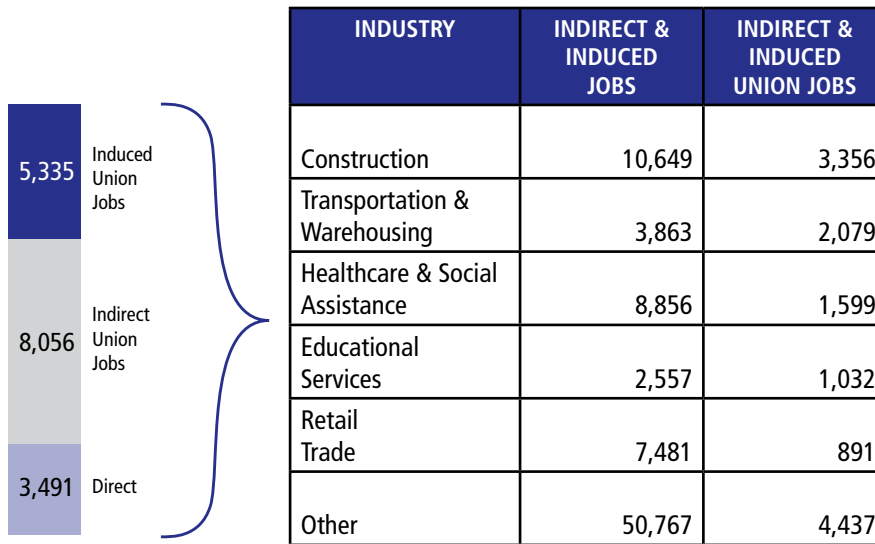
Total Direct Employment: 54,925



Indirect & Induced Employment Effects

2007

Total Union Employment: 16,885



31 Union jobs are created for every 100 biopharmaceutical jobs

If unionization rates remain at their current levels, a growing biopharmaceutical industry will support the growth of organized labor. Approximately 6% of all new direct employment will result in union jobs in both R&D organizations and manufacturing organizations. For construction projects, approximately 30% of all construction jobs for biopharmaceutical facilities are union jobs, which is higher than the average rate for New York, perhaps reflecting the type and quality of work required for FDA-regulated facilities. Therefore, for new construction projects supported in New York, the impact to organized labor is higher than for ongoing operations.

Summary

The biopharmaceutical sector is an important source of employment for New York. The top regions in the state, in terms of both direct and indirect/induced employment, are New York City, Long Island and Westchester. The regions that have the best “clustering” effect, where a larger proportion of jobs created by the biopharmaceutical industry are filled by workers within that region and needs of the biopharmaceutical industry filled by products and services also created in the region, are Long Island, Rochester and Westchester.

Section 2: Microeconomic Impact of the Biopharmaceutical Industry

The biopharmaceutical industry is important to the state of New York for the wages it provides its workers and the taxes paid on wages and profits. This section will discuss this microeconomic impact of the biopharmaceutical industry on New York. Due to the large and highly-educated workforce directly employed by the biopharmaceutical industry, the sector receives wages commensurate with its skill level and generates significant tax revenue for federal and state governments.

Biopharmaceutical Wages Paid

As discussed above, the primary occupations in the biopharmaceutical industry are Life, Physical and Social Science Occupations; Office and Administrative Support Occupations; and Production Occupations. Such occupations indicate a highly-educated workforce that receives wages commensurate with their level of education and experience. In 2006, the biopharmaceutical industry paid a total of \$3.8 billion in wages. The average wage paid to biopharmaceutical employees was \$68,272 in 2006. As compared to other sectors within the state of New York, the biopharmaceutical sector average was over 20% higher than the overall state average. This analysis focuses only on wages for direct employment.

In the nine regions that this report is focusing on, there is a discrepancy in wage levels throughout the state. While this report does not focus on the reasons behind the differences, likely drivers include the differences in wages of various occupations and wage differences driven by cost of

living. The region in the state with the highest wages is New York County (Manhattan). Due to the availability of data, county wage levels were only determined for New York, Nassau, and Suffolk counties. Wage levels were not calculated for the other counties.

Taxes Paid

Weighted Average Biopharmaceutical Wage 2006	
New York State	\$68,272
New York County (Manhattan)	\$77,970
Nassau County	\$60,330
Suffolk County	\$51,117

Due to the wages generated by biopharmaceutical employment, the sector also generates high personal federal, social security and state taxes. The average biopharmaceutical employee contributed \$15,251 to federal and social security taxes in 2006, compared to an average of \$11,783 across all sectors in New York; for a 29% increase for biopharmaceutical employees. For state taxes, the average biopharmaceutical employee generated \$2,183 in state taxes, as compared to \$1,429 for all other sectors for a 53% increase for biopharmaceutical employees. At the national level, New York ranks 6th in taxes paid, behind California and New Jersey as the top two nationwide. Regional tax calculations assume the state-wide biopharmaceutical wage average for all regions.

State Tax Collections from the New York State Biopharmaceutical Sector, 2006

	Average Employee Tax	Total Tax Collections (in U.S. \$, Millions)
New York State	\$2,183	\$121.0
New York City	\$2,159	\$34.3
Buffalo	\$2,177	\$10.0
Capital District	\$2,157	\$17.0
Ithaca	\$2,154	\$0.6
Long Island	\$2,204	\$22.6
Rochester	\$2,203	\$5.4
Syracuse	\$2,182	\$5.7
Westchester	\$2,216	\$13.9
Binghamton	\$2,149	\$0.9

Federal & Social Security Tax Collections from the New York State Biopharmaceutical Sector, 2006

	Average Employee Tax	Total Tax Collections (in U.S. \$, Millions)
New York State	\$15,251	\$845.6
New York City	\$15,149	\$240.3
Buffalo	\$15,225	\$70.1
Capital District	\$15,138	\$119.3
Ithaca	\$15,126	\$4.1
Long Island	\$15,345	\$157.5
Rochester	\$15,343	\$37.3
Syracuse	\$15,247	\$40.0
Westchester	\$15,397	\$96.8
Binghamton	\$15,101	\$6.4

Section 3: Biopharmaceutical Sector in Context

This section will discuss how activities in New York’s biopharmaceutical industry that are run in New York bring in revenue, and how that in turn drives the development of the biopharmaceutical sector, and its supporting sectors, in the state of New York.

Clinical Trials

Clinical trials are an important step in the drug development process, and they employ many people with diverse skill sets to plan, execute and analyze the trials. The drug approval process requires a number of trials be run on each biopharmaceutical before the FDA approves the compound. These trials, as denoted by phases, become increasingly complex at each phase and require more sites and participants.

As a biopharmaceutical company is developing a product, it may have to run the clinical trial at a number of sites in order to get the statistically significant data necessary for approval. Additionally, a given compound (unique chemical or biologic entity) may be developed for multiple “indications” (specific diseases), each of which requires its own clinical trials. Consequently, the number of trials being run in any given year will be much higher than the number of compounds or products in clinical development during that year.

New York is the site of many clinical trials, due in part to the large number of hospitals and teaching facilities within the state. In 2008; 5,053 trials were in the state, making New York second in the nation in total ongoing trials,

behind California with 5,631. For eight of the nine disease states or conditions currently under study, New York ranks in the top two, and is only fourth in the other condition. Mirroring the national trend, New York has the most of its trials in Phase 2. However, New York also has a high percentage of the ongoing Phase 3 trials being run. As these trials are enroll larger numbers of patients and are more expensive, this is a positive sign for the economic impact on New York.

Ongoing Clinical Trials in New York and the United States		
Phase	Number of Trials in New York	Number of Trials in the United States
1	764	4,124
2	1,650	6,179
3	1,249	2,750
4	317	1,500
Other	1,073	7,242
Total	5,053	21,795

Note: clinical trials can be run in multiple site locations, so the total of all trials run by states is higher than total trials in the U.S. Trials listed by clinicaltrials.gov as in-between phases are grouped into earlier phase (e.g., Phase I / II trials are shown with Phase I trials).

Ongoing New York Clinical Trials by Select Condition		
Condition	Total Trials	New York State Rank
Cancers and Other Neoplasms	1,935	1
Rare Diseases	698	2
Behavioral / Mental Disorders	301	1
Heart Disease	211	2
HIV / AIDS	300	2
Respiratory Tract Diseases	142	2
Diabetes	61	4
Parkinson’s Disease	35	2
Alzheimer’s Disease	26	2

Higher Education, Grant Recipients, and Venture Funding

New York is the recipient of a significant amount of research money, coming both from private and public sources. Additionally, it produces one of the highest amounts of bioscience degrees. All of these factors indicate that New York has a good foundation upon which to continue to grow its biopharmaceutical industry. However, the state appears to be stronger in basic research and medical facilities than it is in attracting new biopharmaceutical companies, which have recently been a driver of “big pharma” pipelines, and therefore future revenues and profits.

Indicators of Potential Growth in the New York State Biopharmaceutical Sector, 2006

	Amount	New York State Rank
Total R&D Spending by Biopharmaceutical Firms	\$1,846.4 million	7
NIH Grant Funding	\$1,961.9 million	3
Venture Capital Investment in Biotech	\$51.8 million	13
SBIR / STTR Dollars Awarded	\$28.3 million	5
Number of Bioscience Degrees Awarded (bachelor's through associates)	8,510	4*
Number of PhDs in Life Sciences Awarded	697	2
NSF Dollars Awarded for Biological Science Research	\$51.2 million	2
Planned Expenditures for Academic and Biomedical Research Space (2006 - 2007)	\$434.3 million	3

**Data only available for 10 states*

New York was one of 12 states to authorize stem cell research after the ban on federal funds for new embryonic stem cell research was enacted. New York's stem cell science research will devote \$600 million over 11 years to stem cell in-state research. While that annual number is on par with the state's annual NSF and venture investment, it is second to California, which has the largest state grant at \$3 billion over 10 years.

New York is generally well-positioned in investment in the biopharmaceutical industry. It awards a high number of degrees and has numerous, high-quality medical and research facilities. Of the challenges it faces, aligning education to the needs of the industry is important, especially if New York decides to pursue more biopharmaceutical manufacturing in the state. In early 2009, both Massachusetts and California reported concern with the ability of in-state education to meet the growing needs of the biopharmaceutical industry – a concern New York may share.

This impact can be felt from quality science teachers in primary education, to qualified biologics manufacturing technicians, to trained nurses and technicians who support clinical trials. New York should maintain direct linkage of the educational system to the biopharmaceutical industry to ensure that those educated in New York can be employed in New York, and that biopharmaceutical companies will find New York's workforce skilled enough to meet its needs.

Section 4: Case Studies on Impact and Growth Potential for New York State

Increasing Biopharmaceutical Employment

In 2006, New York was responsible for 6.8% of all biopharmaceutical output. In the following section, this report will discuss methods for increasing biopharmaceutical employment in the state. The report explored the likely economic impact on the state if it were to increase from 6.8% of national biopharmaceutical employment to 7.8%, using three scenarios: (1) increase in employment proportional to the share of research and manufacturing in original analysis, (2) all increase in manufacturing sub-sector, and (3) all increase in research sub-sector.

To highlight a few important points from the above analysis, the “all research” scenario (3) shows the greatest increase in total employment, which also means that the research side of the industry produced less output per employee. Yet due to its higher employment numbers, the resulting induced employment and output in the “all research” scenario (3) is higher.

In the end, a balance between research and manufacturing in the biopharmaceutical industry can achieve both growth of the industry and a stable, diversified economy. The natural and human resources distributed across New York can provide a guide for which types of growth the different regions should pursue. Areas with smaller

strengths and weaknesses of each region, developing plans that build upon the strengths, and resulting in a strong local growth plan and a balanced state-wide approach.

Supporting Clinical Trials

As presented above, running clinical trials in New York requires hospital facilities to manage the trial, doctors and nurses to deliver the drug and perform necessary treatment and testing, and technicians to perform and analyze clinical trial diagnostics. The number of clinical trials supported by New York is evidence of the scope of the hospital and health care provider systems in the state, especially in teaching facilities and universities.

A typical clinical trial costs a biopharmaceutical company \$15,700 for a Phase 1 trial, \$19,300 for a Phase 2 trial, and \$26,000 for a Phase 3 trial per enrolled patient, according to Clinical Trials Benchmarking. This report assessed the impact of all the Phase 3 trial sites currently underway in the state. The assumptions used are that each site enrolls 20 patients and receives 20% of the biopharmaceutical company cost per patient (with the other 80% going to biopharmaceutical staff, outsourced trial managers and drug supply, among others).

Incremental Impact of Biopharmaceutical Sector

	Scenario 1 (proportional)	Scenario 2 (all manufacturing)	Scenario 3 (all research)
Direct Employment	8,165	2,781	20,630
Indirect Employment	5,682	5,336	6,484
Induced Employment	5,364	3,591	9,469
Total Employment	19,211	11,708	36,584
Direct Output	\$ 2.4 bn	\$ 2.4 bn	\$ 2.4 bn
Indirect Output	\$ 1.2 bn	\$ 1.3 bn	\$ 1.0 bn
Induced Output	\$ 0.7 bn	\$ 0.5 bn	\$ 1.3 bn
Total Output	\$ 4.3 bn	\$ 4.1 bn	\$ 4.6 bn

If New York was responsible for 7.8% of direct biopharmaceutical output, it would represent an increase of \$2.4 billion in direct output. Depending on the allocation between research and manufacturing, that could represent an increase in state-wide output from \$4.1 billion to \$4.6 billion.

populations, less expensive land and access to water and transportation are good candidates for biopharmaceutical manufacturing locations; while areas with larger, well-educated populations could provide good research institution sites. The development of biopharmaceutical clusters can be pursued by recognizing the relative

Phase 3 Clinical Trials Impact Analysis	
Direct Employment	1,069
Indirect Employment	307
Induced Employment	458
Total Employment	1,834
Direct Output	\$ 130.0 mil.
Indirect Output	\$ 50.0 mil.
Induced Output	\$ 63.0 mil.
Total Output	\$ 243.0 mil.

The 1,243 Phase 3 trials in New York State are responsible for a total output impact of \$243.0 million dollars and total employment of 1,834 people. Clinical trials are clearly an important driver and contributor to the biopharmaceutical industry of New York.

Developing Biopharmaceutical Clusters

Within the state of New York, nine “clusters” or regions have been identified. The intent of a cluster is to build up an area that contains companies and workers to support a given industry sector. The benefits of “clustering” are the “network effects” that occur when the supporting sectors and occupations that biopharmaceutical companies need are located in close proximity, so that goods, skills and knowledge can be transferred between them. This report will examine the economic impact of three facilities that will possibly serve as anchors for further biopharmaceutical clustering.

Case Study – University of Rochester Translational Research Facility

In October 2008, the University of

Rochester broke ground on its \$76.4 million translational research facility^{xii}. Using the analysis methodology of this report, the economic impact to the state of New York can be calculated for both the construction of the facility and the ongoing operation of the facility.

For the construction of the facility, total employment (direct, indirect, and induced) is estimated to be 1,095 people with a total output impact of \$134.2 million. For the ongoing operation of the facility once completed, total employment is estimated to be 1,064 people with \$134.7 million impact annually.

Case Study – East River Science Park

The planned East River Science Park in Manhattan will have a similar impact on the economy for its size. The project is estimated to cost \$400 million to build and to employ 2,000 people at its site when fully occupied and operational^{xiii}. For the construction of the facility, total employment (direct, indirect, and induced) is estimated to be 5,731 with a total output impact of \$702.4 million. For the ongoing operation of the facility once completed, direct employment is estimated to be 2,000 with \$449.1 million impact annually.

New York State Employment and Output (millions) Supported by the Construction of the University of Rochester’s Clinical and Translational Science Building				
	Direct	Indirect	Induced	Total
Initial Construction	686	144	265	1,095
Ongoing Operations	600	189	275	1,064
Total	1,286	332	541	2,159
Initial Construction	\$ 76.4	\$ 21.2	\$ 36.5	\$ 134.2
Ongoing Operations	\$ 68.4	\$ 28.7	\$ 37.6	\$ 134.7
Total	\$ 144.8	\$ 50.0	\$ 74.1	\$ 268.9

Note: figures may not add to total due to rounding

**New York State Employment and Output (millions)
Supported by the Construction of
the East River Science Park**

	Direct	Indirect	Induced	Total
Initial Construction	3,591	752	1,388	5,731
Ongoing Operations	2,000	629	918	3,547
Total	5,591	1,380	2,306	9,278
Initial Construction	\$ 400.0	\$ 111.2	\$ 191.2	\$ 702.4
Ongoing Operations	\$ 228.1	\$ 95.7	\$ 125.3	\$ 449.1
Total	\$ 628.1	\$ 207.0	\$ 316.5	\$ 1,151.6

Case Study – BioBAT

BioBAT, at the site of the Brooklyn Army Terminal in the Sunset Park neighborhood in Brooklyn, is a similar facility to the East River Science Park and has a similar impact based on its size and scope of construction. This report assumes that 75% of ongoing employment is in the research side of the industry, while the remaining 25% supports manufacturing (in line with expectations that the site will have both research facilities and small-scale contract manufacturing). The site is estimated to cost \$100 million to retrofit and support 1,200 employees when fully operational^{xiv}. For the construction of the facility, total employment (direct, indirect, and induced) is estimated to be 1,433 with a total output impact of \$165.6 million. For the ongoing operation of the facility once completed, direct employment is estimated to be 1,200 with \$647.6 million impact annually.

**New York State Employment and Output (millions)
Supported by the Construction of the BioBAT**

	Direct	Indirect	Induced	Total
Initial Construction	898	188	347	1,433
Ongoing Operations	1,200	859	800	2,859
Total	2,098	1,046	1,148	4,292
Initial Construction	\$ 100.0	\$ 27.8	\$ 47.8	\$ 175.6
Ongoing Operations	\$ 356.5	\$ 181.8	\$ 109.3	\$ 647.6
Total	\$ 456.5	\$ 209.7	\$ 157.1	\$ 823.2

While the total employment numbers for each example are a small addition to the state-wide totals, they are still significant, and the economic impact to the state is positive. As this analysis, along with the clustering analysis, shows; it is important for New York to support projects such as the Rochester facility, as they bring jobs to the state and support its network of

biopharmaceutical companies. It is also important for the state to invest in the right sorts of education and job training to provide qualified workers to the companies, lured to the area through the examples above.

In the Appendix, comparative case studies on Madison, Wisconsin and Fredrick, Maryland can be found.

Section 5: Conclusion and Potential of the Biopharmaceutical Sector

New York is already among the top biopharmaceutical states in the United States, with its strong, nationally-recognized medical and research centers leading the way. On most measures – employment, output, clinical trials, wages and funding received – New York is among the top three states. Looking ahead, to sustain its growth and support of the state-wide economy, New

York needs to continue to invest into bringing biopharmaceutical activities into the state — such as supporting new medical facilities to run clinical trials, new research facilities to bring researchers and companies together, new company incubators to commercialize research, and new manufacturing plants to achieve the high output that such facilities bring. New York State can use

a number of methods, including tax credits, research grants and support for science education at all levels, to keep New York as a leading state in biopharmaceuticals and to keep biopharmaceuticals, a leading industry in New York.

ENDNOTES

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- ⁱⁱ *ibid*
- ⁱⁱⁱ Archstone Consulting LLC and Lawton R. Burns, Ph.D, “The Biopharmaceutical Sector’s Impact on the U.S. Economy: Analysis at the National, State, and Local Levels” (2009)
- ^{iv} United States Department of Health & Human Services (U.S. Food and Drug Administration: Center for Drug Evaluation and Research). (2008). *Drugs@FDA Data Files*. [<http://www.fda.gov/cder/drugsatfda/datafiles/>]. Rockville, MD: FDA (Accessed December, 2008).; and United States Department of Health & Human Services (U.S. Food and Drug Administration: Center for Biologics Evaluation and Research). *Biological License Application and New Drug Application Approvals, 1996-2006*. [<http://www.fda.gov/cber/products.htm>]. Rockville, MD: FDA (Accessed December, 2008).
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- ^{vii} Archstone Consulting LLC and Lawton R. Burns, Ph.D, “The Biopharmaceutical Sector’s Impact on the U.S. Economy: Analysis at the National, State, and Local Levels” (2009)
- ^{viii} *Ibid*
- ^{ix} Definition of Total Employment for New York State is sum of direct, indirect, and induced employment without allocation of inter-state effects
- ^x PILMA, “Impact of the Biopharmaceutical Sector on the U.S. Organized Labor” (2009)
- ^{xi} Henry J. Kaiser Family Foundation. (2008). *State Funding of Embryonic & Fetal Stem Cell Research as of January 2008*. Available: <http://www.statehealthfacts.org/comparetable.jsp?ind=112&cat=2> (Accessed January 14, 2009)
- ^{xii} PRNewswire, “University of Rochester Medical Center Breaks Ground on New Translational Research Institute”, October 27, 2008.
- ^{xiii} Gregor, Allison, “Bringing Laboratory Space Back to New York,” *New York Times*, February 21, 2007. Accessed: <http://www.nytimes.com/2007/02/21/realestate/commercial/21life.html>
- ^{xiv} Pristin, Terry, “AIDS Research Gets a Home at Brooklyn Army Terminal,” *New York Times*, June 20, 2007. Accessed: <http://www.nytimes>

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **New York City**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties New York, Bronx, Queens, Kings, and Richmond

Companies Pfizer, Bristol-Myers Squibb, ImClone/Eli Lilly, Intracellular Therapies, Enzo Biochem, Alzheimer’s Drug Discovery Foundation, and others

Research & Medical Rockefeller University, Columbia University, Memorial, Sloan-Kettering Cancer Center, Weill Medical College, Mount Sinai School of Medicine

Establishments 256

Biopharmaceutical Employment

	New York City	New York State
Direct	15,862	55,446
Indirect	5,371	38,590
Induced	4,798	36,428
Total	26,031	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	New York City	New York State
Direct	\$2,827.0	\$15,978.6
Indirect	\$925.9	\$8,123.5
Induced	\$708.0	\$4,973.5
Total	\$4,460.9	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,159	\$121.0
Federal	\$15,149	\$240.3
Total	\$17,308	\$361.3

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for Westchester

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Westchester and Rockland

Companies Barr, Novartis, Regeneron, Acorda Therapeutics, Aureon Laboratories

Research & Medical . . . Multiple research universities

Establishments 61

Biopharmaceutical Employment

	Westchester	New York State
Direct	6,289	55,446
Indirect	5,453	38,590
Induced	5,317	36,428
Total	17,059	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Westchester	New York State
Direct	\$3,173.9	\$15,978.6
Indirect	\$1,409.4	\$8,123.5
Induced	\$740.1	\$4,973.5
Total	\$5,323.4	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,216	\$13.9
Federal	\$15,397	\$96.8
Total	\$17,613	\$110.7



Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for Long Island

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Nassau and Suffolk

Companies OSI Pharmaceuticals, Forest Labs

Research & Medical . . Cold Spring Harbor Laboratories, SUNY at Stony Brook

Establishments 113

Biopharmaceutical Employment

	Long Island	New York State
Direct	10,265	55,446
Indirect	9,475	38,590
Induced	6,779	36,428
Total	26,518	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Long Island	New York State
Direct	\$3,758.8	\$15,978.6
Indirect	\$1,979.2	\$8,123.5
Induced	\$882.7	\$4,973.5
Total	\$6,620.7	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,204	\$22.6
Federal	\$15,345	\$157.5
Total	\$17,549	\$180.1

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Rochester**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Monroe

Companies Vaccinex

Research & Medical . . University of Rochester

Establishments 26

Biopharmaceutical Employment

	Rochester	New York State
Direct	2,434	55,446
Indirect	2,359	38,590
Induced	1,556	36,428
Total	6,349	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Rochester	New York State
Direct	\$916.6	\$15,978.6
Indirect	\$419.9	\$8,123.5
Induced	\$170.5	\$4,973.5
Total	\$1,507.0	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,203	\$5.4
Federal	\$15,343	\$37.3
Total	\$17,546	\$42.7

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Buffalo**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Niagara and Erie

Companies ZIOpharm, Cleveland Biosciences, Kinex

Research & Medical . . University of Buffalo Center for Excellence in Bioinformatics, Roswell Park Cancer Center

Establishments 42

Biopharmaceutical Employment

	Buffalo	New York State
Direct	4,603	55,446
Indirect	3,396	38,590
Induced	2,798	36,428
Total	10,797	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Buffalo	New York State
Direct	\$1,081.5	\$15,978.6
Indirect	\$542.2	\$8,123.5
Induced	\$304.2	\$4,973.5
Total	\$1,927.8	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,177	\$10.0
Federal	\$15,225	\$70.1
Total	\$17,402	\$80.1

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Syracuse**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Onondaga

Companies Welch Allyn, ConMed, Bristol-Myers Squibb

Research & Medical . . Central New York Laboratory Alliance, Central New York Biotechnology Research Center, SUNY Health Sciences Center in Syracuse, Syracuse University

Establishments 21

Biopharmaceutical Employment

	Syracuse	New York State
Direct	2,626	55,446
Indirect	2,060	38,590
Induced	1,543	36,428
Total	6,229	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Syracuse	New York State
Direct	\$722.4	\$15,978.6
Indirect	\$334.7	\$8,123.5
Induced	\$172.0	\$4,973.5
Total	\$1,229.1	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,182	\$5.7
Federal	\$15,247	\$40.0
Total	\$17,429	\$45.7



Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Ithaca**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Tompkins

Companies Vybion, Bybrid Silica, Novomer

Research & Medical . . Cornell University, Ithaca University

Establishments 14

Biopharmaceutical Employment

	Ithaca	New York State
Direct	271	55,446
Indirect	49	38,590
Induced	91	36,428
Total	410	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Ithaca	New York State
Direct	\$37.4	\$15,978.6
Indirect	\$6.2	\$8,123.5
Induced	\$8.4	\$4,973.5
Total	\$52.0	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,154	\$0.6
Federal	\$15,126	\$4.1
Total	\$17,280	\$4.7



Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Capital District**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Albany, Schenectady, Rensselaer, and Saratoga

Companies Alban Molecular Research, Inc. (AMRI),
AngioDynamics, Taconic

Research & Medical . . . Rensselaer Polytechnic Institute, Albany Medical
College, SUNY-Albany, Center for Functional
Genomics

Establishments 52

Biopharmaceutical Employment

	Capital District	New York State
Direct	7,879	55,446
Indirect	3,565	38,590
Induced	4,958	36,428
Total	16,402	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Capital District	New York State
Direct	\$1,350.7	\$15,978.6
Indirect	\$477.0	\$8,123.5
Induced	\$566.3	\$4,973.5
Total	\$2,394.0	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,157	\$17.0
Federal	\$15,138	\$119.3
Total	\$17,295	\$136.3

Economic Impact of Biopharmaceutical Industry on New York State

Report Highlights for **Binghamton**

The report **Economic Impact of the Biopharmaceutical Industry on New York State** will discuss these highlights, as well as provide an overview of the state of the biopharmaceutical industry on the entire state of New York.

Counties Broome

Companies None

Research & Medical SUNY-Binghamton

Establishments 5

Biopharmaceutical Employment

	Buffalo	New York State
Direct	426	55,446
Indirect	116	38,590
Induced	91	36,428
Total	634	130,464

Biopharmaceutical Economic Output (U.S. \$ mm)

	Buffalo	New York State
Direct	\$35.8	\$15,978.6
Indirect	\$10.6	\$8,123.5
Induced	\$9.0	\$4,973.5
Total	\$55.3	\$29,075.6

Taxes Paid

	Per Employee	Total (\$mm)
State	\$2,149	\$0.9
Federal	\$15,101	\$6.4
Total	\$17,250	\$7.3