

BIO SCIENCE 07



Growing the Nation's Bioscience Sector: A Regional Perspective

A Companion Document to *Growing the Nation's Bioscience Sector:
State Bioscience Initiatives 2006*

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The Biosciences in the United States: a Regional Perspective

Introduction

The publication of “*Growing the Nation’s Bioscience Sector: State Bioscience Initiatives 2006*” in April 2006 marked the first comprehensive assessment of the bioscience industry from a national, state, and metropolitan area perspective.¹ Employment metrics were utilized to gauge economic activity and performance across the United States. With the majority of the written focus of the report placed on national and state trends, Battelle and the Biotechnology Industry Organization (BIO) have chosen to publish this companion report with a more detailed examination of the biosciences at the local level.

Local economic development in a nation as large and diverse as the U.S. is as varied as the country itself. A complex array of factors influence the allocation of resources and the nature of industry development: the presence of universities, talent in the workforce, climate and geography, sufficiency of business capital, and historical economic influences. Ultimately, these characteristics combine to impact a local or regional economy and most often determine its success.

The biosciences are a knowledge-based industry and require a region to harness its best in terms of talent and leveraging niche characteristics in order to effectively grow business and boost employment. The industry cluster is unique in that it requires a strong foundation and significant investments in scientific research and development. The bioscience sector often thrives in metropolitan areas and states with premier university, hospital, and other centers of life sciences research. A strong local bioscience industry yields economic benefits in the form of high-paying jobs and their subsequent positive ripple effect.

Analysis of U.S. metropolitan areas demonstrates the breadth of the national bioscience sector. Local and geographical specializations within the industry vary, but the vast distribution of bioscience employment² is impressive:

- Among 361 Metropolitan Statistical Areas (MSAs)³ with some bioscience employment, 193 have a specialization in at least one of the four major bioscience subsectors.
- Thirteen metropolitan areas have an employment specialization in three of the four major bioscience subsectors; and two have a specialization in all four subsectors—Lincoln, NE and Madison, WI.



¹ To access the full report released April 2006, visit the Biotechnology Industry Organization (BIO) website at <http://www.bio.org/local/battelle2006/>.

² Note that employment analysis in this report does not include the Hospitals sector.

³ The U.S. Census Bureau defines a metropolitan statistical area (MSA) as a core area containing a substantial population nucleus, together with adjacent communities having a high degree of social and economic integration with that core. MSAs consist of one or more entire counties.

- Twenty five metropolitan areas have total bioscience employment that exceeds 10,000.
- Regional bioscience workers earn a significant wage premium compared with their counterparts in the rest of the private sector. Nationally, the average bioscience worker earns \$65,775 versus \$39,003 in the overall private sector.

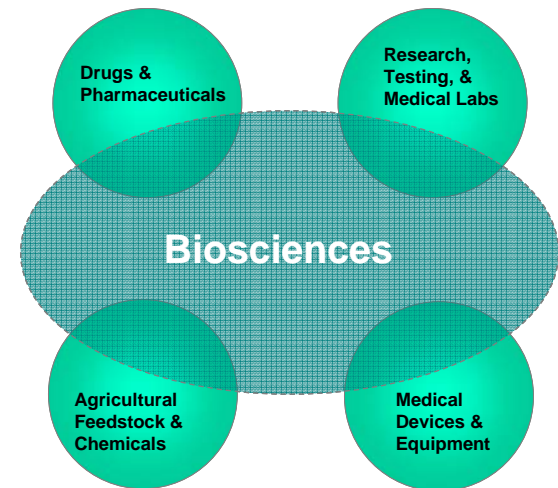
It is important to note that a large portion of U.S. counties do not lie within the borders of an MSA. Significant bioscience activity occurs in more rural sections of the nation, particularly with respect to the agricultural component of the biosciences.

The report will first discuss and define the bioscience sector and its major subsectors, as well as the economic data used in this analysis. Following this discussion will be an analysis of metropolitan area activity within each major bioscience subsector.

Figure 1. Bioscience industry subsectors

The Bioscience Sector and Subsectors

The changing and diverse nature of the biosciences makes it difficult to define. The federal statistical system does not identify one complete biosciences industry classification. To encompass the range of bioscience activity in the U.S., many detailed industries must be combined. Battelle has assisted numerous states and local areas throughout the U.S. in identifying and developing their bioscience industry base. The Battelle definition of the biosciences has been used in multiple editions of the national industry report, “*Growing the Nation’s Bioscience Sector: State Bioscience Initiatives.*” After years of research and field work, Battelle has identified four major subsectors that engage in key bioscience activity. The four major subsectors are shown in Figure 1.



- **Agricultural Feedstock and Chemicals.** This subsector applies life sciences knowledge and biotechnologies to the processing of agricultural goods and production of organic and agricultural chemicals. Product examples include: ethanol, fertilizers, pesticides, sustainable lubricants and oils, and food and feed additives.
- **Drugs and Pharmaceuticals.** The subsector produces commercially available medicinal and diagnostic substances. Firms are generally large and multinational and are heavily engaged in R&D activities to bring drugs to market. Product examples include: vaccines; oncology, neurology, and cardiology treatments; tissue and cell culture media; herbal supplements; and diagnostic substances.
- **Medical Devices and Equipment.** Firms in this subsector produce biomedical instruments and other health care products and supplies for diagnostics, surgery, patient care, and laboratories. Product examples include: bioimaging equipment; orthopedic and prosthetic implants and devices; dental instruments and orthodontics; laser eye surgery equipment; defibrillators (AEDs); and stents and other implantable devices.

- **Research, Testing, and Medical Laboratories.** The subsector includes a range of activities, from highly research-oriented companies developing and commercializing new drug discovery/delivery systems, to more service-oriented medical or other testing firms. Product examples include: functional genomics and drug discovery techniques; diagnostic testing; preclinical drug therapeutics; protein receptors; and research models and laboratory support services.

The North American Industry Classification System (NAICS) is the official Federal government system for classifying establishments and their activities into the appropriate sectors. The NAICS is based on the production processes of firms and categorizing them into groups with other business establishments engaged in the same or similar activities. Twenty Seven NAICS industries at the most detailed (6-digit) level are combined by Battelle for this analysis. Detailed industries are aggregated up to the four major subsectors of the bioscience industry. A full list of bioscience NAICS codes is shown in Table 1.

A *fifth* subsector of the biosciences might include research hospitals, academic health centers, and other research-driven medical institutions. Many U.S. hospitals partner with universities and other research centers to further advances in the biosciences with a particular focus on healthcare applications. From a data perspective, however, under the current NAICS system it is not possible to isolate the relevant bioscience research-oriented establishments within the larger hospitals sector. Thus, while Battelle acknowledges the critical role these research institutions play in advancing life sciences research and the bioscience industry, we are unable to accurately isolate this activity in the current federal data framework.

Given the dynamic and broad nature of the biosciences, one must acknowledge the possibility that certain economic activities are not captured in this definition according to NAICS codes. Aggregating production activities on a broad scale will inevitably result in some data gaps; however, characterizing this industry according to the most detailed NAICS data available is the best approach to analyze the vast majority of key bioscience economic activity in the U.S.

Table 1. The Bioscience Subsector Industries

NAICS Code	NAICS Description
AGRICULTURAL FEEDSTOCK & CHEMICALS	
311221	Wet corn milling
311222	Soybean processing
311223	Other oilseed processing
325193	Ethyl alcohol manufacturing
325199	All other basic organic chemical manufacturing
325221	Cellulosic organic fiber manufacturing
325311	Nitrogenous fertilizer manufacturing
325312	Phosphatic fertilizer manufacturing
325314	Fertilizer (mixing only) manufacturing
325320	Pesticide and other agricultural chemical mfg.
DRUGS & PHARMACEUTICALS	
325411	Medicinal and botanical manufacturing
325412	Pharmaceutical preparation manufacturing
325413	In-vitro diagnostic substance manufacturing
325414	Other biological product manufacturing
MEDICAL DEVICES & EQUIPMENT	
334510	Electromedical apparatus manufacturing
334516	Analytical laboratory instrument manufacturing
334517	Irradiation apparatus manufacturing
339111	Laboratory apparatus and furniture manufacturing
339112	Surgical and medical instrument manufacturing
339113	Surgical appliance and supplies manufacturing
339114	Dental equipment and supplies manufacturing
339115	Ophthalmic goods manufacturing
339116	Dental laboratories
RESEARCH, TESTING, & MEDICAL LABORATORIES	
541380*	Testing laboratories
541710*	Physical, engineering, and biological research
621511	Medical laboratories
621512	Diagnostic imaging centers

*Includes only the portion of these industries engaged in relevant biological or other life sciences activities.

Source: Battelle

Methodology and Data Concepts

The methodology and data utilized in this report follow exactly from that in the companion report, “*Growing the Nation’s Bioscience Sector: State Bioscience Initiatives 2006.*” This section will discuss general data, concepts, and metrics incorporated to measure the bioscience industry across all U.S. metropolitan statistical areas. A more detailed discussion of data and methodology can be found in the Appendix of this report, or in the data Appendix of the full national report.

Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) program data are used as the source of employment, establishment, and wage data in this bioscience industry analysis. The QCEW provide the most current, accurate employment data at the national and subnational levels. Information collected by the QCEW represent a census, not a survey, of workers covered under the Unemployment Insurance system administered by the states and reported by employers.⁴

Employment data are used to measure and compare the size and relative concentration of each major bioscience subsector across every MSA within the U.S. figures for 2001 and 2004 are calculated and represent the most current annual data (2004) as well as the furthest comparable year available under the new NAICS system (2001).

Employment metrics are used in this report to measure and compare both the size and level of concentration of biosciences employment in each metropolitan area. The **size** is measured by both the absolute level of employment within each MSA and the region’s share of total U.S. employment. A metropolitan area is designated as “large” in this analysis if local employment accounts for at least a 2.0 percent share of total national employment in that particular subsector.

The **level of concentration** is a useful way in which to gauge a region’s activities within a subsector relative to the national average. A location quotient (LQ) measures the degree of employment concentration within a metropolitan area relative to the nation.⁵ When an MSA is significantly above average, 1.20 or greater, the region is said to have a “specialization” in the industry. An MSA designated as both “**large and specialized**” in this report meets two thresholds—a share of national subsector employment at or above 2.0 percent, and an LQ at or above 1.20. Subsector maps presented in this report highlight regions with *highly concentrated/specialized* employment (location quotient of 1.50 or greater), representing a concentration of regional jobs that is 50 percent more than the national average.

In comparing the degree of employment concentration (location quotients) in this report, MSAs are tabulated and presented within one of three classifications—small, medium, or large. A “large” MSA has total employment at or above 250,000; “medium” has total employment greater than or equal to 75,000, but less than 250,000; and “small” has total employment less than 75,000.⁶ Within each size designation, the top 20 metropolitan areas are then ranked by their location quotient. Dividing the MSAs by overall employment size allows for a more “apples to apples” comparison of relative employment concentration.

⁴ For a detailed discussion of these data, see the Appendix to this report.

⁵ The location quotient is the share of total regional employment in the particular industry divided by the share of total industry employment in the nation. An LQ greater than 1.0 for a particular industry indicates that the region is relatively concentrated, whereas an LQ less than 1.0 signifies a relative under representation. The minimum concentration threshold for declaring a regional specialization is a matter of judgment and varies somewhat in the relevant literature. In this analysis, regional specializations are defined by LQs of 1.20 or greater.

⁶ Dividing the 361 total MSAs in this manner yields the following metro totals for each category: 72 large, 123 medium, and 166 small.

The identification of “emerging” metropolitan areas in the biosciences is determined by both employment levels and employment growth during the early 2000s. In this report, an **emerging** metropolitan area in a bioscience subsector has more than 500 employed but fewer than 5,000, and has experienced job growth of at least 20 percent during the 2001 to 2004 time period. A minimum employment threshold (500 in this case) serves two purposes—to insure that the region has a significant enough base of activity in the subsector, and to avoid overstating growth trends among metro areas with a small employment base. Those metropolitan areas that already employ 5,000 or more in a subsector are clearly an established player in the biosciences and are not included in the analysis of emerging centers of bioscience activity.

The Biosciences in the United States

National Overview

In “*Growing the Nation’s Bioscience Sector: State Bioscience Initiatives 2006*,” the national and state-level bioscience sectors were examined in detail. The report found that the U.S. is home to 1.2 million bioscience jobs spanning more than 40,000 business establishments (Table 2). Bioscience jobs grew at a modest pace from 2001 to 2004, increasing by 1 percent; this increase, however, is noteworthy given the sluggish nature of the overall national labor market and steep job cuts in manufacturing during this period. For comparison, total U.S. employment was down slightly over the period (-0.7 percent). National industry multipliers reveal an overall bioscience employment impact of 7.0 million jobs.

The national BIO report showed the two largest bioscience subsectors—research, testing, and medical labs and medical devices—each employ more than 400,000 and account for one-third of total bioscience employment. Drugs and pharmaceuticals makes up 25 percent of total national bioscience employment; and the remaining 8 percent of industry jobs are in the agricultural feedstock and chemicals subsector. Since 2001, two of the major bioscience subsectors added jobs. The research, testing, and medical laboratories sector grew by 8 percent and employment in drugs and pharmaceuticals increased by almost 3 percent.

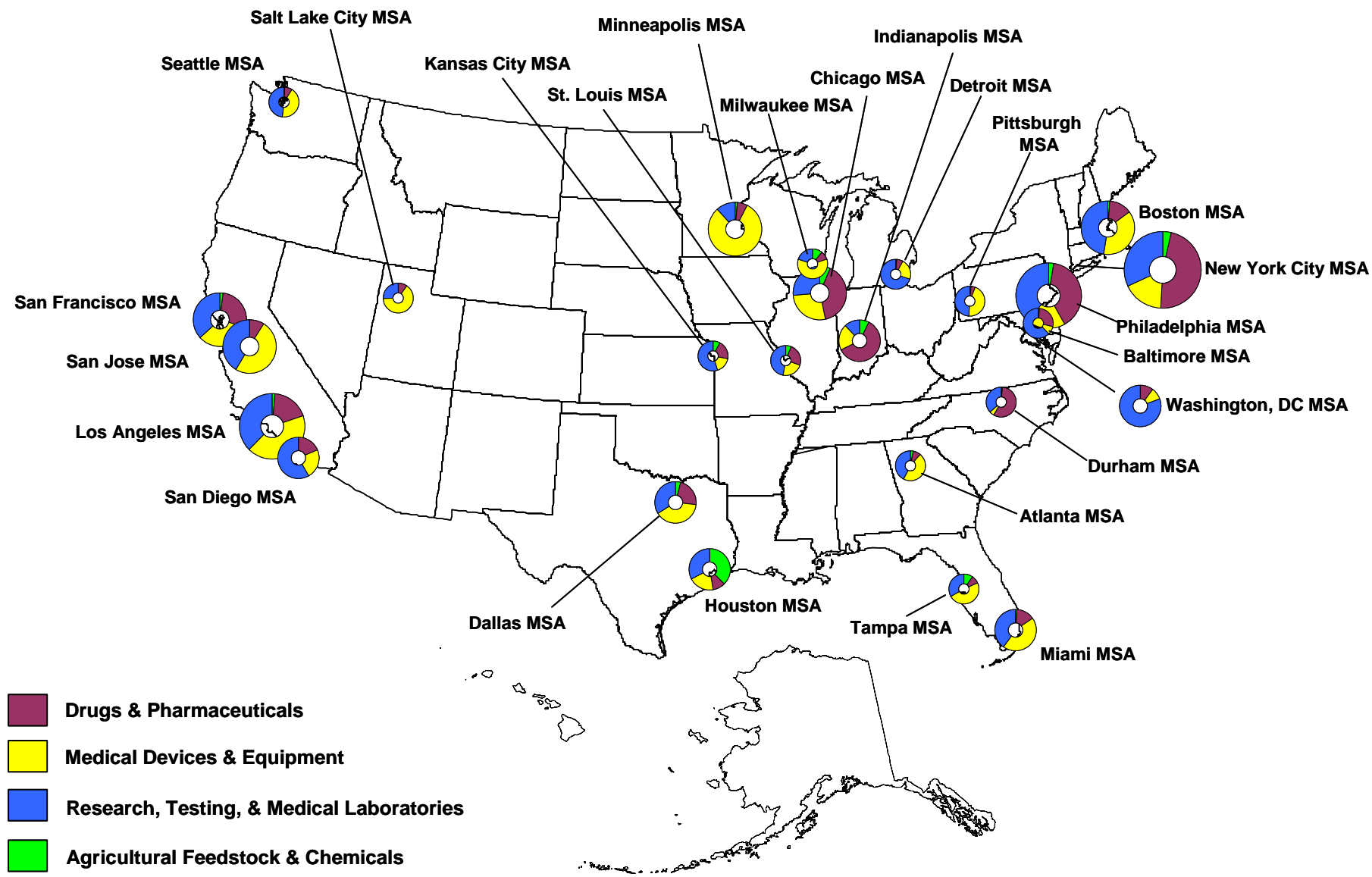
Table 2. U.S. Bioscience Employment and Establishments by Major Subsector, 2001 and 2004

Bioscience Subsector	2001 Employment	2001 Establishments	2004 Employment	2004 Establishments
Agricultural Feedstock & Chemicals	112,693	2,103	104,893	2,111
Drugs & Pharmaceuticals	304,829	2,606	313,207	2,589
Medical Devices & Equipment	426,949	15,163	411,460	15,190
Research, Testing, & Medical Laboratories	382,105	17,222	413,550	20,565
Total U.S. Biosciences	1,226,576	37,094	1,243,109	40,454

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

While the national BIO report included employment metrics, rankings, and tables for metropolitan statistical areas, it did not include a detailed analysis. This report will focus almost exclusively on economic activity in the bioscience sector among metropolitan regions. The national map in Figure 2 presents the 25 MSAs with more than 10,000 total bioscience jobs. Each metro area is denoted on the map by a pie/doughnut graphic that shows the employment composition of the overall sector by the four major subsectors. The size of each chart on the map represents the overall employment size of the biosciences in that particular region. For example, the metropolitan area with the most bioscience jobs, the New York City MSA, employs more than 110,000 and thus has the largest doughnut chart on the map.

Figure 2. Metropolitan Areas with the Largest Total Employment Levels (greater than 10,000) in the Biosciences by Major Subsector Composition, 2004



The national bioscience employment map in Figure 2 provides a revealing look not only at the largest overall regional employment centers, but also at the subsector composition of each. Many metropolitan areas, including Chicago, Boston, Los Angeles, and St. Louis, have a broad employment base in three or even four of the subsectors. Others, by comparison, are highly specialized in one or two particular subsectors, like Minneapolis (medical devices), Washington, DC (research, testing, and medical labs), and Pittsburgh (research, testing, and medical labs and medical devices). Table 3 shows subsector and total employment in the biosciences for the largest overall metro regions shown in the national map.

Table 3. Metropolitan Areas with the Largest Total Employment Levels (greater than 10,000) in the Biosciences by Major Subsector Composition, 2004

Metropolitan Statistical Area	2004 Employment				
	Agricultural Feedstock & Chemicals	Drugs & Pharmaceuticals	Medical Devices & Equipment	Research, Testing, & Medical Laboratories	Total Biosciences
New York-N. New Jersey-Long Island, NY-NJ-PA	4,137	51,978	19,252	35,228	110,596
Los Angeles-Long Beach-Santa Ana, CA	910	12,058	28,304	24,886	66,158
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,362	20,819	10,277	20,578	53,036
Chicago-Naperville-Joliet, IL-IN-WI	2,997	18,480	12,337	12,187	46,000
Boston-Cambridge-Quincy, MA-NH	415	5,984	15,874	20,051	42,323
San Francisco-Oakland-Fremont, CA	645	9,775	11,832	12,831	35,083
Minneapolis-St. Paul-Bloomington, MN-WI	384	1,781	23,148	3,301	28,613
San Jose-Sunnyvale-Santa Clara, CA	18	2,181	12,485	10,356	25,040
Indianapolis, IN Metropolitan Statistical Area	1,773	14,523	4,808	2,947	24,051
San Diego-Carlsbad-San Marcos, CA	71	4,353	5,559	13,927	23,912
Washington-Arlington-Alexandria, DC-VA-MD-WV	20	2,165	1,969	17,168	21,322
Miami-Fort Lauderdale-Miami Beach, FL	178	2,446	7,639	6,894	17,157
Dallas-Fort Worth-Arlington, TX	712	3,777	6,648	5,727	16,863
Houston-Baytown-Sugar Land, TX	5,989	1,594	3,135	5,217	15,933
Durham, NC	182	8,226	741	5,273	14,422
St. Louis, MO-IL	806	3,391	3,174	6,559	13,930
Seattle-Tacoma-Bellevue, WA	124	1,110	5,798	6,585	13,617
Detroit-Warren-Livonia, MI	153	924	2,985	9,412	13,474
Salt Lake City, UT	21	1,190	8,208	3,169	12,588
Tampa-St. Petersburg-Clearwater, FL	1,211	1,099	6,083	4,190	12,583
Baltimore-Towson, MD	160	3,382	1,113	7,714	12,369
Pittsburgh, PA	151	502	5,065	5,488	11,206
Milwaukee-Waukesha-West Allis, WI	1,121	1,011	6,360	2,113	10,605
Kansas City, MO-KS	792	2,169	1,781	5,810	10,552
Atlanta-Sandy Springs-Marietta, GA	311	853	4,744	4,362	10,270

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Regional Profile: Madison Wisconsin

The Regional Story

Madison is a mid-sized metro area that is specialized in all four bioscience subsectors studied by Battelle. As home to the main research campus of the University of Wisconsin and its medical center, Madison has been the focal point for bioscience development (and policy) statewide. (However, there is now also growing interest in the biosciences in Milwaukee.) Madison also benefits from its status as state capital, which gives all the university's technology initiatives very high visibility in the legislature.

UW-Madison, a land-grant institution with a long tradition of industrial service and engagement, has therefore benefited enormously from a series of state-funded capital programs to increase university research capacity. Most recently, the UW-Madison has skillfully applied this bonding capacity to build several large interdisciplinary research labs that will also lever its status as home to a plurality of the stem-cell lines approved for federally financed research.

Strategy: Custodians, Elements and Coordination

Madison's high profile can be traced in part to the early success of the Wisconsin Alumni Research Foundation at licensing university-owned intellectual property—long before the Bayh-Dole act codified the process nationally. In recent years, the university has equipped itself with both state-financed and privately endowed “gap funds” that promote the formation of spin-off vehicles that become WARF licensees.

UW-Madison has also worked diligently to develop the nearby University Research Park. This is one of the nation's older and better

developed university research parks, with a significant wet-lab incubator that was underwritten initially by the local utility company. With 110 companies in 34 buildings over 1.5 million square feet on 255 acres, Park is rapidly filling, and the university has begun plans for a second 270-acre campus nearby.

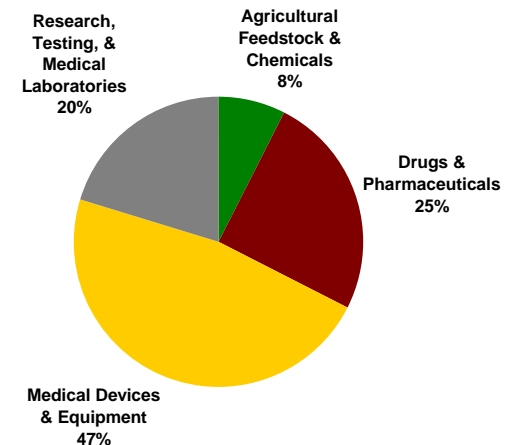
Entrepreneurial activity in the region is further stimulated by a generous angel-investor tax credit capped at \$30 million over two years, a long-standing \$50 million Certified Capital Company program, and \$135 million committed by the State of Wisconsin Investment Board to four venture-capital funds with substantial operations in-state.

Notable Recent Successes

Although Madison is smaller than and somewhat distant from the larger city of Milwaukee, the two mayors have formed an M2 Collaborative to work together on promoting development, including in the biosciences. This effort is a subset of what is being promoted as “the I-Q corridor” linking Minneapolis-St. Paul, Madison, Milwaukee, and Chicago.

Bioscience Employment Distribution: Madison, WI

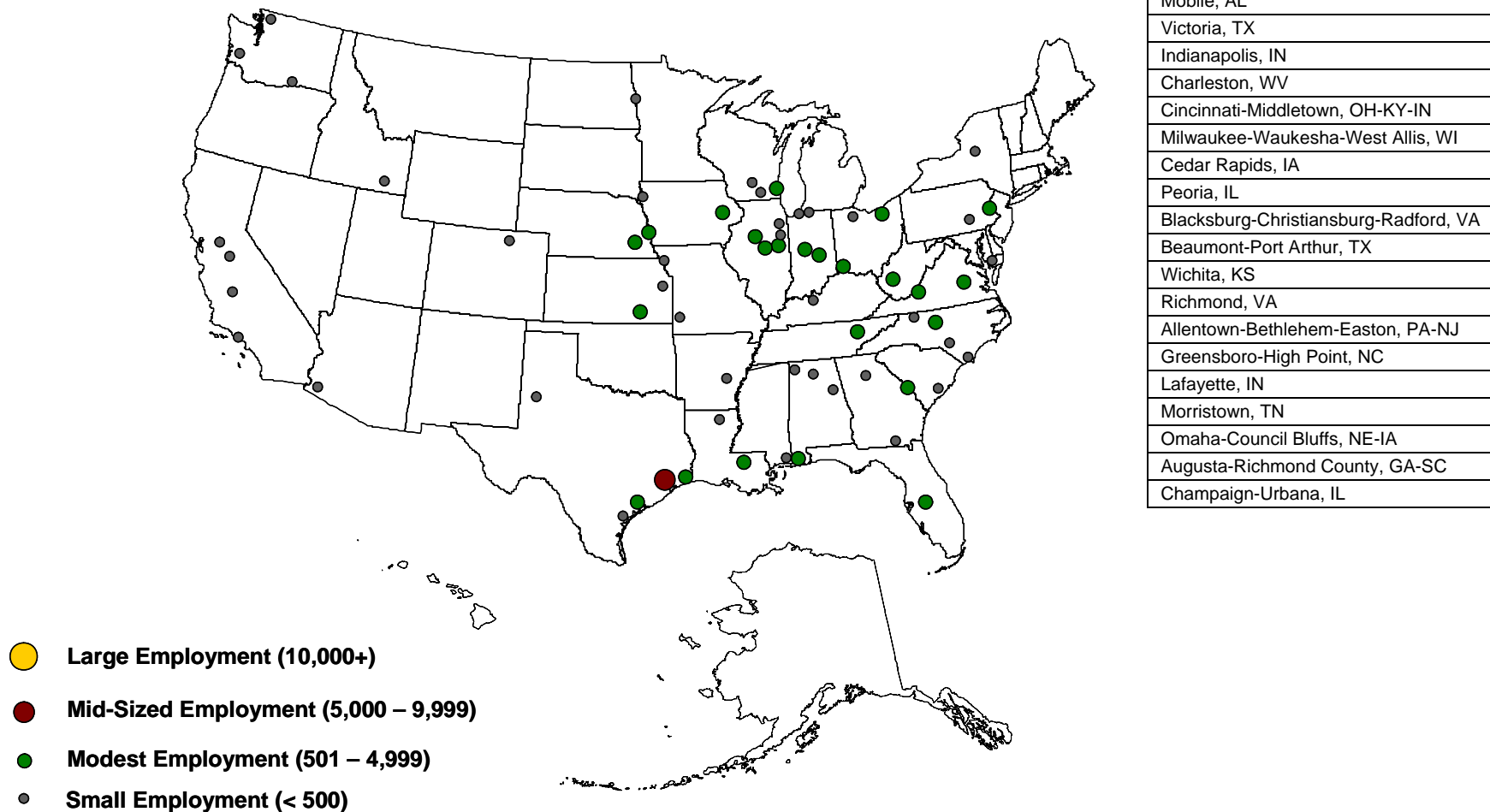
Specialized Employment Concentration in all 4 Bioscience Subsectors



Agricultural Feedstock and Chemicals

The agricultural feedstock and chemicals subsector applies life sciences knowledge and biotechnologies to the processing of agricultural goods and the production of organic and agricultural chemicals. The principal components of the subsector include 1) organic and agricultural chemicals and 2) agricultural feedstock and processing.

Figure 3. Metropolitan Statistical Areas Highly Specialized in Agricultural Feedstock and Chemicals (Location Quotient of 1.50 or above), 2004



Product Examples Include:	Ethanol, fertilizers, pesticides, sustainable lubricants and oils, and food and feed additives.
Metropolitan Statistical Areas that are both Large and Specialized:	Houston-Baytown-Sugar Land, TX; Decatur, IL; Lakeland, FL; and Baton Rouge, LA.

Overview

At the national level, the agricultural feedstock and chemicals subsector employs 104,893 across 2,111 business establishments. These employment metrics register fewest among the major bioscience subsectors. Employment in agricultural feedstock and chemicals accounts for 8 percent of all U.S. bioscience jobs. The average worker in this subsector earned \$63,383 in 2004, just below the average wage for all bioscience workers, \$65,775, but significantly greater than that for the average private sector worker, \$39,003.

Geographically, jobs in the subsector are concentrated in the Midwest and South; but as the U.S. map above shows, a geographically-varied and large number of metropolitan areas have significant employment concentrations (location quotients of 1.50 or greater). Most regions have “modest” subsector employment—more than 500 but fewer than 10,000 jobs. The exception is the Houston-Baytown-Sugar Land, TX metropolitan area with nearly 6,000 jobs mostly within the organic and agricultural chemicals component of the sector.

While the map presented above highlights regions with highly concentrated/specialized employment (location quotient of 1.50 or greater), a generally “specialized” region will have a location quotient of 1.20 or greater—representing a concentration of regional jobs that is 20 percent more than the national average. Among 284 metropolitan statistical areas with at least some employment in agricultural feedstock and chemicals, 72 are considered to be specialized under this definition. Of these 72 with an employment specialization, 65 have a LQ that is 1.50 or above and are shown in the national subsector map.

Employment Size

While a majority of jobs in agricultural feedstock and chemicals are found within metropolitan areas, a significant share lie within rural, non-metro counties. This is not surprising given the nature of the agricultural component of the sector. The chemicals component of the subsector employs the majority of workers nationally, nearly 80 percent. Much of the metropolitan area employment in this industry is engaged in the production of organic and agricultural chemicals.

The 40 metropolitan areas with the largest number of agricultural bioscience jobs are shown in Table 4. Together, these regions account for more than half (55 percent) of national subsector employment. In general, the smaller, more agriculturally-focused areas tend to have this subsector account for the vast majority of all local bioscience jobs. Agricultural feedstock and Chemicals in Decatur for example, accounts for more than 90 percent of its total bioscience base. Subsector employment in Chicago, on the other hand, accounts for less than 7 percent of a more varied bioscience base. While this result is rather intuitive for smaller versus larger metro areas, this metric allows for interesting comparisons among different regions and acts as a reference for the degree of bioscience variety within a particular area.

Table 4. Metropolitan Statistical Areas with the Largest Employment in Agricultural Feedstock and Chemicals and Subsector Share of Total Bioscience Employment, 2004

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Houston-Baytown-Sugar Land, TX	5,989	37.6%
Decatur, IL	4,311	91.9%
New York-Northern New Jersey-Long Island, NY-NJ-PA	4,137	3.7%
Lakeland, FL	3,236	91.9%
Baton Rouge, LA	3,092	82.6%
Chicago-Naperville-Joliet, IL-IN-WI	2,997	6.5%
Cleveland-Elyria-Mentor, OH	1,984	23.4%
Mobile, AL	1,946	83.4%
Victoria, TX	1,787	98.3%
Indianapolis, IN	1,773	7.4%
Charleston, WV	1,570	73.5%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,362	2.6%
Cincinnati-Middletown, OH-KY-IN	1,333	21.9%
Tampa-St. Petersburg-Clearwater, FL	1,211	9.6%
Milwaukee-Waukesha-West Allis, WI	1,121	10.6%
Riverside-San Bernardino-Ontario, CA	1,084	12.2%
Cedar Rapids, IA	1,005	63.9%
Charlotte-Gastonia-Concord, NC-SC	996	24.7%
Peoria, IL	969	68.4%
Blacksburg-Christiansburg-Radford, VA	935	91.4%
Beaumont-Port Arthur, TX	930	73.3%
Wichita, KS	916	51.4%
Los Angeles-Long Beach-Santa Ana, CA	910	1.4%
Columbus, OH	858	13.9%
Richmond, VA	831	22.7%
Nashville-Davidson--Murfreesboro, TN	815	19.8%
St. Louis, MO-IL	806	5.8%
Kansas City, MO-KS	792	7.5%
Allentown-Bethlehem-Easton, PA-NJ	790	20.5%
New Orleans-Metairie-Kenner, LA	751	36.5%
Memphis, TN-MS-AR	744	10.0%
Dallas-Fort Worth-Arlington, TX	712	4.2%
Greensboro-High Point, NC	708	17.4%
San Francisco-Oakland-Fremont, CA	645	1.8%

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Lafayette, IN	640	28.4%
Morristown, TN	600	76.2%
Omaha-Council Bluffs, NE-IA	587	23.5%
Augusta-Richmond County, GA-SC	511	27.1%
Champaign-Urbana, IL	508	70.5%
Charleston-North Charleston, SC	479	18.2%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Employment Concentration

Even without a large employment base, a metropolitan region can rely heavily on one industry if it is a relatively large share of all local jobs. Location quotients are a valuable metric in local area analysis in order to gauge this relative importance. The following three tables (combined as Table 5) present metro areas with the highest LQs in the agricultural feedstock and chemicals subsector. Given the varying size of all metropolitan areas with some subsector employment, the analysis is separated into small, medium, and large metro areas based on overall private sector employment in the region.

Table 5. Metropolitan Statistical Areas with the Highest Location Quotients in Agricultural Feedstock and Chemicals, by Size of Metro Area, Employment, Establishments, and Relative Average Wages, 2004

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
Baton Rouge, LA	11.46	3,092	20	252%
Houston-Baytown-Sugar Land, TX	3.07	5,989	83	182%
Allentown-Bethlehem-Easton, PA-NJ	2.77	790	6	228%
Indianapolis, IN	2.42	1,773	9	219%
Greensboro-High Point, NC	2.27	708	8	274%
Cleveland-Elyria-Mentor, OH	2.14	1,984	19	229%
Richmond, VA	1.74	831	7	191%
Oxnard-Thousand Oaks-Ventura, CA	1.70	455	2	125%
Toledo, OH	1.57	441	4	166%
Omaha-Council Bluffs, NE-IA	1.56	587	9	144%
Milwaukee-Waukesha-West Allis, WI	1.52	1,121	17	117%
Cincinnati-Middletown, OH-KY-IN	1.50	1,333	6	196%
New Orleans-Metairie-Kenner, LA	1.49	751	9	218%
Charlotte-Gastonia-Concord, NC-SC	1.48	996	13	152%
Memphis, TN-MS-AR	1.43	744	14	238%
Nashville-Davidson-Murfreesboro, TN	1.32	815	3	225%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
Dayton, OH	1.20	414	4	189%
Tampa-St. Petersburg-Clearwater, FL	1.15	1,211	17	189%
Raleigh-Cary, NC	1.15	417	4	173%
Columbus, OH	1.13	858	9	197%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
MEDIUM MSAs (TOTAL PRIVATE EMPLOYMENT BETWEEN 75,000 AND 250,000):				
Lakeland, FL	19.27	3,236	22	180%
Mobile, AL	14.10	1,946	9	241%
Charleston, WV	13.73	1,570	9	222%
Cedar Rapids, IA	8.72	1,005	9	171%
Beaumont-Port Arthur, TX	7.32	930	15	213%
Peoria, IL	6.30	969	13	127%
Wilmington, NC	3.78	395	4	194%
Wichita, KS	3.74	916	4	172%
Lincoln, NE	3.22	413	2	155%
Augusta-Richmond County, GA-SC	3.00	511	4	219%
Fayetteville, NC	2.77	241	3	201%
Stockton, CA	2.46	451	12	137%
Charleston-North Charleston, SC	2.28	479	7	195%
Winston-Salem, NC	2.19	402	3	155%
Kennewick-Richland-Pasco, WA	1.94	153	4	165%
Corpus Christi, TX	1.87	255	2	198%
Lubbock, TX	1.72	167	5	121%
Madison, WI	1.72	440	7	124%
Utica-Rome, NY	1.69	165	1	105%
South Bend-Mishawaka, IN-MI	1.67	202	2	187%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Decatur, IL	90.84	4,311	8	182%
Victoria, TX	45.57	1,787	6	223%
Blacksburg-Christiansburg-Radford, VA	19.13	935	3	205%
Danville, IL	14.79	374	2	104%
Pocatello, ID	14.54	401	13	183%
Morristown, TN	13.94	600	1	196%
Lafayette, IN	9.96	640	4	238%
Valdosta, GA	9.14	378	7	184%
Decatur, AL	8.06	375	2	118%
Sioux City, IA-NE-SD	7.28	458	8	203%
Champaign-Urbana, IL	6.85	508	2	177%
St. Joseph, MO-KS	5.53	237	7	171%
Kankakee-Bradley, IL	5.05	181	3	159%
Pascagoula, MS	4.83	199	1	179%
Janesville, WI	4.35	256	3	149%
Longview, WA	3.62	112	1	214%
Owensboro, KY	3.50	138	2	166%
Yuma, AZ	3.16	160	2	168%
Hanford-Corcoran, CA	3.10	86	4	154%
Joplin, MO	2.89	195	4	162%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Large and Specialized Metropolitan Areas

Four metropolitan statistical areas can be considered to have employment bases in the agricultural feedstock and chemicals subsector that are both large and specialized (Table 6). A region characterized as large and specialized meets two thresholds: an employment base in the subsector that meets or exceeds 2.0 percent of total U.S. subsector employment (large) and a location quotient that meets or exceeds 1.20 (specialized). These metropolitan areas have a significant presence and influence within the agricultural feedstock and chemicals industry.

Table 6. Metropolitan Areas with Large and Specialized Employment in the Agricultural Feedstock and Chemicals Subsector, 2004

Metropolitan Area	Employment, 2004	Share of U.S. Subsector Empl, 2004	LQ, 2004	Avg. Wages, 2004	Principal Key Component	Metro Size
Houston-Baytown-Sugar Land, TX	5,989	5.4%	3.07	\$83,072	Organic & Ag Chemicals	LARGE
Decatur, IL	4,311	3.9%	90.84	\$67,012	Agricultural Feedstock	SMALL
Lakeland, FL	3,236	2.9%	19.27	\$55,172	Organic & Ag Chemicals	MEDIUM
Baton Rouge, LA	3,092	2.8%	11.46	\$83,272	Organic & Ag Chemicals	LARGE

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Emerging Metropolitan Areas

The metropolitan statistical areas shown in Table 7 meet the requirements of an “emerging” region in the agricultural feedstock and chemicals subsector. Specifically, each has 2004 employment that is more than 500 but fewer than 5,000, and has experienced job growth of at least 20 percent during the 2001 to 2004 time period.

Table 7. Emerging Metropolitan Statistical Areas in the Agricultural Feedstock and Chemicals Subsector, by overall size of Region, 2004

LARGE MSAs	MEDIUM MSAs	SMALL MSAs
Allentown-Bethlehem-Easton, PA-NJ	Lakeland, FL	Decatur, IL
Charlotte-Gastonia-Concord, NC-SC		
Greensboro-High Point, NC		
Nashville-Davidson--Murfreesboro, TN		
New Orleans-Metairie-Kenner, LA		
New York-N. New Jersey-Long Island, NY-NJ-PA		
Riverside-San Bernardino-Ontario, CA		
St. Louis, MO-IL		

Regional profile: St. Louis, Missouri

The Regional Story

St. Louis is a large, multicounty metro area that is specialized in research, testing and medical laboratories and “concentrated” in drugs and pharmaceuticals. As the region organized its bioscience development efforts in the last decade, it has focused on industrial strengths in ag-biotech and biologics, and on spin-offs from the large research enterprise at Washington University in St. Louis.

Capital has flowed to existing technology centers in St. Louis and St. Charles counties, and to the multi-institutional medical district in St. Louis City where a long-standing life science business incubator anchors a new 185-acre research-park initiative known as Cortex. A second prominent bioscience incubator operates in suburban Creve Coeur, across from the privately endowed Donald Danforth Plant Science Center, built on land contributed by Monsanto.

Strategy: Custodians, Elements and Coordination

What is now known as the St. Louis Plant and Life Sciences Strategy was commissioned from Battelle by the St. Louis Regional Chamber and Growth Association and funded by the Danforth Foundation. Long interested in food and agriculture, the foundation had already invested \$60 million creating the Danforth Center (and \$100 million in parallel capacity at Washington University) when its interest turned to promoting science-based economic development in the region.

Working with business leadership at Regional Chamber and Growth Association, the Danforth Foundation funded full-time staff for a Regional Plant and Life Science Coalition that aggressively branded the region as the “BioBelt.” The Coalition’s leadership and staff mobilized institutional and private investors to attract several hundred million dollars in new venture capital to the region, with deal flow now

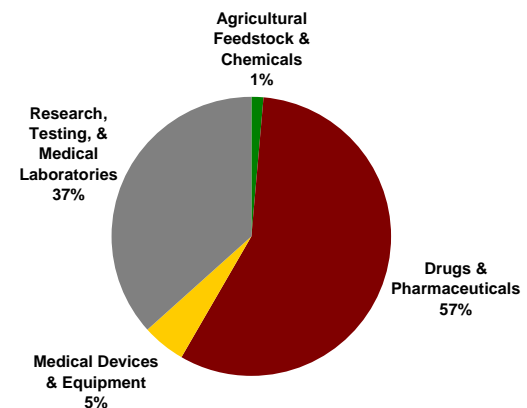
fed by BioGenerator, a non-profit technology commercialization organization supported by the business and philanthropic community.

The regional effort in turn energized creation of a statewide BIO affiliate and caused state government to create its own life science strategy that links efforts in St. Louis, Kansas City and Columbia. The state plans to allocate certain tobacco-settlement monies to research aimed at long-term economic development.

Notable Recent Successes

In the past few years, the St. Louis region has seen major expansions by Pfizer (a \$200 million R&D center), Sigma-Aldrich, and Tyco’s Mallinckrodt unit, among others. The Cortex project received a boost when Stereotaxis, a recent bioscience IPO born at the midtown Center for Emerging Technologies incubator, graduated into space in Cortex’s new 170,000 square-foot multi-tenant wet lab. Additional wet lab space is being developed on the Danforth Center’s land.

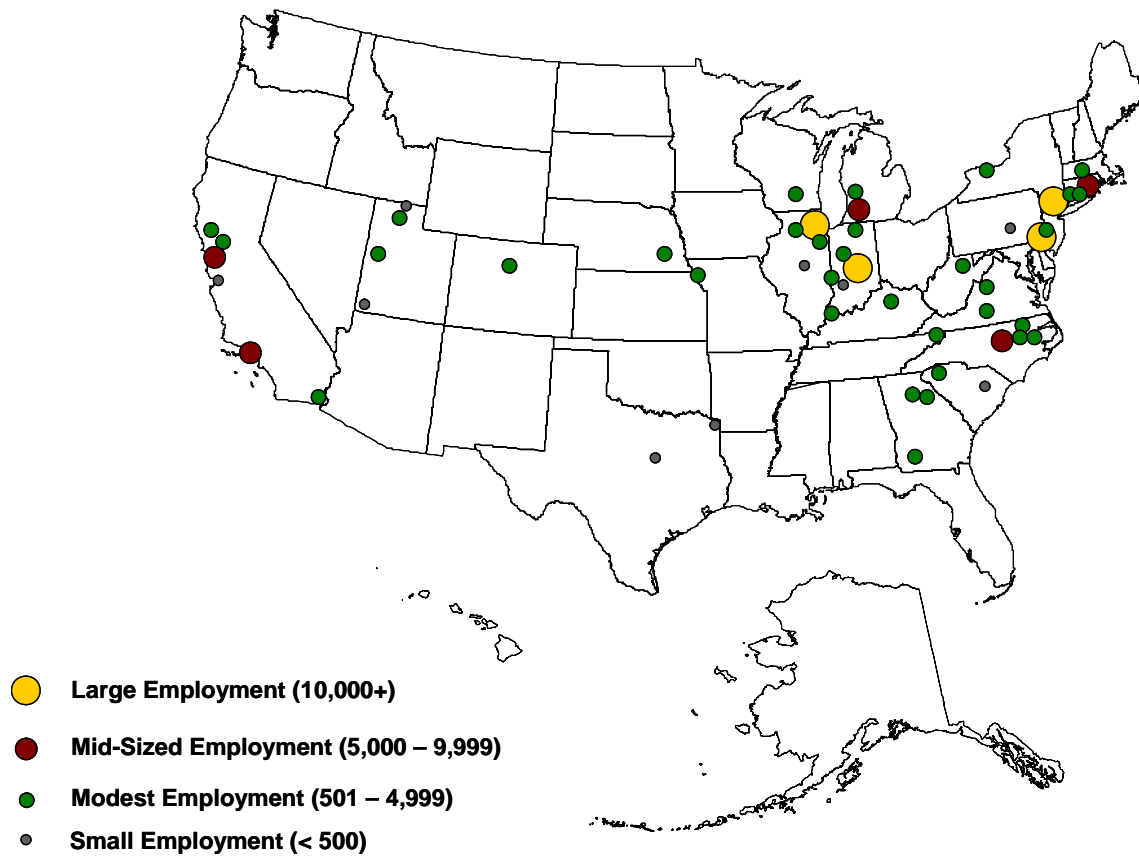
**Bioscience
Employment
Distribution:
St. Louis, MO**
Specialized
Employment
Concentration in
*Research, Testing,
and Medical
Laboratories*



Drugs and Pharmaceuticals

The drugs and pharmaceuticals subsector produces commercially available medicinal and diagnostic substances. Firms are generally large and multinational and are heavily engaged in R&D activities to bring drugs to market. The principal components of the subsector include 1) therapeutics and 2) diagnostic substances.

Figure 4. Metropolitan Statistical Areas Highly Specialized in Drugs and Pharmaceuticals (Location Quotient of 1.50 or above), 2004



LARGE EMPLOYMENT
New York-N. New Jersey-Long Island, NY-NJ-PA
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Chicago-Naperville-Joliet, IL-IN-WI
Indianapolis, IN
MID-SIZED EMPLOYMENT
San Francisco-Oakland-Fremont, CA
Durham, NC
Oxnard-Thousand Oaks-Ventura, CA
Kalamazoo-Portage, MI
Norwich-New London, CT

Product Examples Include:	Vaccines; oncology, neurology, and cardiology treatments; tissue and cell culture media; herbal supplements; and diagnostic substances.
Metropolitan Statistical Areas that are both Large and Specialized:	New York-Northern New Jersey-Long Island, NY-NJ-PA; Philadelphia-Camden-Wilmington, PA-NJ-DE-MD; Chicago-Naperville-Joliet, IL-IN-WI; Indianapolis, IN; San Francisco-Oakland-Fremont, CA; Durham, NC; and Oxnard-Thousand Oaks-Ventura, CA.

Overview

In 2004, the drugs and pharmaceuticals subsector employed one in four U.S. bioscience workers (313,207). The subsector spans 2,587 business establishments, yielding a workers-per-establishment metric of 121, largest among the bioscience subsectors. Also highest among the four major subsectors are earnings of drug and pharmaceutical workers—\$79,303 in 2004, substantially higher than the average bioscience wage, \$65,775. The national drugs and pharmaceuticals industry grew employment by 2.7 percent from 2001 to 2004, this despite being part of an overall manufacturing sector that shed a significant share of its jobs.

More than other bioscience subsectors, drug and pharmaceutical employment tends to be concentrated in a smaller number of states and metropolitan areas. Among the 246 metropolitan statistical areas with some 2004 employment in drugs and pharmaceuticals, 58 can be considered “specialized” (LQ of 1.20 or above). The preceding national map highlights 51 of these regions that might be considered highly specialized, that is, their subsector LQ is at or above 1.50 (50 percent more concentrated than the national average).

Among the highly specialized metropolitan areas shown on the national map, four regions have employment levels that exceed 10,000: New York, Philadelphia, Chicago, and Indianapolis. In this and other bioscience subsectors, the maps generally reveal strong regional clusters of metropolitan areas that surround these major centers of economic activity in the biosciences. Indiana, for example, is home to all or part of 7 different metropolitan areas that meet or exceed the 1.50 location quotient threshold. Effective clustering of resources including university research, a talented labor force, availability of investment capital, and strong local firms that anchor the industry result in a strong bioscience industry at the regional level.

Employment Size

Reflecting the relatively concentrated nature of the drugs and pharmaceuticals sector, 70 percent of national subsector jobs can be found within the top 40 metropolitan area employers. Table 8 presents these top 40 centers of drug and pharmaceutical activity and the share of total bioscience jobs these account for in each region.

Table 8. Metropolitan Statistical Areas with the Largest Employment in Drugs and Pharmaceuticals and Subsector Share of Total Bioscience Employment, 2004

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
New York-Northern New Jersey-Long Island, NY-NJ-PA	51,978	47.0%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	20,819	39.3%
Chicago-Naperville-Joliet, IL-IN-WI	18,480	40.2%
Indianapolis, IN	14,523	60.4%
Los Angeles-Long Beach-Santa Ana, CA	12,058	18.2%
San Francisco-Oakland-Fremont, CA	9,775	27.9%
Durham, NC	8,226	57.0%
Oxnard-Thousand Oaks-Ventura, CA	6,131	72.5%
Boston-Cambridge-Quincy, MA-NH	5,984	14.1%
Kalamazoo-Portage, MI	5,387	71.2%
Norwich-New London, CT	5,137	78.4%
San Diego-Carlsbad-San Marcos, CA	4,353	18.2%
Raleigh-Cary, NC	3,837	49.6%
Dallas-Fort Worth-Arlington, TX	3,777	22.4%
St. Louis, MO-IL	3,391	24.3%
Baltimore-Towson, MD	3,382	27.3%
New Haven-Milford, CT	2,591	29.0%
Miami-Fort Lauderdale-Miami Beach, FL	2,446	14.3%
San Jose-Sunnyvale-Santa Clara, CA	2,181	8.7%
Kansas City, MO-KS	2,169	20.6%
Washington-Arlington-Alexandria, DC-VA-MD-WV	2,165	10.2%
Greenville, SC	2,043	60.3%
Bridgeport-Stamford-Norwalk, CT	1,956	31.0%
Riverside-San Bernardino-Ontario, CA	1,900	21.3%
Austin-Round Rock, TX	1,851	31.4%
Vallejo-Fairfield, CA	1,820	90.0%
Cincinnati-Middletown, OH-KY-IN	1,783	29.3%
Minneapolis-St. Paul-Bloomington, MN-WI	1,781	6.2%
Rochester, NY	1,703	23.1%
Lincoln, NE	1,661	43.5%
Provo-Orem, UT	1,621	71.2%
Houston-Baytown-Sugar Land, TX	1,594	10.0%
Providence-New Bedford-Fall River, RI-MA	1,574	18.6%
Boulder, CO	1,553	28.2%
Morgantown, WV	1,553	97.3%

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Buffalo-Niagara Falls, NY	1,544	23.2%
Columbus, OH	1,494	24.3%
Evansville, IN-KY	1,494	80.7%
Rocky Mount, NC	1,462	95.2%
Madison, WI	1,458	25.0%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Employment Concentration

The concentration of high-paying drugs and pharmaceuticals jobs are critical to regional economies. Table 9 presents those metropolitan areas of varying sizes with a significant stake in this bioscience subsector. The table is broken into three parts, each highlighting those 20 regions of a similar size with the highest degree of employment concentration relative to the nation.

Table 9. Metropolitan Statistical Areas with the Highest Location Quotients in Drugs and Pharmaceuticals, by Size of Metro Area, Employment, Establishments, and Relative Average Wages, 2004

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
Oxnard-Thousand Oaks-Ventura, CA	8.84	6,131	13	367%
Indianapolis, IN	7.66	14,523	10	242%
Raleigh-Cary, NC	4.08	3,837	14	186%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	3.44	20,819	77	201%
New Haven-Milford, CT	3.13	2,591	11	257%
New York-Northern New Jersey-Long Island, NY-NJ-PA	2.92	51,978	283	164%
San Francisco-Oakland-Fremont, CA	2.20	9,775	70	273%
Bridgeport-Stamford-Norwalk, CT	2.02	1,956	11	156%
Chicago-Naperville-Joliet, IL-IN-WI	1.89	18,480	88	184%
Worcester, MA	1.70	1,218	9	186%
Rochester, NY	1.56	1,703	4	201%
San Diego-Carlsbad-San Marcos, CA	1.56	4,353	76	175%
Austin-Round Rock, TX	1.36	1,851	12	107%
Buffalo-Niagara Falls, NY	1.34	1,544	10	167%
Baltimore-Towson, MD	1.27	3,382	33	150%
St. Louis, MO-IL	1.14	3,391	54	161%
Richmond, VA	1.14	1,413	4	159%
Boston-Cambridge-Quincy, MA-NH	1.12	5,984	80	193%
Greensboro-High Point, NC	1.11	899	5	158%
San Jose-Sunnyvale-Santa Clara, CA	1.07	2,181	31	116%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
MEDIUM MSAs (TOTAL PRIVATE EMPLOYMENT BETWEEN 75,000 AND 250,000):				
Norwich-New London, CT	21.84	5,137	2	245%
Kalamazoo-Portage, MI	17.12	5,387	4	272%
Durham, NC	15.34	8,226	14	205%
Vallejo-Fairfield, CA	6.76	1,820	7	187%
Lincoln, NE	5.01	1,661	3	177%
Provo-Orem, UT	4.73	1,621	17	129%
Boulder, CO	4.58	1,553	14	170%
Evansville, IN-KY	3.70	1,494	3	238%
Kingsport-Bristol-Bristol, TN-VA	3.40	909	2	226%
Holland-Grand Haven, MI	3.34	870	10	164%
Greenville, SC	3.25	2,043	10	142%
Lynchburg, VA	2.91	636	2	188%
Elkhart-Goshen, IN	2.49	758	3	162%
Santa Cruz-Watsonville, CA	2.38	499	4	110%
Trenton-Ewing, NJ	2.22	915	14	156%
Madison, WI	2.20	1,458	24	146%
Ogden-Clearfield, UT	2.11	783	18	144%
Lexington-Fayette, KY	1.99	1,018	7	176%
Rockford, IL	1.82	643	6	139%
Waco, TX	1.54	328	2	188%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Morgantown, WV	15.26	1,553	1	249%
Kankakee-Bradley, IL	10.97	1,013	4	225%
Rocky Mount, NC	10.61	1,462	2	180%
Harrisonburg, VA	9.28	1,205	1	266%
Greenville, NC	9.03	1,190	3	200%
Terre Haute, IN	7.87	1,191	3	257%
Athens-Clarke County, GA	7.00	987	4	220%
Lafayette, IN	6.68	1,110	2	227%
St. Joseph, MO-KS	6.36	705	5	179%
Logan, UT-ID	5.12	499	4	180%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Albany, GA	4.94	640	2	280%
Lebanon, PA	4.92	494	2	243%
Napa, CA	4.82	703	2	202%
Gainesville, GA	3.84	581	4	180%
St. George, UT	2.85	280	3	113%
Decatur, IL	2.70	331	1	194%
Bloomington, IN	2.18	312	4	238%
Florence, SC	2.00	361	1	122%
Texarkana, TX-Texarkana, AR	1.70	183	3	143%
Winchester, VA-WV	1.36	165	1	227%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Large and Specialized Metropolitan Areas

Regions of both a significant size and concentration of drugs and pharmaceuticals jobs are critical to highlight. As leaders in the economic base of the subsector, other metropolitan areas can look to these for a model or blueprint in their targeted efforts to grow. Seven MSAs have at least a 2 percent share of national employment in drugs and pharmaceuticals as well as a LQ that is at or above 1.20 (Table 10).

The key component sector for each of these metropolitan areas, therapeutics, reflects the fact that nearly all of the national drugs and pharmaceuticals sector is involved in the production of therapeutics. Diagnostics manufacturing makes up a smaller share of the overall industry. Most of these large metropolitan areas have significant employment not only in drugs and pharmaceuticals, but also among other of the major bioscience subsectors. Only Indianapolis (60 percent of employment in drugs and pharmaceuticals), Durham (57 percent), and Oxnard-Thousand Oaks-Ventura (73 percent) are heavily concentrated in this particular subsector (have a majority of bioscience employment in this subsector).

Table 10. Metropolitan Areas with Large and Specialized Employment in the Drugs and Pharmaceuticals Subsector, 2004

Metropolitan Area	Employment, 2004	Share of U.S. Subsector Empl, 2004	LQ, 2004	Avg. Wages, 2004	Principal Key Component	Metro Size
New York-Northern New Jersey-Long Island, NY-NJ-PA	51,978	18.1%	2.92	\$92,245	Therapeutics	LARGE
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	20,819	7.2%	3.44	\$89,715	Therapeutics	LARGE
Chicago-Naperville-Joliet, IL-IN-WI	18,480	6.4%	1.89	\$83,200	Therapeutics	LARGE
Indianapolis, IN	14,523	5.1%	7.66	\$94,629	Therapeutics	LARGE
San Francisco-Oakland-Fremont, CA	9,775	3.4%	2.20	\$152,007	Therapeutics	LARGE
Durham, NC	8,226	2.9%	15.34	\$95,068	Therapeutics	MEDIUM
Oxnard-Thousand Oaks-Ventura, CA	6,131	2.1%	8.84	\$154,203	Therapeutics	LARGE

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Emerging Metropolitan Areas

The metropolitan statistical areas shown in Table 11 meet the requirements of an “emerging” region in the drugs and pharmaceuticals subsector. Specifically, each has 2004 employment that is more than 500 but fewer than 5,000, and has experienced job growth of at least 20 percent during the 2001 to 2004 time period.

Table 11. Emerging Metropolitan Statistical Areas in the Drugs and Pharmaceuticals Subsector, by overall size of Region, 2004

LARGE MSAs	MEDIUM MSAs	SMALL MSAs
Albuquerque, NM	Lexington-Fayette, KY	Athens-Clarke County, GA
Cleveland-Elyria-Mentor, OH	Lincoln, NE	Gainesville, GA
Denver-Aurora, CO	Lynchburg, VA	
Portland-Vancouver-Beaverton, OR-WA	Portland-South Portland-Biddeford, ME	
Providence-New Bedford-Fall River, RI-MA	Rockford, IL	
Salt Lake City, UT	Trenton-Ewing, NJ	
St. Louis, MO-IL	Vallejo-Fairfield, CA	
Worcester, MA		

Regional Profile: Philadelphia, Pennsylvania

The Regional Story

Philadelphia is a large, multi-county metro area with specialization in three of the four bioscience subsectors studied by Battelle. The state has several regions with bioscience strengths, but Philadelphia is the only one with a historic presence by the pharmaceutical and fine-chemical industry.

Building on this base, and driven largely by the research and clinical strengths of the University of Pennsylvania medical complex, the Route 202 corridor west and north of the city has emerged as a bioscience cluster over the past couple of decades, with sustained support from the various programs of the Ben Franklin Partners of Southeastern Pennsylvania.

In recent years, efforts have intensified both within Penn and in outside organizations to stimulate more spin-off formation and to keep more startups and spin-offs inside city limits, closer to the underlying research base. There is also enhanced focus on advanced medical devices.

Strategy: Custodians, Elements and Coordination

For nearly 25 years, Philadelphia has been the base for the southeastern node of the Ben Franklin Partners program, which operates four centers statewide that provide entrepreneurial support and seed-stage investment across a range of technologies including biosciences. In the last five years, Philadelphia also became the headquarters for BioAdvance, one of three regional “life science greenhouses” capitalized by the state’s tobacco settlement fund.

With a \$20 million capital base, BioAdvance substantially enhanced the amount of early-stage capital focused on creating viable spin-offs from university-based research. BioAdvance specifically targets ventures in biopharmaceuticals, bioinformatics, medical devices, and clinical trials infrastructure. Additional tobacco funds were invested by

the state in four venture capital firms with a statewide mandate, and three of these four are now based in the Philadelphia region.

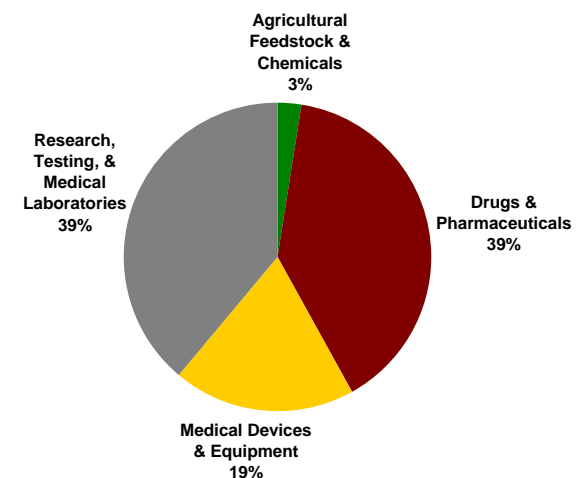
During this period, the city government also funded creation of Innovation Philadelphia, a nonprofit development entity that provides entrepreneurial support and training, manages an associated angel group, connects students to internships, and promotes the city and the region as a credible locus for advanced technology enterprises. Finally, the Science Center—a 40-year-old consortial research park located between Penn and Drexel—resumed building wet-lab space, equipped itself with an internal venture fund, and reoriented its activities to commercialization.

Notable Recent Successes

Collaborations between Penn and Drexel stimulated by the Ben Franklin Partners levered a major NSF Nanoscience and Technology Center focused on the bio/nano interface. Drexel’s heavy investment in its School of Biomedical Engineering led to its selection by the Coulter Foundation as one of only nine “translational partnership” centers nationwide.

Bioscience Employment Distribution: Philadelphia, PA

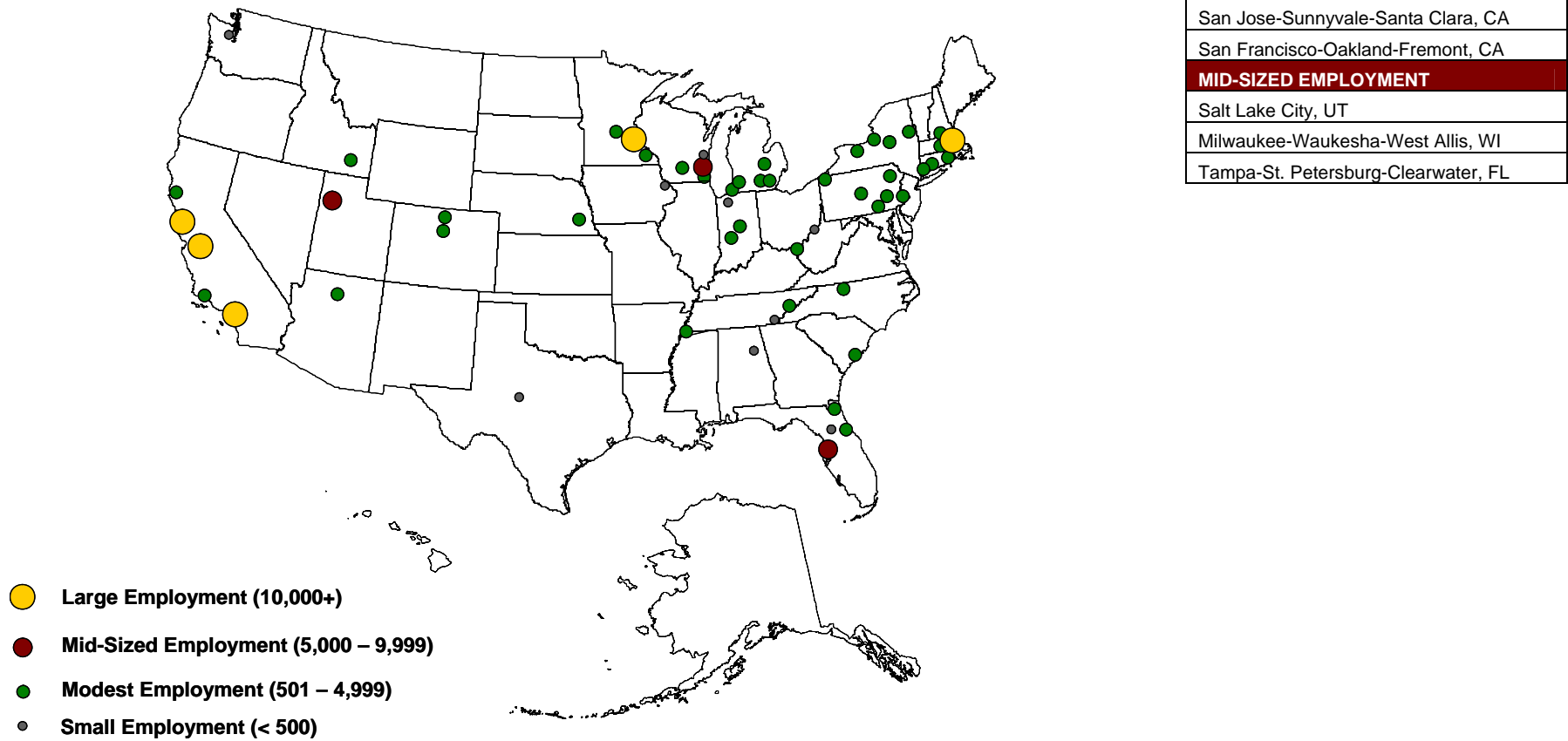
Specialized Employment Concentration in: *Drugs and Pharmaceuticals; Research, Testing, and Medical Laboratories; and in Medical Devices and Equipment*



Medical Devices and Equipment

Firms in the medical device and equipment subsector produce biomedical instruments and other health care products and supplies for diagnostics, surgery, patient care, and laboratories.

Figure 5. Metropolitan Statistical Areas Highly Specialized in Medical Devices and Equipment (Location Quotient of 1.50 or above), 2004



Product Examples Include:	Bioimaging equipment; orthopedic and prosthetic implants and devices; dental instruments and orthodontics; laser eye surgery equipment; defibrillators (AEDs); and stents and other implantable devices.
Metropolitan Statistical Areas that are both Large and Specialized:	Los Angeles-Long Beach-Santa Ana, CA; Minneapolis-St. Paul-Bloomington, MN-WI; Boston-Cambridge-Quincy, MA-NH; San Jose-Sunnyvale-Santa Clara, CA; San Francisco-Oakland-Fremont, CA; Philadelphia-Camden-Wilmington, PA-NJ-DE-MD; and Salt Lake City, UT.

Overview

Medical device and equipment manufacturing embodies biotechnologies derived from scientific research, testing, advanced materials, and cutting-edge engineering and manufacturing capabilities. The subsector produces state-of-the-art biomedical devices and laboratory and surgical equipment. National employment in medical devices was 411,460 in 2004, or about one-third of total U.S. bioscience jobs, and spanned 15,190 establishments. Subsector employment was down 3.6 percent from 2001. Though it shed jobs, it fared better than the overall manufacturing sector which decreased by 13 percent during this same time period.

The average worker in the medical device subsector earned \$56,449 in 2004, lower than for the overall bioscience sector (\$65,775), but still higher than the private sector average (\$39,003). Reflecting the profitable and advanced nature of this manufacturing niche, average workers earn considerably more than their counterparts in the rest of the manufacturing sector (\$47,705).

Among the 246 metropolitan areas with some employment in medical device manufacturing, 73 are specialized (LQ at or above 1.20). More regions have an employment specialization in this subsector than for any other. Among these 73 specialized regions, 57 have a concentration that is 50 percent greater than the national average (LQ of 1.50 or above) and are featured in the national map above. Five of these highly specialized metropolitan areas have employment levels that exceed 10,000: Los Angeles, Minneapolis, Boston, San Jose, and San Francisco.

Several states have numerous metropolitan areas with highly concentrated employment in medical devices—Pennsylvania, Michigan, California, New York, and Wisconsin.

Employment Size

The 40 largest metropolitan areas in terms of medical device employment are presented in Table 12. The largest range from Los Angeles with more than 28,000 employed to Phoenix with over 2,200. Employment among these top 40 regions account for more than 60 percent of the national total.

While each of these 40 metro areas have a large presence in the medical device subsector, the majority do not count this subsector as their primary bioscience sector. Twenty five have less than 50 percent of their total bioscience base in medical devices, signaling a strong variety of bioscience activity. While it is important for regions to have a strong specialty, some excel at more than one. It is clear that metropolitan areas like Minneapolis (81 percent in medical devices), Jacksonville, FL (74 percent in medical devices), and Bloomington, IN (87 percent in medical

devices) have a distinct niche in this particular subsector. Regions like Los Angeles (43 percent), New York (17 percent), and Philadelphia, have large medical device sectors, but also employment in some combination of the 3 other subsectors.

Table 12. Metropolitan Statistical Areas with the Largest Employment in Medical Devices and Equipment and Subsector Share of Total Bioscience Employment, 2004

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Los Angeles-Long Beach-Santa Ana, CA	28,304	42.8%
Minneapolis-St. Paul-Bloomington, MN-WI	23,148	80.9%
New York-Northern New Jersey-Long Island, NY-NJ-PA	19,252	17.4%
Boston-Cambridge-Quincy, MA-NH	15,874	37.5%
San Jose-Sunnyvale-Santa Clara, CA	12,485	49.9%
Chicago-Naperville-Joliet, IL-IN-WI	12,337	26.8%
San Francisco-Oakland-Fremont, CA	11,832	33.7%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	10,277	19.4%
Salt Lake City, UT	8,208	65.2%
Miami-Fort Lauderdale-Miami Beach, FL	7,639	44.5%
Dallas-Fort Worth-Arlington, TX	6,648	39.4%
Milwaukee-Waukesha-West Allis, WI	6,360	60.0%
Tampa-St. Petersburg-Clearwater, FL	6,083	48.3%
Seattle-Tacoma-Bellevue, WA	5,798	42.6%
San Diego-Carlsbad-San Marcos, CA	5,559	23.2%
Pittsburgh, PA	5,065	45.2%
Indianapolis, IN	4,808	20.0%
Atlanta-Sandy Springs-Marietta, GA	4,744	46.2%
Providence-New Bedford-Fall River, RI-MA	4,579	54.2%
Cleveland-Elyria-Mentor, OH	4,452	52.5%
Riverside-San Bernardino-Ontario, CA	4,430	49.7%
Rochester, NY	4,293	58.3%
Denver-Aurora, CO	3,890	50.4%
New Haven-Milford, CT	3,636	40.7%
Portland-Vancouver-Beaverton, OR-WA	3,568	51.2%
Memphis, TN-MS-AR	3,477	46.8%
Jacksonville, FL	3,448	73.7%
St. Louis, MO-IL	3,174	22.8%
Houston-Baytown-Sugar Land, TX	3,135	19.7%
Detroit-Warren-Livonia, MI	2,985	22.2%
Bloomington, IN	2,778	86.9%
Madison, WI	2,752	47.1%

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Boulder, CO	2,748	49.9%
Bridgeport-rStamford-Norwalk, CT	2,743	43.5%
Worcester, MA	2,722	50.3%
Santa Rosa-Petaluma, CA	2,712	77.7%
Glens Falls, NY	2,431	99.1%
Scranton-Wilkes-Barre, PA	2,319	75.7%
Santa Barbara-Santa Maria-Goleta, CA	2,312	67.8%
Phoenix-Mesa-Scottsdale, AZ	2,217	27.4%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Employment Concentration

The 20 metropolitan areas with the highest location quotients in each of the small, medium, and large sized classifications are shown in Table 13. Each of these regions is heavily engaged in the advanced manufacturing of medical devices.

Table 13. Metropolitan Statistical Areas with the Highest Location Quotients in Medical Devices and Equipment, by Size of Metro Area, Employment, Establishments, and Relative Average Wages, 2004

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
Salt Lake City, UT	4.79	8,208	120	125%
San Jose-Sunnyvale-Santa Clara, CA	4.41	12,485	247	139%
Minneapolis-St. Paul-Bloomington, MN-WI	4.27	23,148	317	173%
New Haven-Milford, CT	3.16	3,636	70	119%
Rochester, NY	2.83	4,293	48	188%
Worcester, MA	2.73	2,722	51	274%
Milwaukee-Waukesha-West Allis, WI	2.40	6,360	130	191%
Boston-Cambridge-Quincy, MA-NH	2.14	15,874	349	131%
Knoxville, TN	2.11	2,039	51	127%
Providence-New Bedford-Fall River, RI-MA	2.06	4,579	116	175%
Bridgeport-Stamford-Norwalk, CT	2.04	2,743	61	96%
Jacksonville, FL	1.98	3,448	59	166%
San Francisco-Oakland-Fremont, CA	1.92	11,832	352	167%
Memphis, TN-MS-AR	1.86	3,477	58	165%
Indianapolis, IN	1.83	4,808	81	178%
Allentown-Bethlehem-Easton, PA-NJ	1.64	1,681	33	129%
Los Angeles-Long Beach-Santa Ana, CA	1.61	28,304	865	140%
Tampa-St. Petersburg-Clearwater, FL	1.61	6,083	179	130%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
Pittsburgh, PA	1.44	5,065	122	149%
San Diego-Carlsbad-San Marcos, CA	1.43	5,559	230	176%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
MEDIUM MSAs (TOTAL PRIVATE EMPLOYMENT BETWEEN 75,000 AND 250,000):				
Boulder, CO	5.83	2,748	39	126%
Santa Rosa-Petaluma, CA	4.57	2,712	53	185%
Santa Barbara-Santa Maria-Goleta, CA	4.22	2,312	42	179%
Kalamazoo-Portage, MI	4.06	1,773	16	188%
Utica-Rome, NY	3.52	1,233	17	121%
Reading, PA	3.20	1,669	24	158%
St. Cloud, MN	3.05	902	17	99%
Madison, WI	3.00	2,752	49	171%
Scranton--Wilkes-Barre, PA	2.91	2,319	33	114%
Fort Collins-Loveland, CO	2.41	889	26	133%
Charleston-North Charleston, SC	2.40	1,816	23	125%
York-Hanover, PA	2.13	1,170	18	199%
Deltona-Daytona Beach-Ormond Beach, FL	2.12	1,034	29	155%
Lincoln, NE	2.08	957	13	150%
Saginaw-Saginaw Township North, MI	2.05	589	13	179%
Syracuse, NY	1.98	1,803	32	153%
Winston-Salem, NC	1.92	1,267	25	87%
Ann Arbor, MI	1.90	913	28	122%
Huntington-Ashland, WV-KY-OH	1.81	601	15	121%
Ocala, FL	1.64	456	15	114%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Glens Falls, NY	15.77	2,431	12	137%
Bloomington, IN	13.96	2,778	17	130%
Flagstaff, AZ	7.36	1,101	6	163%
Pocatello, ID	4.00	396	6	116%
State College, PA	3.26	503	12	159%
Jackson, MI	3.07	548	14	120%
Dubuque, IA	2.82	485	7	129%
Niles-Benton Harbor, MI	2.72	545	12	128%
Michigan City-La Porte, IN	2.33	319	9	90%
Anniston-Oxford, AL	2.33	313	6	68%
Racine, WI	2.16	527	14	107%
Parkersburg-Marietta, WV-OH	2.06	448	8	135%
Cleveland, TN	2.03	256	7	120%
Bremerton-Silverdale, WA	1.58	304	14	118%
San Angelo, TX	1.52	194	5	421%
Sheboygan, WI	1.50	293	5	113%
Corvallis, OR	1.49	143	8	116%
Gainesville, GA	1.49	312	20	103%
Lafayette, IN	1.31	303	7	123%
Bellingham, WA	1.23	280	17	113%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Regional Profile: Boulder, Colorado

The Regional Story

Though only a mid-sized metropolitan area, Boulder is one of only 15 metro areas found to be specialized in three of the four bioscience subsectors studied by Battelle. In part, this success manifests one aspect of Boulder's overall heritage as a technology center, dating to the 1950s, when the physical science and radio labs of what was then the National Bureau of Standards were relocated to land adjacent to the University of Colorado at Boulder. While much of the early impact of this collocation was felt in data-storage, software, and broadcasting technologies, the biosciences were developing in parallel fashion as CU physical sciences grew in strength.

In 1982, soon after the biotech revolution began, CU chemist Thomas Cech discovered the catalytic properties of RNA. Starting with Synergen in the early 1980s, a series of startups built on several CU-derived RNA technology platforms began to populate the Boulder-Longmont region, until then known mainly as a center of diversified and high-value manufacturing (including some in medical devices). Some of the main RNA technology players include Dharmacon (now a unit of Fisher Scientific), SomaLogic, and Ribozyme (now siRNA Therapeutics). Synergen itself was acquired by Amgen, which maintains a large manufacturing plant in Boulder.

Strategy: Custodians, Elements and Coordination

A central focus of the state's bioscience strategy, supported by the Colorado Bioscience Association is currently in Aurora, 20 miles from Boulder, where the Fitzsimons Army Hospital is converting to a new home for CU Health Sciences Center (formerly downtown) and an accompanying bioscience park and a new accelerator called the Fitzsimons BioBusiness Incubator.

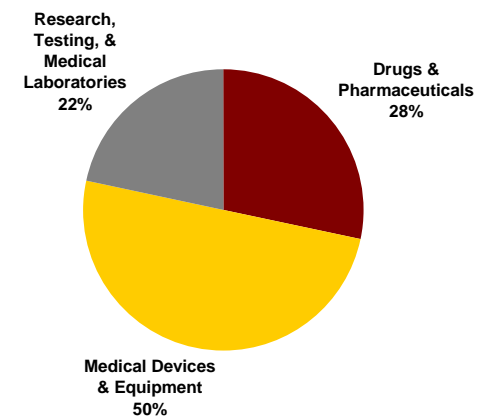
However, despite this new focus on the eastern side of the metro region, the biosciences continue to exhibit strong clustering in Boulder. One factor linking the two sub-regions is a CU System Technology Transfer Office (TTO) that provides services to all three CU campuses. The CU TTO has become particularly aggressive at leveraging the entrepreneurial community of the Front Range to CU technology. In the past four years, CU technology has formed the basis for 34 startups.

Notable Recent Successes

For the past two years, CU TTO has offered proof of concept *investments* of up to \$100,000 in startups emerging from CU discovery. Eight of 10 investments were in bioscience. Last year, it began proof of concept *grants* to faculty for pre-commercialization research, placing \$525,000 in 28 projects, the majority in biosciences. This program was augmented by state commitment of \$1 million matched by \$1 million from the CU Foundation, enabling grants up to \$200,000. Last year, Amgen announced a \$150 million expansion of its manufacturing plant.

Bioscience Employment Distribution: Boulder, CO

Specialized Employment Concentration in: *Medical Devices and Equipment; Drugs and Pharmaceuticals; and in Research, Testing, and Medical Laboratories*



Large and Specialized Metropolitan Areas

Seven metropolitan areas have a large employment base that also comprises a significant share of their overall employment relative to the rest of the U.S. These large and specialized regions are highlighted in Table 14. While Los Angeles has a small majority of its employment in the equipment and supplies component, the other six regions are more focused in the production of devices including electromedical and irradiation apparatus. As mentioned previously, Minneapolis has the majority of its bioscience employment in this medical device subsector. The other large and specialized regions have a relatively wider bioscience employment distribution.

Table 14. Metropolitan Areas with Large and Specialized Employment in the Medical Device and Equipment Subsector, 2004

Metropolitan Area	Employment, 2004	Share of U.S. Subsector Empl, 2004	LQ, 2004	Avg. Wages, 2004	Principal Key Component	Metro Size
Los Angeles-Long Beach-Santa Ana, CA	28,304	7.1%	1.61	\$62,402	Equipment & Supplies	LARGE
Minneapolis-St. Paul-Bloomington, MN-WI	23,148	5.8%	4.27	\$78,420	Devices	LARGE
Boston-Cambridge-Quincy, MA-NH	15,874	4.0%	2.14	\$70,200	Devices	LARGE
San Jose-Sunnyvale-Santa Clara, CA	12,485	3.1%	4.41	\$99,067	Devices	LARGE
San Francisco-Oakland-Fremont, CA	11,832	3.0%	1.92	\$92,656	Devices	LARGE
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	10,277	2.6%	1.22	\$58,938	Devices	LARGE
Salt Lake City, UT	8,208	2.1%	4.79	\$43,852	Devices	LARGE

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Emerging Metropolitan Areas

The metropolitan statistical areas shown in Table 15 meet the requirements of an “emerging” region in the medical devices and equipment subsector. Specifically, each has 2004 employment that is more than 500 but fewer than 5,000, and has experienced job growth of at least 20 percent during the 2001 to 2004 time period.

Table 15. Emerging Metropolitan Statistical Areas in the Medical Devices and Equipment Subsector, by overall size of Region, 2004

LARGE MSAs	MEDIUM MSAs	SMALL MSAs
Columbus, OH	Charleston-North Charleston, SC	Bloomington, IN
Indianapolis, IN	Fort Collins-Loveland, CO	Flagstaff, AZ
Memphis, TN-MS-AR	Greenville, SC	Racine, WI
Raleigh-Cary, NC	Madison, WI	
Washington-Arlington-Alexandria, DC-VA-MD-WV	Ogden-Clearfield, UT	
	Winston-Salem, NC	

Regional Profile: Flagstaff, Arizona

The Regional Story

Flagstaff owes its heavy specialization in medical devices among small metro areas mainly to the long-time presence of a major medical-products R&D facility of W. L. Gore & Associates, the large, privately held advanced materials company that started in 1958 as a spin-off of DuPont and is still headquartered in Delaware.

Northern Arizona University—a mid-sized public institution once known primarily for its exceptional environmental and natural-resource programs—has begun developing additional capacity in biomedicine to complement Gore’s expertise. More than one-third of Gore’s science and engineering staff have some connection to NAU.

Flagstaff owes a number of recent startups to managers who spent formative time in the Gore operation and want to pursue entrepreneurial visions while remaining in the region and enjoying the outdoor quality of life and the attributes of a college town. One example is Machine Solutions Inc., which sells equipment to medical-device manufacturers nationwide, and has gone from zero to 75 employees since 1999. Gore has also grown by acquiring startups, such as Neural Intervention Technologies, based on licenses from Arizona State and the University of Michigan.

Strategy: Custodians, Elements and Coordination

The Flinn Foundation of Phoenix, which commissioned the state’s overall roadmap, has insisted in equal participation by NAU in activities that might otherwise be dominated by larger cities and universities. For example, TGen, the Phoenix-based institute supported

by Flinn and many others to further anchor Arizona’s biosciences, has collaborated with NAU faculty who are building pathogen expertise useful in the biodefense sector and has established TGen North.

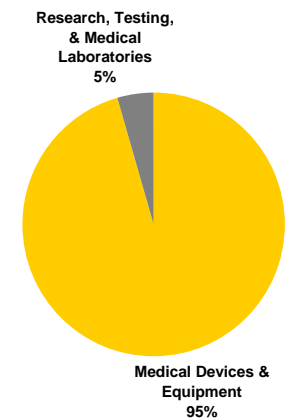
NAU’s overall bioscience efforts are spearheaded by the Strategic Alliance for Bioscience Research and Education (SABRE), which will coordinate applications to the Arizona Board of Regents infrastructure fund, the Arizona Biomedical Research Commission, and the newly created Science Foundation Arizona. The local strategy is also championed by the Greater Flagstaff Economic Council, an umbrella nonprofit economic development organization.

Notable Recent Successes

Gore has continued to expand in Flagstaff, consolidating certain cardiovascular operations there. It has opened a 32,000 square-foot expansion, is two thirds complete with a new 100,000 square-foot building, and has announced plans for another of similar size. Private developers are a planning multi-tenant science park near the NAU campus.

Bioscience Employment Distribution: Flagstaff, AZ

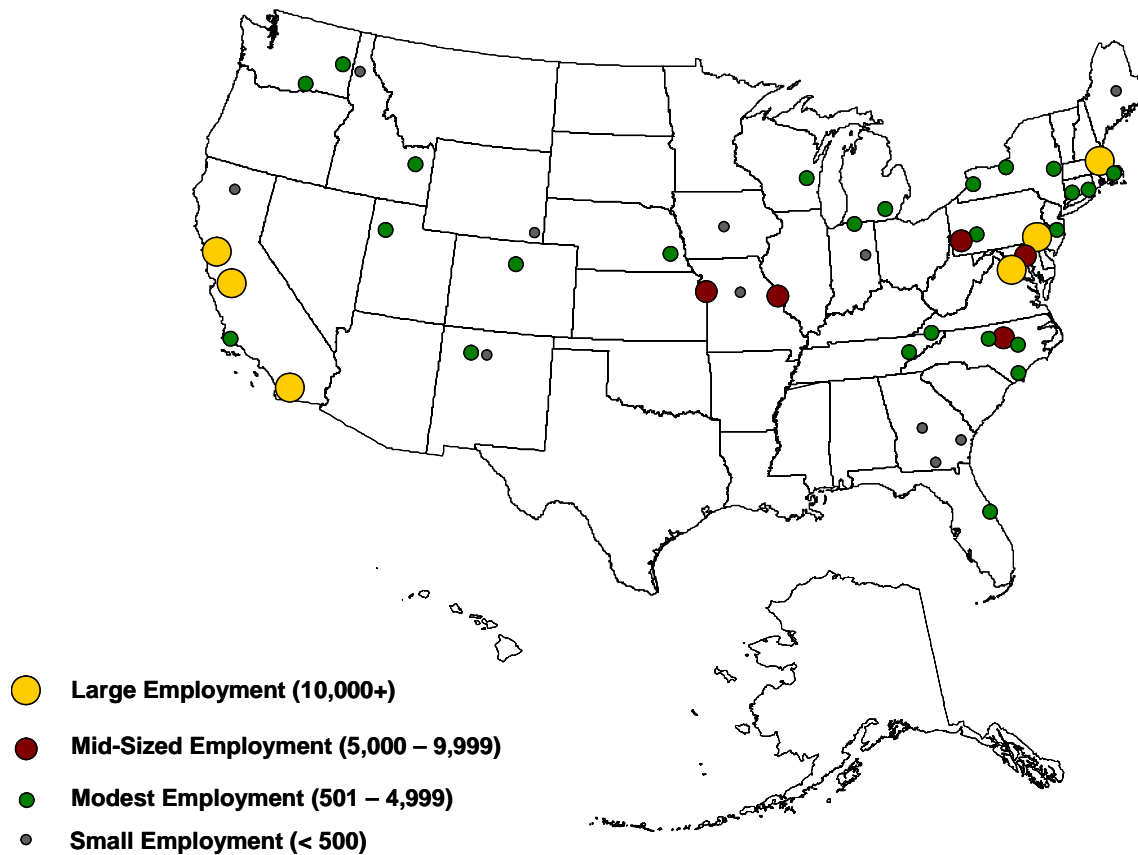
Specialized Employment Concentration in: *Medical Devices and Equipment*



Research, Testing, and Medical Laboratories

The research, testing, and medical laboratories subsector includes a range of activities, from highly research-oriented companies developing and commercializing new drug discovery/delivery systems, to more service-oriented medical or other testing firms.

Figure 6. Metropolitan Statistical Areas Highly Specialized in Research, Testing, and Medical Labs (Location Quotient of 1.50 or above), 2004



LARGE EMPLOYMENT
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Boston-Cambridge-Quincy, MA-NH
Washington-Arlington-Alexandria, DC-VA-MD-WV
San Diego-Carlsbad-San Marcos, CA
San Francisco-Oakland-Fremont, CA
San Jose-Sunnyvale-Santa Clara, CA
MID-SIZED EMPLOYMENT
Baltimore-Towson, MD
St. Louis, MO-IL
Kansas City, MO-KS
Pittsburgh, PA
Durham, NC

Product Examples Include:	Functional genomics and drug discovery techniques; diagnostic testing; preclinical drug therapeutics; protein receptors; and research models and laboratory support services.
Metropolitan Statistical Areas that are both Large and Specialized:	New York-Northern New Jersey-Long Island, NY-NJ-PA; Los Angeles-Long Beach-Santa Ana, CA; Philadelphia-Camden-Wilmington, PA-NJ-DE-MD; Boston-Cambridge-Quincy, MA-NH; Washington-Arlington-Alexandria, DC-VA-MD-WV; San Diego-Carlsbad-San Marcos, CA; San Francisco-Oakland-Fremont, CA; San Jose-Sunnyvale-Santa Clara, CA; and Detroit-Warren-Livonia, MI.

Overview

The research, testing, and medical laboratories subsector contributes to the bioscience industry an array of both life sciences research and commercial activities. Overall, the subsector employed 413,550 U.S. workers in 2004, or one-third of all bioscience employment. With strong job growth during the 2001 to 2004 period (up 8.2 percent), the industry surpassed the medical device subsector as the largest component subsector of the biosciences. Research, testing, and medical laboratories also account for the most business establishments among the major subsectors, with 20,565 in 2004. The average worker in the subsector earned \$65,414 in 2004, about the same as the overall average for the biosciences.

Among the 360 U.S. metropolitan areas with some employment in the research, testing, and medical laboratories subsector, 65 had a location quotient that met or exceeded the 1.20 required to be considered specialized. Of these 65 specialized regions, 47 have a LQ of 1.50 or greater and are featured in the national map on the preceding page. While these highly specialized metropolitan areas are widespread geographically, the large centers of subsector employment are located on the east and west coasts. The following metropolitan areas have at least a 1.50 location quotient and 10,000 subsector jobs: Philadelphia, Boston, Washington, DC, San Diego, San Francisco, and San Jose.

Employment Size

Table 16 presents the 40 largest metropolitan area employers in the U.S. research, testing, and medical labs subsector. These regions account for just over 70 percent of total national subsector employment. Top 40 employment ranges from the New York City metropolitan area's more than 35,000 jobs to the Milwaukee area's more than 2,100.

As with other major subsectors, the share of total bioscience jobs that this sector accounts for provides a revealing look at the overall composition of each metro's bioscience industry. Among the five largest regional employers in the research, testing, and medical labs subsector are New York, Los Angeles, and Philadelphia where this subsector makes up only about one-third of their bioscience base; and the Washington, DC region where the subsector accounts for the vast majority of its overall bioscience employment, about 81 percent.

Table 16. Metropolitan Statistical Areas with the Largest Employment in Research, Testing, and Medical Laboratories and Subsector Share of Total Bioscience Employment, 2004

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
New York-Northern New Jersey-Long Island, NY-NJ-PA	35,228	31.9%
Los Angeles-Long Beach-Santa Ana, CA	24,886	37.6%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	20,578	38.8%
Boston-Cambridge-Quincy, MA-NH	20,051	47.4%
Washington-Arlington-Alexandria, DC-VA-MD-WV	17,168	80.5%
San Diego-Carlsbad-San Marcos, CA	13,927	58.2%
San Francisco-Oakland-Fremont, CA	12,831	36.6%
Chicago-Naperville-Joliet, IL-IN-WI	12,187	26.5%
San Jose-Sunnyvale-Santa Clara, CA	10,356	41.4%
Detroit-Warren-Livonia, MI	9,412	69.9%
Baltimore-Towson, MD	7,714	62.4%
Miami-Fort Lauderdale-Miami Beach, FL	6,894	40.2%
Seattle-Tacoma-Bellevue, WA	6,585	48.4%
St. Louis, MO-IL	6,559	47.1%
Kansas City, MO-KS	5,810	55.1%
Dallas-Fort Worth-Arlington, TX	5,727	34.0%
Pittsburgh, PA	5,488	49.0%
Durham, NC	5,273	36.6%
Houston-Baytown-Sugar Land, TX	5,217	32.7%
Phoenix-Mesa-Scottsdale, AZ	4,672	57.7%
Atlanta-Sandy Springs-Marietta, GA	4,362	42.5%
Tampa-St. Petersburg-Clearwater, FL	4,190	33.3%
Albany-Schenectady-Troy, NY	3,634	81.6%
Albuquerque, NM	3,570	71.8%
Minneapolis-St. Paul-Bloomington, MN-WI	3,301	11.5%
Salt Lake City, UT	3,169	25.2%
San Antonio, TX	3,155	56.1%
Indianapolis, IN	2,947	12.3%
Denver-Aurora, CO	2,913	37.8%
Orlando, FL	2,854	52.7%
Nashville-Davidson-Murfreesboro, TN	2,591	62.9%
Buffalo-Niagara Falls, NY	2,549	38.2%
New Haven-Milford, CT	2,548	28.5%
Idaho Falls, ID	2,499	97.1%

Metropolitan Statistical Area	Employment Level	Share of Total MSA Bioscience Employment
Portland-Vancouver-Beaverton, OR-WA	2,418	34.7%
Raleigh-Cary, NC	2,379	30.7%
Trenton-Ewing, NJ	2,316	63.8%
Las Vegas-Paradise, NV	2,277	69.3%
Providence-New Bedford-Fall River, RI-MA	2,199	26.0%
Milwaukee-Waukesha-West Allis, WI	2,113	19.9%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Regional Profile: Kansas City, Missouri

The Regional Story

Kansas City is a large, multicounty (bistate) metro area that is specialized in research/testing/medical labs, concentrated in drugs and pharmaceuticals, and “expanded” in agricultural chemicals/feedstock. The bistate region is now heavily marketing its status as U.S. or global headquarters to 37 firms in animal health, representing an estimated 30% of global sales in this market.

Within the last decade, Kansas City has also seen the establishment of the Stowers Institute for Medical Research, a large privately endowed entity that now occupies 600,000 square feet at a former community hospital site directly across from the University of Missouri at Kansas City. Phase I of Stowers will ultimately house 45 teams of 10–12 scientists each.

The Stowers family, which has committed \$2 billion to date, has pledged additional investment in the region contingent on voter approval in November (2006) of Missouri’s stem-cell initiative (which did pass).

Strategy: Custodians, Elements and Coordination

Kansas City has important biomedical assets distributed across both sides of the state line, but of the two jurisdictions, Kansas has had the bolder commitment to capacity-building and commercialization and the larger academic medical center. As a result, efforts have been steered by the Kansas City Civic Council, a regional CEO leadership group that crosses the border, and the Area Development Council, a large umbrella economic-development nonprofit.

These groups encouraged eight “stakeholder” institutions (including Stowers, both public universities, and the Midwest Research Institute) to form the Kansas City Area Life Sciences Institute, an umbrella

coordinating entity whose goal is to raise the region’s R&D base from \$86 million annually at the time of inception to \$500 million. The goal is approximately halfway met.

These regional entities have repeatedly studied the local bioscience sector, first in 1999 and then again in 2004. The most recent regional roadmap targets health care knowledge and personalized medicine; animal health and research; bio-pharma drug discovery pathways; oncology; cardiovascular research and tissue engineering; neuroscience; medical transaction management.

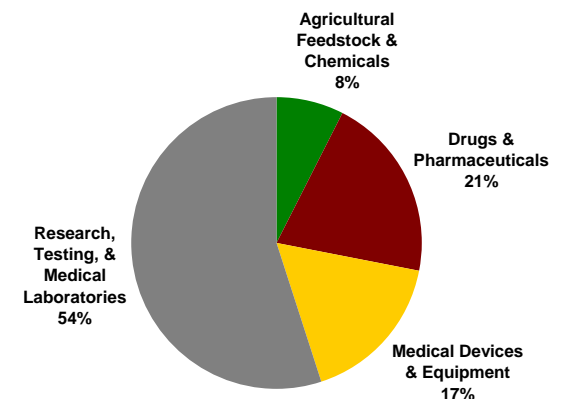
More recently, a study underwritten by the Kansas City Community Foundation, suggested a strategy for building the research and commercialization capacities of both KU Medical Center, the medical center of UMKC. With resources expected mainly from the new Kansas Bioscience Authority, the cross-border political challenges remain.

Notable Recent Successes

Recent successes in the animal health sector include recruitment from San Diego of the corporate and R&D headquarters for Synbiotics, a developer of test kits for animal disease, and attraction of a new subsidiary of IdentiGEN, which develops DNA-based to track meat through the food chain.

Bioscience Employment Distribution: Kansas City, MO

Specialized Employment Concentration in:
Research, Testing, and Medical Laboratories



Employment Concentration

Metropolitan areas with the highest concentration of research, testing, and medical laboratories jobs appear in Table 17. The table is in three parts, separating out those regions that are considered to be small, medium, or large metros based on total private sector employment. Highlighting metropolitan areas with high relative employment concentrations is revealing about the importance of the research, testing, and medical laboratories to these local economies. It is important to note, however, that among the regions in Table 17, many have low overall job totals (especially among the smaller metros).

Regional specializations in the bioscience subsectors often lead to significant wage premiums. The biosciences require a talented, high-skilled workforce in scientific, engineering, and other technical occupations. Research, testing, and medical laboratory workers in the St. Louis, Albany, and Norwich MSAs, for example, earn more than twice the average wages of their counterparts in the overall private sector.

Table 17. Metropolitan Statistical Areas with the Highest Location Quotients in Research, Testing, and Medical Laboratories, by Size of Metro Area, Employment, Establishments, and Relative Average Wages, 2004

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
LARGE MSAs (TOTAL PRIVATE EMPLOYMENT GREATER THAN 250,000):				
San Jose-Sunnyvale-Santa Clara, CA	3.60	10,356	274	145%
San Diego-Carlsbad-San Marcos, CA	3.54	13,927	388	187%
Albuquerque, NM	3.33	3,570	88	173%
Albany-Schenectady-Troy, NY	3.05	3,634	65	202%
Boston-Cambridge-Quincy, MA-NH	2.66	20,051	670	164%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.41	20,578	556	169%
New Haven-Milford, CT	2.18	2,548	115	169%
Washington-Arlington-Alexandria, DC-VA-MD-WV	2.14	17,168	610	138%
Baltimore-Towson, MD	2.06	7,714	255	167%
San Francisco-Oakland-Fremont, CA	2.05	12,831	463	165%
Kansas City, MO-KS	1.95	5,810	151	132%
Knoxville, TN	1.84	1,805	61	177%
Salt Lake City, UT	1.82	3,169	121	130%
Raleigh-Cary, NC	1.80	2,379	112	169%
St. Louis, MO-IL	1.57	6,559	190	229%
Buffalo-Niagara Falls, NY	1.56	2,549	109	123%
Pittsburgh, PA	1.54	5,488	205	164%
Detroit-Warren-Livonia, MI	1.46	9,412	230	175%
Worcester, MA	1.45	1,462	84	180%
New York-Northern New Jersey-Long Island, NY-NJ-PA	1.40	35,228	1,382	133%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
MEDIUM MSAs (TOTAL PRIVATE EMPLOYMENT BETWEEN 75,000 AND 250,000):				
Durham, NC	6.98	5,273	105	157%
Kennewick-Richland-Pasco, WA	6.72	1,928	19	187%
Wilmington, NC	4.06	1,542	26	199%
Trenton-Ewing, NJ	3.98	2,316	68	236%
Norwich-New London, CT	3.48	1,152	22	274%
Barnstable Town, MA	3.47	1,032	33	172%
Ann Arbor, MI	3.08	1,498	29	266%
Boulder, CO	2.49	1,188	50	196%
Oshkosh-Neenah, WI	2.42	683	5	202%
South Bend-Mishawaka, IN-MI	2.22	975	16	152%
Spokane, WA	1.97	1,177	29	130%
Palm Bay-Melbourne-Titusville, FL	1.93	1,198	44	135%
Lincoln, NE	1.67	783	23	167%
Kingsport-Bristol-Bristol, TN-VA	1.64	620	15	103%
Santa Barbara-Santa Maria-Goleta, CA	1.64	910	45	203%
Syracuse, NY	1.58	1,466	48	107%
Erie, PA	1.48	617	18	128%
Eugene-Springfield, OR	1.38	603	25	158%
Madison, WI	1.28	1,191	61	180%
Tallahassee, FL	1.24	480	26	196%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Idaho Falls, ID	15.64	2,499	19	248%
Burlington, NC	4.91	966	16	132%
Johnstown, PA	3.22	565	7	219%
Muncie, IN	2.79	417	3	109%
Hinesville-Fort Stewart, GA	2.73	101	2	154%
Santa Fe, NM	2.36	386	17	217%
Warner Robins, GA	2.31	254	11	201%
Bangor, ME	2.13	452	22	121%
Columbia, MO	2.11	435	17	160%
Valdosta, GA	1.91	288	14	127%
Cheyenne, WY	1.73	177	7	234%

Metropolitan Statistical Area	Location Quotient	Employment	Establishments	Avg. Wages Relative to Private Sector
SMALL MSAs (TOTAL PRIVATE EMPLOYMENT LESS THAN 75,000):				
Redding, CA	1.67	329	21	128%
Coeur d'Alene, ID	1.63	241	13	285%
Ames, IA	1.55	158	17	153%
Logan, UT-ID	1.49	205	12	224%
Lima, OH	1.44	264	6	102%
St. Joseph, MO-KS	1.41	221	7	262%
Terre Haute, IN	1.40	299	19	125%
Lewiston, ID-WA	1.29	101	3	123%
Corvallis, OR	1.28	124	11	140%

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Large and Specialized Metropolitan Areas

The metropolitan areas designated as both large and specialized in Table 18 meet two criteria—an employment base that meets or exceeds 2.0 percent of national employment, and a location quotient that meets or exceeds 1.20. Nine regions meet these thresholds in the research, testing, and medical laboratories subsector of the biosciences.

All but one of the large and specialized regions have a majority of subsector activity in research laboratories. These labs conduct research and experimental development in the life sciences and are the source of scientific breakthroughs that drive the overall biosciences. The Los Angeles metropolitan area, on the other hand, has a majority of activity in this subsector in the medical and diagnostic laboratories component.

Table 18. Metropolitan Areas with Large and Specialized Employment in the Research, Testing, and Medical Laboratories Subsector, 2004

Metropolitan Area	Employment, 2004	Share of U.S. Subsector Empl., 2004	LQ, 2004	Avg. Wages, 2004	Principal Key Component	Metro Size
New York-Northern New Jersey-Long Island, NY-NJ-PA	35,228	8.7%	1.40	\$74,688	Research Labs	LARGE
Los Angeles-Long Beach-Santa Ana, CA	24,886	6.1%	1.40	\$64,136	Medical/Diagnostic Labs	LARGE
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	20,578	5.1%	2.41	\$75,353	Research Labs	LARGE
Boston-Cambridge-Quincy, MA-NH	20,051	5.0%	2.66	\$87,678	Research Labs	LARGE
Washington-Arlington-Alexandria, DC-VA-MD-WV	17,168	4.2%	2.14	\$69,996	Research Labs	LARGE
San Diego-Carlsbad-San Marcos, CA	13,927	3.4%	3.54	\$77,802	Research Labs	LARGE
San Francisco-Oakland-Fremont, CA	12,831	3.2%	2.05	\$92,018	Research Labs	LARGE
San Jose-Sunnyvale-Santa Clara, CA	10,356	2.6%	3.60	\$103,854	Research Labs	LARGE
Detroit-Warren-Livonia, MI	9,412	2.3%	1.46	\$80,351	Research Labs	LARGE

Source: Battelle calculations based on Bureau of Labor Statistics, QCEW program data from the Minnesota IMPLAN Group.

Emerging Metropolitan Areas

The metropolitan statistical areas shown in Table 19 meet the requirements of an “emerging” region in the research, testing, and medical laboratories subsector. Specifically, each has 2004 employment that is more than 500 but fewer than 5,000, and has experienced job growth of at least 20 percent during the 2001 to 2004 time period.

Table 19. Emerging Metropolitan Statistical Areas in the Research, Testing, and Medical Laboratories Subsector, by overall size of Region, 2004

LARGE MSAs	MEDIUM MSAs	SMALL MSAs
Albuquerque, NM	Ann Arbor, MI	Idaho Falls, ID
Atlanta-Sandy Springs-Marietta, GA	Boise City-Nampa, ID	
Charlotte-Gastonia-Concord, NC-SC	Kennewick-Richland-Pasco, WA	
Cincinnati-Middletown, OH-KY-IN	Kingsport-Bristol-Bristol, TN-VA	
Greensboro-High Point, NC	Lancaster, PA	
Honolulu, HI	Norwich-New London, CT	
Knoxville, TN	Oshkosh-Neenah, WI	
Las Vegas-Paradise, NV	Palm Bay-Melbourne-Titusville, FL	
Nashville-Davidson-Murfreesboro, TN	Santa Rosa-Petaluma, CA	
New Haven-Milford, CT	Sarasota-Bradenton-Venice, FL	
Portland-Vancouver-Beaverton, OR-WA	Spokane, WA	
Raleigh-Cary, NC	Trenton-Ewing, NJ	
Sacramento-Arden-Arcade-Roseville, CA	Wichita, KS	
Tucson, AZ	Wilmington, NC	

Regional Profile: Durham, North Carolina*

The Regional Story

As a mid-sized metropolitan area imbedded in the much larger Raleigh-Durham combined region, Durham achieves strong specialization rankings in both drugs/pharmaceuticals and research, testing and medical laboratories.

The Durham metropolitan region includes the medical centers of both Duke University and UNC Chapel Hill, and Durham City, particularly, has seen significant private development of commercial bioscience space downtown. However, the dominant factor in Durham's ranking must be considered the historical success of the 7,000-acre Research Triangle Park, a good part of which lies within Durham County (although the balance is in Wake County, part of the Raleigh region).

RTP has been developing since the early 1950s, originally with the goal of attracting corporate R&D laboratories to provide employment for university graduates. RTP made its reputation first with federal environmental science laboratories and information technology investments by IBM, but the bioscience sector made rapid gains after the recruitment of Burroughs Wellcome and Glaxo in the 1970s. In recent decades, the region as a whole has made progress in entrepreneurial development, including business incubators and other sites for development of early-stage enterprises.

Strategy: Custodians, Elements and Coordination

RTP is governed by a community-based foundation and operates as a land bank, liquidating holdings it acquired long ago through state and private fund-raising in favor of developers and owner-occupiers. The strategic direction of the park in the biosciences has been heavily

influenced by the North Carolina Biotechnology Center, a resident, state-sponsored intermediary organization that promotes cooperation between academic and industrial researchers.

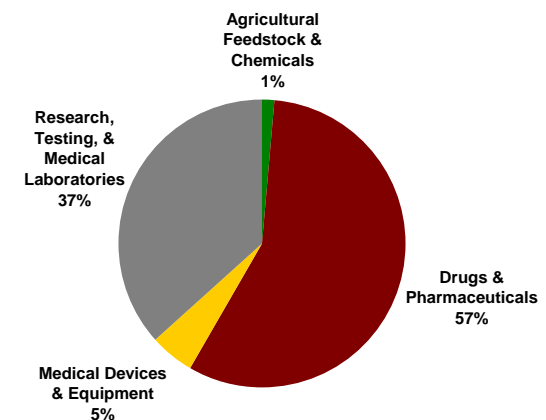
The entrepreneurial aspects of the strategy are supported by the private non-profit Council for Entrepreneurial Development. The first wet-lab business incubator in the park was created by another nonprofit, the North Carolina Technological Development Authority. It was soon complemented by private incubation space opened by a range of for-profit developers, both within the Park boundaries and "outside the gates" where growth has also been vigorous.

Notable Recent Successes

So successful has the RTP/NC Biotech model been at developing the region, that the Center has now opened a series of regional offices across the state and is engaged in regional development. RTP itself has now 136 resident companies employing 37,000 in 20 million square feet of built space. The total includes 30 start-up companies in incubators in and around the park.

Bioscience Employment Distribution: Durham, NC

Specialized Employment Concentration in: *Drugs and Pharmaceuticals; and in Research, Testing, and Medical Laboratories*



*Note: Raleigh-Cary, North Carolina is a separate MSA.

Conclusion

The biosciences represent a broad base of both leading research and commercial pursuits in the life sciences. The varied nature of the sector allows communities to utilize a local niche (e.g. universities, research hospitals, existing industry anchors) in order to successfully develop one or more unique specializations in components of the bioscience industry. The assessment of local area bioscience activity in this report reveals a vibrant national sector. The biosciences are thriving in metropolitan areas of all sizes and geographic locales; from smaller, rural metros engaged in agricultural bioscience pursuits, to large metropolitan areas with active research and testing sectors partnering with drug and pharmaceutical or medical device manufacturers. Indeed, more than half of the 361 metropolitan statistical areas in the U.S. have an employment specialization in at least one of the four bioscience subsectors.

While the bioscience sector yields opportunities for economic growth, it presents unique challenges for local areas competing for available R&D and venture funding, and for the supply of talented researchers and technical workers it requires. Skilled, well-educated bioscience workers are in demand, as evidenced by wages that continually exceed private sector averages, helping boost local economies. Regions must continue to promote their key niche characteristics whether they include a premier research institution, a desirable climate, or perhaps close proximity to available business capital, in order to attract and retain its base of technical talent and a growing base of firms.

Appendix: Data and Methodology

Data and methodology in this metropolitan area analysis of the U.S. bioscience industry correspond exactly to these same data presented in the 2006 Biotechnology Industry Organization (BIO) report, “*Growing the Nation’s Bioscience Sector: State Bioscience Initiatives 2006*.” Battelle has expanded upon the regionally-focused information by producing this companion report, but the methodology remains the same. Nevertheless, the following provides an overview of the data sources and concepts utilized for this report.

Employment, Establishments, and Wages

The economic analysis in this report examines national and metropolitan area data and corresponding trends in the biosciences from 2001 to 2004. For employment analysis, Battelle has selected the Bureau of Labor Statistics’ (BLS) Quarterly Census of Employment and Wages (QCEW) data set. The QCEW data (also known as the ES-202 program data) provide the most current, detailed industry employment, establishment, and wage figures available at both a national and sub-national level.⁷ Battelle receives an enhanced version of these state and county data from a private vendor, the Minnesota IMPLAN Group, Inc.

The QCEW Program is a cooperative program involving BLS and the State Employment Security Agencies (SESAs). The QCEW program produces a comprehensive tabulation of employment and wage information for workers covered by State unemployment insurance (UI) laws and Federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. Publicly available files include data on the number of establishments, monthly employment, and quarterly wages, by NAICS (North American Industry Classification System) industry, by county, by ownership sector, for the entire United States. These data are aggregated to annual levels, to higher industry levels (NAICS industry groups, sectors, and supersectors), and to higher geographic levels (national, State, and Metropolitan Statistical Area (MSA)).⁸

⁷ In general, QCEW monthly *employment* data represent the number of covered workers who worked during, or received pay for, the pay period that included the 12th day of the month. Virtually all workers are reported in the State in which their jobs are located. Covered private-industry employment includes most corporate officials, executives, supervisory personnel, professionals, clerical workers, wage earners, piece workers, and part-time workers. It excludes proprietors, the unincorporated self-employed, unpaid family members, and certain farm and domestic workers. An *establishment* is an economic unit such as a farm, mine, factory, or store that produces goods or provides services. It is typically at a single physical location and engaged in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. *Total wages*: Covered employers in most States report total compensation paid during the calendar quarter, regardless of when the services were performed. A few State laws, however, specify that wages be reported for or be based on the period during which services are performed, rather than for the period during which compensation is paid. Under most State laws or regulations, wages include bonuses, stock options, severance pay, the cash value of meals and lodging, tips and other gratuities, and--in some States--employer contributions to certain deferred compensation plans such as 401(k) plans.

⁸ Major exclusions from UI coverage, and thus from the QCEW data, include self-employed workers (both Farmers and Non-agricultural), some wage and salary agricultural workers, unpaid family workers, railroad workers, and some State and Local government workers.

Since 2001, the QCEW has been producing and publishing data according to the NAICS system. Federal statistical agencies have a mandate to publish industry data according to this improved classification system. Compared with the prior classification system—the 1987 Standard Industrial Classification (SIC) system—NAICS better incorporates new and emerging industries. Employment, establishment, and wage estimates produced by the QCEW program for 2001 to present are not comparable with SIC-based industry estimates from prior years. This limits the ability to construct a longer time series for data analysis; however, four years of NAICS-based data are available for analysis.

Twenty seven NAICS industries at the most detailed (6-digit) level were selected for this analysis and together make up the biosciences and its major subsectors. These detailed industries were aggregated up to four major subsectors of the bioscience industry. Two of the detailed NAICS industries, Testing Laboratories (NAICS 541380) and Physical, Engineering, and Biological Research (NAICS 541710), were adjusted in this analysis to include only the share of these industries directly involved in biological or other life sciences activities. To isolate these relevant life sciences components, Battelle used information and data from the U.S. Census Bureau’s Economic Census.

National and Metropolitan Statistical Area (MSA) data were tabulated and presented in analytical tables. U.S. employment, establishment, and wage totals in this report reflect the sum of all State data and include both Puerto Rico and DC. Metropolitan area data, however, do not include estimates for Puerto Rico as they are generally not disclosed at the 6-digit NAICS level of detail by BLS.

Data for 361 U.S. Metropolitan Statistical Areas with biosciences employment activity were tabulated for this report. In order to best analyze location quotients for MSAs, the areas were sorted by their total private sector employment base and designated as either large, medium, or small metro areas. A “large” MSA has total employment at or above 250,000. A “medium” MSA has employment greater than or equal to 75,000, but less than 250,000. A “small” MSA has employment less than 75,000. Within each size classification, the metropolitan areas are then ranked by their location quotient.