



# OLR RESEARCH REPORT

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## CONNECTICUT'S BIOSCIENCE INDUSTRY

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You asked us to describe Connecticut's bioscience industry and how it contributes to the state's economy.

### SUMMARY

Descriptions of Connecticut's bioscience industry vary depending on the criteria used to identify bioscience businesses. In a 2010 national study, the Battelle Memorial Institute (Battelle) and the Biotechnology Industry Organization (BIO) used the North American Industrial Classification System (NAICS) to identify and group bioscience businesses. They named the groups agricultural feedstock and chemicals; drugs and pharmaceuticals; medical devices and equipment; and research, testing, and medical laboratories.

We used Battelle's and BIO's groups to identify Connecticut's bioscience businesses and 2007 economic census data to describe them. The census collects data on businesses that comprise each group. Our analysis suggests that the medical devices and equipment manufacturers and research, testing, and medical laboratories account for the largest shares of the state's bioscience industry. It also suggests that drugs and pharmaceutical manufacturers' share of the industry declined since the 2002 Economic Census.

According to the census, Connecticut's bioscience industry employed at least 15,587 people in 2007, about 1% of all paid employees, and generated over \$3 billion in sales, shipments, receipts, and other

specified revenue (i.e., revenue), about 1% of the revenue generated by all business sectors. About 54% of the industry's employees worked for medical devices and equipment manufacturers and almost 41% for research, testing, and medical laboratories.

Over 67% of the industry's revenue was generated by medical devices and equipment manufacturers. Census data also suggests that drugs and pharmaceutical businesses' share of bioscience jobs and revenue decreased between 2002 and 2007. For example, this group's share of total paid employees dropped 89%, from 6,200 to 643.

But census data provides an incomplete picture of Connecticut's bioscience industry. The Battelle and BIO study found that the industry employed 25,800 people in 2008, 10,000 more employees than reported in the 2007 census, and paid an annual average wage of \$93,000. The study also found that drugs and pharmaceutical businesses employed 7,000 people and paid an average annual wage of \$125,700.

The Battelle and BIO study also examined the factors that sustain Connecticut's bioscience industry. It found that:

1. the state's colleges and universities spent about \$595 million in bioscience research in 2008, about 81% of all academic research and development expenditures;
2. 54% of the \$1.2 billion in venture capital invested in Connecticut between 2005 and 2011 went to biotechnology and medical devices businesses; and
3. of the 2,600 patents issued in Connecticut between 2005 and 2009, 45% (1,187) were for drugs and pharmaceutical products and techniques.

We found no recent study analyzing the economic impact of Connecticut bioscience industry. But Archstone Consulting's 2008 study of the nation's "biopharmaceutical" sector included state data. (The sector comprises a portion of the bioscience industry, namely business that discover, test, and manufacturer medications.) According to that study, Connecticut biopharmaceutical sector:

1. directly or indirectly contributed over \$14 billion to the state's economy in 2008, about 6% of Connecticut's gross state product;
2. employed almost 9,700 people whose average output equaled \$717,700;

3. invested \$4.5 billion researching and developing new products and techniques; and
4. indirectly supported 34,700 jobs in other businesses.

The study also found that biopharmaceutical employees on average paid \$5,580 in taxes, about four times the average taxes paid by other employees in other business sectors. The study did not report the total amount of state and local taxes bioscience businesses paid.

### **BIOSCIENCE INDUSTRY DEFINED**

The bioscience industry consists of businesses that use the knowledge gained from studying plants, animals, and humans to produce products, such as ethyl alcohol, and provide services, such as laboratory testing. These businesses are included in the NAICS, which groups most businesses into industry-wide sectors based on the processes and methods they use to make products or deliver services.

NAICS does not identify a separate bioscience sector, but groups different types of bioscience businesses in more generic industry sectors, such as manufacturing and professional, scientific, and technical services. Because researchers do not always analyze the same mix of businesses, their findings vary. (See [\*Identifying & Defining Life Science, Bio-Tech, High-Tech, Knowledge Industries, and Information Technology Industries\*](#), Massachusetts Department of Workforce Development, July 2007.)

For this report, we use the NAICS sectors Battelle and BIO used in their [2010 study](#) on the nation's bioscience sector. The report grouped 27 bioscience-related industry subsectors into four general categories, which Table 1 describes.

**Table 1: Bioscience Industry Categories and Sectors**

Agricultural Feedstock and Chemicals	
Businesses in this category:	NAICS subsectors and codes
Apply life science knowledge, biochemistry, and biotechnologies to processing agricultural goods and producing organic foods, chemicals, and biofuels	<ul style="list-style-type: none"> <li>• Wet corn milling, 312112</li> <li>• Soybean processing, 311222</li> <li>• Other oilseed processing, 311223</li> <li>• Ethyl alcohol manufacturing, 325193</li> <li>• All other basic organic chemical manufacturing, 325199</li> <li>• Cellulosic organic fiber manufacturing, 325221</li> <li>• Nitrogenous fertilizer manufacturing, 325311</li> <li>• Phosphatic fertilizer manufacturing, 325312</li> <li>• Fertilizer (mixing only) manufacturing, 325314</li> <li>• Pesticide and other agricultural chemical manufacturing, 325320</li> </ul>
Drugs and Pharmaceuticals	
Businesses in this category:	NAICS subsectors and codes
Produce commercially available medicinal and diagnostic substances	<ul style="list-style-type: none"> <li>• Medicinal and botanical manufacturing, 325411</li> <li>• Pharmaceutical preparation manufacturing, 325412</li> <li>• In-vitro diagnostic substance manufacturing, 325413</li> <li>• Biological product (except diagnostic) manufacturing, 325414</li> </ul>
Medical Devices and Equipment	
Businesses in this category:	NAICS subsectors and codes
Produce many different types of biomedical instruments and other health care products and supplies for diagnostics, surgery, patient care, and laboratories	<ul style="list-style-type: none"> <li>• Electromedical apparatus manufacturing, 334510</li> <li>• Analytical laboratory instrument manufacturing, 334516</li> <li>• Irradiation apparatus manufacturing, 334517</li> <li>• Surgical and medical instrument manufacturing, 339112</li> <li>• Surgical appliance and supplies manufacturing, 339113</li> <li>• Dental equipment and supplies manufacturing, 339114</li> <li>• Ophthalmic goods manufacturing, 339115</li> <li>• Dental laboratories, 339116</li> </ul>
Research, Testing, and Medical Laboratories	
Businesses in this category:	NAICS subsectors and codes
<ul style="list-style-type: none"> <li>• Develop and commercialize new drugs and delivery systems</li> <li>• Develop gene and cell therapies</li> <li>• Perform medical and other life science testing</li> </ul>	<ul style="list-style-type: none"> <li>• Testing laboratories, 541380</li> <li>• Biotechnology-related R&amp;D, 541711</li> <li>• Physical-, engineering-, and life sciences-related R&amp;D, 541712</li> <li>• Medical laboratories, 621511</li> <li>• Diagnostic imaging centers, 621512</li> </ul>

Source: [State Bioscience Initiatives 2010](#)

## CONNECTICUT'S BIOSCIENCE INDUSTRY

### *Methodology*

Economists use the [Economic Census](#) to measure and analyze industry sectors. The census provides data on the:

1. number of places where businesses conduct business (i.e., establishments);

2. number of permanent full-time and part-time nonleased employees on each establishment's payroll on specified dates during the year; (i.e., paid employees);
3. total salaries, wages, commissions, dismissal pay, bonuses, and other compensation paid to these employees (i.e., annual payroll); and
4. total value of shipments, receipts, revenue, or "business done" by domestic businesses, excluding their foreign subsidiaries.

The Census Bureau collects data on these and other metrics every five years, and this report is based on the 2007 census. It aggregates the data by NAICS codes, which group businesses into major sectors and subsectors. The bureau does not provide data for a subsector if doing so would identify one of its businesses, but adds the data to the sector's total where a larger pool of businesses tends to mask each individual business' identity.

This practice poses a problem for researchers analyzing the bioscience industry. NAICS does not identify "bioscience businesses" and group them into bioscience sectors and subsectors. Consequently, researchers must define the sector and determine the NAICS subsectors that comprise it. Because the bureau does not provide all of the data for certain subsectors, this report provides an incomplete picture of Connecticut's bioscience industry and its share of the state's economy.

### ***Bioscience Industry's Share of the Connecticut Economy***

As Table 2 shows, bioscience businesses operated in least 0.8% of all Connecticut establishments; employed 1.1% of all paid employees; paid 1.3% of all payroll wages; and generated 1% of all business revenue. (Attachment 1 provides aggregate data on establishments, paid employees, payrolls, and revenue for Connecticut's major business sectors.)

**Table 2: Bioscience Industry' Share of the Connecticut Economy, 2007**

<b>Metrics</b>	<b>All Non Agricultural Industry Sectors</b>	<b>Bioscience Industry Sectors</b>
Number of Establishments	90,377	702 (0.8%)
Number of Paid Employees	1,464,557	15,587 (1.1%)
Annual Payroll	\$74.1 billion	\$1.0 billion (1.3%)
Sales, Shipments, Receipts, Revenue, or Business Done	\$353.2 billion	\$3.4 billion (1.0%)

Source: [2007 Economic Census](#)

As we explained above, the census does not provide aggregate data for every subsector. But Battelle and BIO, using U.S. Labor Department and [Minnesota IMPLAN Group](#) (an economic analysis firm) data, provided a more complete picture of the bioscience industry's share of the state's establishments and jobs in 2008. They also provided data on the industry's average annual wages for that year.

Table 3 compares the bioscience industry's shares of the Connecticut and U.S. economies using Battelle's and BIO's data. As the table shows, Connecticut's industry compares favorably with the national industry. For example, the industry accounts for 1.8% of Connecticut jobs and 1.2% of U.S. jobs. Further, the Connecticut industry's average annual wage is over:

1. 1.5 times the average annual wage for all Connecticut industries,
2. twice the national average annual wage for all industries, and
3. 1.2 times the national average annual wage for the U.S. bioscience industry.

**Table 3: Comparison of the Connecticut and U.S. Bioscience Industry 2008**

<b>Variable</b>	<b>Connecticut</b>	<b>United States</b>
Total Establishments	109,479	8,860,956
Total Bioscience Establishments and Percent of Establishments	670 (0.6%)	47,593 (0.5%)
Total Employment	1,437,602	113,917,377
Total Bioscience Employment and Percent of Employment	25,842 (1.8%)	1,420,324 (1.2%)
Average Annual Wage	\$59,302	\$45,229
Average Annual Bioscience Wage	\$93,898	\$77,595

Source: Battelle and BIO, [State Bioscience Initiatives 2010](#)

## ***Bioscience Industry's Major Sectors***

As explained above, this report groups bioscience businesses into four major business groups or sectors. Table 4 compares the sectors and the types of businesses that comprise them based on the 2007 economic census.

As the table shows, the medical devices and equipment and research, testing, and medical laboratories sectors appear to dominate the industry, together constituting about 90% of its establishments, paid employees, annual payrolls, and revenue, respectively. The research, testing, and medical laboratories sector alone accounted for over 66% of the industry's establishments while the medical devices and equipment sector accounted for over half of the industry's paid employees, annual payroll, and total revenues, respectively.

The other sectors constitute relatively smaller shares of the bioscience industry. Drugs and pharmaceutical manufacturers constituted 2.6% of the establishments and 4% of the employees and payroll, respectively. (The census does not provide revenue data for the types of businesses that comprise this sector.) Agricultural feedstock and chemical manufacturers constitute 1.7% of the industry's establishments. (The census does not provide exact employee totals and payroll and revenue data for this sector.)

**Table 4: Metrics for Connecticut Bioscience Major Industry Sectors, 2007**  
(in \$1,000)

<b>Metrics</b>	<b>Bioscience Sectors</b>			
	<b>Agricultural Feedstock and Chemicals</b>	<b>Drugs and Pharmaceuticals</b>	<b>Medical Devices and Equipment</b>	<b>Research, Testing, and Medical Laboratories</b>
Establishments	12 (1.7%)	18 (2.6%)	205 (28.9%)	467 (66.5%)
Paid Employees	Not Available	643 (4.1%)	8,479 (54.4%)	6,365 (40.8%)
Annual Payroll (in \$1,000)	Not Available	\$41,193 (4.0%)	\$514,972 (50.0%)	\$398,756 (40.0%)
Sales, Shipments, Receipts, Revenue, or Business Done (in \$1,000)	Not Available	Not Available	\$2,288,680 (67.6%)	\$1,069,886 (21.9%)

Source: [2007 Economic Census](#)

Battelle's and BIO's 2010 study covers some of the gaps in the 2007 census. (It also includes jobs in the agricultural and feedstock sector.) As Table 5 shows, Battelle and BIO counted over 25,000 bioscience jobs in

2008, including almost 8,000 in the drugs and pharmaceutical sector and over 600 in the agricultural feedstock and chemical sector. Significantly, the drugs and pharmaceutical sector accounted for almost 31% of the state's bioscience jobs, and its average annual wage was 1.3 times the industry's annual average wage.

**Table 5 Connecticut Bioscience Industry by Major Industry Sector, 2008**

<b>Sector</b>	<b>Total Establishments (% of total)</b>	<b>Total Employment (% of total)</b>	<b>Annual Average Wage (% of industry average)</b>
Agricultural Feedstock and Chemicals	22 (3.3)	635 (2.5)	\$85,318 (90.1)
Drugs and Pharmaceuticals	35 (5.2)	7,926 (30.7)	125,702 (133.9)
Medical Devices and Equipment	215 (32.1)	9,487 (36.7)	63,334 (67.4)
Research, Testing, and Medical Laboratories	398 (59.4)	7,794 (30.2)	99,459 (106.4)
All Bioscience Sectors	670 (100.0)	25,842 (100.0)	93,898 (100.0)

Source: Battelle and BIO, [State Bioscience Initiatives 2010](#)

### ***Bioscience Industry's Subsectors***

Table 6 narrows our focus to the industry's subsectors and shows that over 60% of the industry's establishments are operated by businesses that:

1. conduct physical-, engineering-, and life science-related research and development (19.9%);
2. perform diagnostic imaging; (18.9%);
3. operate testing (13%) and medical laboratories (8.1%); and
4. conduct biotechnology-related R&D (8.1%).

Almost 11% of the establishments are operated by dental laboratories, which NAICS includes in the medical devices and equipment sector. Less than 2% of the establishments are operated by businesses in two subsectors—(1) organic chemicals and (2) pesticides and other agricultural chemicals manufacturers.

While laboratories comprise the largest share of bioscience establishments, surgical and medical supply manufacturers account for the largest shares of bioscience employees (almost 29%), annual payrolls (24.8%), and revenue from specified sources (41.5%). Medical laboratories and diagnostic imaging centers together account for 30.2% of the employees, 32.6% of the payroll, and 25.5% of the revenue.

**Table 6: Bioscience Subsectors Totals and Shares, 2007**

Bioscience Subsector and NAICS Code	Subsector Total and Share (%) of Bioscience Industry			
	Establishments	Paid Employees	Annual Payroll (in \$1,000)	Total Sales, Shipments, Receipts, Revenue or Business Done (in \$1,000)
<b>Agricultural Feedstock and Chemical</b>				
Wet Corn Milling (311221)	0 (0)	0 (0)	0 (0)	0 (0)
Soybean Processing (311222)	0 (0)	0 (0)	0 (0)	0 (0)
Other Oilseed Processing (311223)	0 (0)	0 (0)	0 (0)	0 (0)
Ethyl Alcohol Manufacturing (325193)	0 (0)	0 (0)	0 (0)	0 (0)
All Other Basic Organic Chemical Manufacturing (325199)	6 (0.9)	100-249 employees	Data withheld because it could identify individual firms	Data withheld because it could identify individual firms
Cellulosic Organic Chemical Manufacturing (325221)	0 (0)	0 (0)	0 (0)	0 (0)
Nitrogenous Fertilizer Manufacturing (325311)	0 (0)	0 (0)	0 (0)	0 (0)
Phosphatic Fertilizer Manufacturing (325312)	0 (0)	0 (0)	0 (0)	0 (0)
Fertilizer (mixing only) Manufacturing (325314)	6 (0.9)	250-499 employees	Data withheld because it could identify individual firms	Data withheld because it could identify individual firms
Pesticide and Other Agricultural Chemical Manufacturing (325320)	0 (0)	0 (0)	0 (0)	0 (0)
<b>Drugs and Pharmaceutical</b>				
Medicinal and Botanical Manufacturing (325411)	5 (0.7)	100-249 employees	Data withheld because it could identify individual firms	Data withheld because it could identify individual firms
Pharmaceutical Preparation Manufacturing (325412)	13 (1.9)	643 (4.1)	\$41,193 (4.3)	Data withheld because it could identify individual firms
In-vitro Diagnostic Substance Manufacturing (325413)	0 (0)	0 (0)	0 (0)	0 (0)
Biological Product (except diagnostic) Manufacturing (325413)	0 (0)	0 (0)	0 (0)	0 (0)
<b>Medical Devices and Equipment</b>				
Electromedical Apparatus Manufacturing (334510)	13 (1.9)	669 (4.3)	\$41,790 (4.4)	\$234,306 (7.0)
Analytical Laboratory Instrument Manufacturing (334516)	17 (2.4)	963 (6.2)	126,893 (13.3)	394,373 (11.7)
Irradiation Apparatus Manufacturing (334517)	6 (0.9)	501 (3.2)	33,511 (3.6)	Data withheld because it could identify individual firms
Surgical and Medical Instrument Manufacturing (339112)	45 (6.4)	4,485 (28.8)	236,952 (24.8)	1,394,231 (41.5)
Surgical Appliance and Supplies Manufacturing (339113)	32 (4.6)	667 (4.3)	31,629 (3.3)	108,812 (3.2)
Dental Equipment and Supplies Manufacturing (339114)	11 (1.6)	446 (2.9)	19,189 (2.0)	74,396 (2.2)
Ophthalmic Goods Manufacturing (339115)	6 (0.9)	220 (1.4)	6,866 (0.7)	40,854 (1.2)
Dental Laboratories (339116)	205 (10.7)	528 (3.4)	18,142 (1.9)	41,708 (1.3)
<b>Research, Testing and Medical Laboratories</b>				
Testing Laboratories (541380)	91 (13.0)	1,611 (10.3)	\$87,741 (9.2)	\$211,545 (6.3)

Table 6 (continued)

<i>Bioscience Subsector and NAICS Code</i>	<i>Subsector Total and Share (%) of Bioscience Industry</i>			
	<i>Establishments</i>	<i>Paid Employees</i>	<i>Annual Payroll (in \$1,000)</i>	<i>Total Sales, Shipments, Receipts, Revenue or Business Done (in \$1,000)</i>
Biotechnology-Related R&D (541711)	46 (6.6)	5,000-9,999 employees	Data withheld because it could identify individual firms	Data withheld because it could identify individual firms
Physical-, Engineering-, and Life Science-Related R&D (541712)	140 (19.9)	5,000-9,999 employees	Data withheld because it could identify individual firms	Data withheld because it could identify individual firms
Medical Laboratories (621511)	57 (8.1)	2,472 (15.6)	144,794 (15.2)	418,277 (12.4)
Diagnostic Imaging Centers (621512)	133 (18.9)	2,282 (14.6)	166,248 (17.4)	440,044 (13.1)

Source: [2007 Economic Census](#)

### ***Bioscience Industry Changes since 2002 Economic Census***

Table 7 suggests that the state's bioscience sectors underwent significant changes between 2002 and 2007.

Table 7: Percent of Change for Selected Major Bioscience Sectors: 2002-2007

<i>Major Sector</i>	<i>Percent of Change</i>			
	<i>Establishments</i>	<i>Paid Employees</i>	<i>Annual Payroll</i>	<i>Total Sales, Shipments, Receipts, Revenue or Business Done</i>
Drugs and Pharmaceuticals	(8)	(89)	(89)	Not available
Medical Devices and Equipment*	3	(16)	10	15
Research, Testing, and Medical Laboratories **	26	7	27	32

\* Medical Devices and Equipment does not include percent of change in irradiation apparatus manufacturing subsector (334517) because the census did not have data for certain metrics

\*\* Research, testing, and medical laboratories sector does not include percent of change in biotechnology-related R&D (541711) and physical-, engineering-, and life science-related R&D (541712) because the census did not have complete data for these subsectors

Source: [2007 Economic Census](#)

(Attachment 2 provides the data we used to calculate the percent of changes.)

As Table 7 shows, pharmaceutical preparation manufacturers (NAICS 335412) cut over 5,000 jobs, shrinking their workforce and payrolls by 89%, respectively. This change appears to be part of a national trend. According to [Battelle and BOI](#):

The U.S. drugs and pharmaceuticals sector began the recent recession, from 2007 to 2008, by shedding 2.3 percent of its employment base, which totaled 311,882 by 2008. During much of the economic expansion of the 2000s, employment in this bioscience subsector remained relatively flat, though it grew in both 2006 and 2007. Its rate of job loss was greater than that for the overall U.S. private sector in 2008, which declined by just 0.7 percent in the first year of the recession. As the only of the four bioscience subsectors to lose jobs in 2008, drugs and pharmaceuticals' share of national bioscience employment declined from 24 percent in 2006 to 22 percent in 2008 (p. 27).

Connecticut's other bioscience sectors fared better. Although jobs dropped 16% in the medical devices and equipment sector, it added more establishments (up 3%), and increased payrolls (up 10%) and revenues (up 5%). Again, this change seems to reflect national trends. [Battelle and BIO](#) reported:

After the 2001 recession, three years of job declines, the subsector has grown steadily since 2004, increasing its employment base by nearly 6 percent or an average annual growth rate of 1.5 percent. This recent growth includes expanded hiring in 2008 during the first year of the recent recession, with the subsector jobs increasing by 2.4 percent over the year (p. 31).

Connecticut's research, testing and medical laboratories sector performed strongly during the period. It added establishments (up 26%) and jobs (up 7%) and increased payroll (up 27%) and revenue (up 32%). According to Battelle and BIO,

Research, testing, and medical laboratories, with rapid job growth in recent years, has firmly established itself as the largest among the four U.S. bioscience subsectors. It has continuously grown since 2001, adding more than 176,000 jobs or 46.1 percent to its employment base during the 7-year period (p. 35).

## CONNECTICUT’S CAPACITY TO SUSTAIN BIOSCIENCE BUSINESSES

Several things have to happen to sustain a state’s bioscience industry. These include colleges and universities investing in bioscience-related R&D, students graduating with degrees in bioscience fields, private venture capitalists investing in fledging bioscience businesses, and the ability of bioscience businesses to obtain patents. [Battelle’s and BIO’s 2010](#) analysis of Connecticut’s bioscience sector suggests that these things are happening sufficiently enough to sustain the state’s bioscience industry.

### ***Bioscience-Related R&D***

Battelle and BIO measured the amount of money colleges and universities spend on bioscience R&D, the amount of grants the National Institutes of Health (NIH) awarded to state researchers, and the number of clinical trials conducted here. As Table 8 shows, bioscience R&D accounts for over 80% of the \$733 million Connecticut colleges and universities spent on R&D and amounted to a per capita R&D expenditure that was 1.6 times the national average. Most of the bioscience R&D dollars spent in Connecticut went toward researching medical (63.1%) and biological sciences (34.6%), Battelle and BIO stated.

**Table 8: Academic R&D Expenditures in 2008**

<i>Metrics</i>	<i>Connecticut</i>	<i>United States</i>
Total R&D Expenditures for all Academic Fields	\$732.8 million	\$51,907 million
Total Bioscience-Related R&D Expenditures	\$595.0 million	\$31,819 million
National Rank Based on Total Bioscience-Related R&D Expenditures	16	Not Applicable
Percent of Bioscience R&D Expenditures for all Academic Fields	81.2%	61.3%
National Rank Based on Percent of Bioscience-Related R&D Expenditures	3	Not Applicable
Academic Bioscience R&D Expenditures Per Capita	\$169.72	\$104.54

Source: Battelle and BIO, [State Bioscience Initiatives 2010](#)

Federal grants for bioscience R&D is another measure of a state’s capacity for bioscience research, and NIH is the major source of such funding. Again, Connecticut compared favorably to the nation. It received over \$546 million in NIH grants in 2009, which ranked it 13 among the states. It also ranked fifth among the states in per capita NIH grants (i.e., \$155.22, 1.8 times the national average).

The number of clinical trials conducted in a state also indicates its capacity for bioscience R&D. (Such trials methodologically test a new drug or treatment's effects on humans.) Of the 5,299 clinical trials that were started in 2009, 307 (5.8%) were conducted in Connecticut.

### ***Workforce***

Bioscience businesses need a highly trained workforce, and Battelle and BIO measured each state's capacity to supply that workforce by identifying the number of students graduating with bioscience-related degrees and the number of workers in specified bioscience occupations.

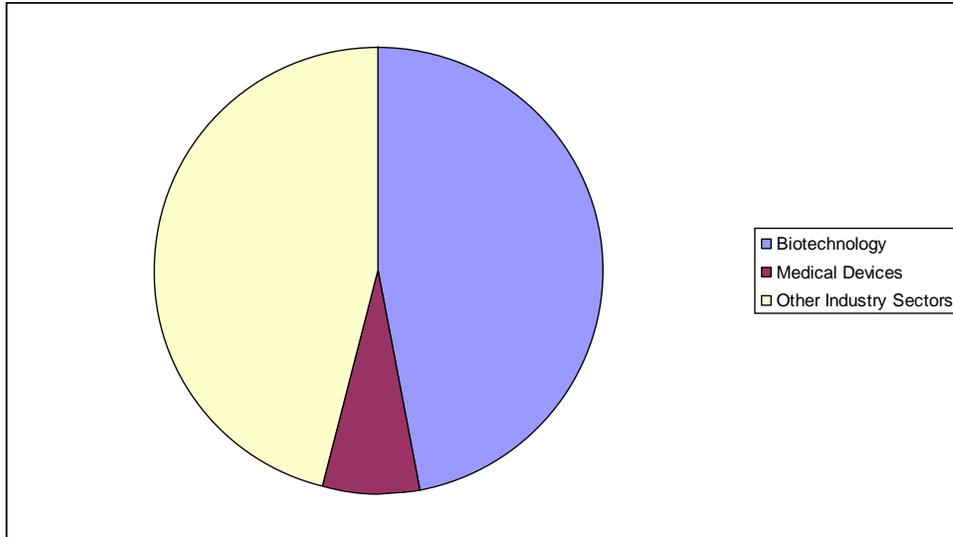
In 2008, 1,867 students graduated from Connecticut colleges and universities with bioscience related degrees, about 1.1% of the nation's total bioscience-related graduates. About 50% of Connecticut's bioscience graduates graduated with undergraduate and graduate degrees in the biological sciences and about 17% with degrees in agricultural, food, or nutrition science.

In 2008, over 53% of Connecticut's almost 26,000 bioscience workers were medical or clinical laboratory technicians and 37% biological scientists and technicians. About 10% were (1) biomedical or biochemical scientists and engineers and (2) agricultural, food, and nutrition scientists or technicians.

### ***Venture Capital Investments***

Venture capitalists help people start and expand businesses. From 2005-2010, they invested \$1.2 billion in Connecticut. As Chart 1 shows, they invested 47% (\$590 million) in biotechnology and 7% (\$89 million) in medical devices businesses. (The data comes from Pricewaterhouse Coopers' *Money Tree Report*, which tracks venture investments in the states, but does not identify the businesses sectors receiving the investments according to NAICS codes.)

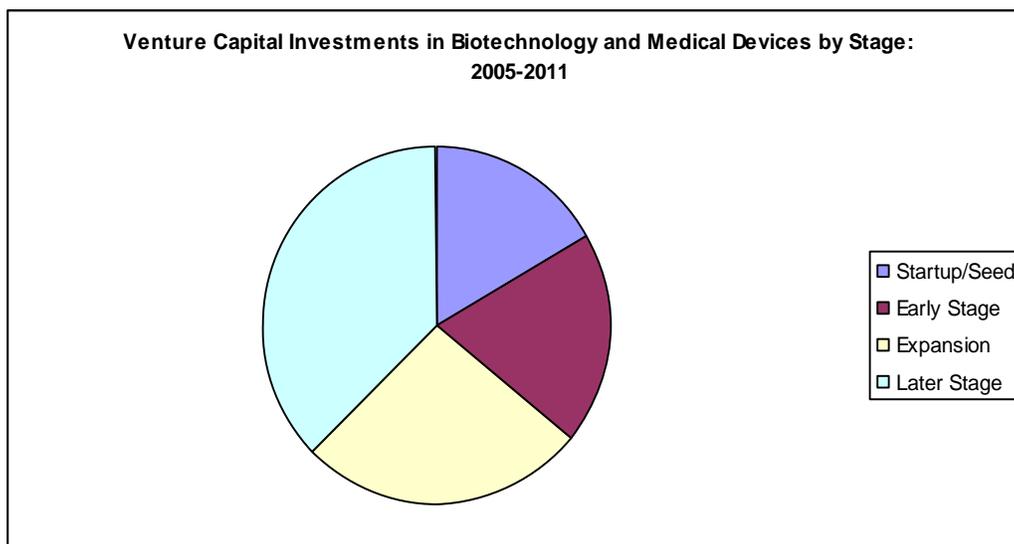
**Chart 1: Share of Venture Capital Investments in Biotechnology and Medical Devices Businesses, 2005-2010**



Source: [PricewaterhouseCoopers and National Venture Capital Association Money Tree Report](#)

A state's capacity's to sustain new bioscience businesses depends on the extent to which venture capitalists invest in newly formed businesses. Pricewaterhouse Coopers identifies four developmental stages—seed and start-up, early stage, expansion, and later stage—and tracks how much venture capitalists invest in each. Chart 2 shows, the greatest share of venture capital investments between 2005 and 2011 went to expanding and later stage companies.

**Chart 2: Venture Capital Investments in Connecticut by Developmental Stage, 2005-2011**



**Patents**

The number of patents issued to a state’s businesses indicates their capacity to develop new innovative products and techniques. According to [Battelle and BIO](#), from 2005-2009, 2,615 bioscience-related patents were issued in Connecticut, 3.5% of all U.S. bioscience patents issued during that period. As Table 9 shows, over 45% of the patents issued in Connecticut were for drugs and pharmaceutical products and treatments.

**Table 9: Patents Issued in Connecticut by Specified Bioscience Applications, 2004-2009**

<i>Bioscience Application</i>	<i>Total Patents</i>	<i>Percent of Patents</i>
Agricultural Bioscience	18	0.7
Biochemistry	462	17.7
Biotechnology	48	1.8
Drugs and Pharmaceuticals	1,187	45.4
Surgical and Medical Instruments	417	15.9
Other Medical Equipment	183	7.0
Other Bioscience-Related Patents	300	11.5

## **ECONOMIC IMPACT**

### ***Defined***

The money businesses spend to make products or deliver services ripples through the economy. Businesses employ people, purchase goods and services, and operate facilities. They also pay taxes on the things they buy and the profits they make. Consequently, the money businesses and their employees spend allow other businesses to maintain or expand their operations. And the taxes they pay allow governments to maintain or increase public services. Economists use mathematical models to gauge these economic impacts.

### ***Biopharmaceutical Sector's Economic Impact***

As we explained above, Connecticut's bioscience industry consists of four distinct business sectors, but we found no recent study gauging the collective economic impact of these sectors or the separate impacts of the agricultural feedstock and chemical; medical devices and equipment; and research, testing, and medical laboratories sectors. [Archstone Consulting](#) analyzed the economic impact of the biopharmaceutical sector in 2008, and we summarize the findings below.

Archstone determined the sector's economic impact by identifying specific measurable outputs and the extent to which they affected the macro economy, other businesses, and government. (It did not identify any potential costs, such as the cost of providing public services to bioscience facilities.)

***Impact on Macro Economy.*** Economists measure a state's economic performance by tallying the total value of all the goods and services produced in the state (i.e., gross state product or GSP). Connecticut's 2008 GSP was \$230.1 billion (FY 2012-FY 2013 Economic Report of the Governor, Office of Policy and Management, February 16, 2011). The pharmaceutical sector contributed about 6% to the state's GSP (\$14.6 billion). The total value of the goods and services it contributed was \$7 billion and the value of those provided by other supporting businesses totaled \$7.7 billion.

The \$7 billion the sector directly contributed to GSP was generated by its 9,688 employees. The average output per pharmaceutical employee equaled \$717,749, which is four times the direct out per employee for the rest of the Connecticut economy. This ratio also compares favorably with the sector's \$174,931 national output per employee.

**Future Capacity.** The biopharmaceutical sector's capacity to sustain or expand its contribution to GSP depends partly on the time and money spent researching and developing new drugs and treatments. Archstone measured that capacity by identifying the amount of money the sector spent on R&D, the amount of grants it received from national sources, and the number of clinical trials it conducted.

In 2008, Connecticut's pharmaceutical sector invested \$4.5 billion in R&D, almost 9% of the national sector's total R&D investment (about \$51 billion). This investment was supported by \$497 million in funding from the NIH, National Science Foundation, and Small Business Innovation Research Program. Over 95% of the funding came from NIH. The \$476 million in NIH grants awarded to Connecticut pharmaceutical businesses equaled 2% of its total 2008 awards.

Connecticut pharmaceutical businesses conducted 1,223 clinical trials in 2008, 8% of the 15,134 clinical trials that were being conducted nationally that year. Forty-three percent of Connecticut's trials focused on cancer; 23%, rare diseases; and 9%, respiratory conditions.

**Jobs.** Like any business sector, the pharmaceutical sector affects job levels in other sectors. Biopharmaceutical businesses buy goods and services from other businesses and consequently support jobs in those businesses (i.e., indirect jobs). These businesses and their employees also support jobs in other businesses when they spend their income to buy their goods and services from other businesses (i.e., induced jobs). In 2008, the pharmaceutical sector's 9,688 employees indirectly supported and induced 37,429 jobs in other sectors.

**Taxes.** The taxes biopharmaceutical businesses and employees pay help fund public services. Archstone identify only the federal and state income taxes these employees paid. In 2008, they paid \$254 million in federal taxes and \$43.5 million in state taxes. The state taxes per employee equaled \$5,580, four times the taxes paid by employees in other sectors (about \$1,296).

## LINKS

*Identifying & Defining Life Science, Bio-Tech, High-Tech, Knowledge Industries, and Information Technology Industries*, Massachusetts Department of Workforce Development, July 2007  
<http://lmi2.detma.org/lmi/pdf/Definitions.pdf>

*State Bioscience Initiatives 2010*, Biotechnology Industry Organization and Battelle, [http://www3.bio.org/local/battelle2010/Battelle\\_Report\\_2010.pdf](http://www3.bio.org/local/battelle2010/Battelle_Report_2010.pdf)

*State Bioscience Initiatives 2010: Connecticut*, Biotechnology Industry Organization and Battelle, [http://www3.bio.org/local/battelle2010/CONNECTICUT\\_profile.pdf](http://www3.bio.org/local/battelle2010/CONNECTICUT_profile.pdf)

*Economic Census*, U.S. Census Bureau,  
[http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=ECN&\\_tabId=ECN1&\\_submenuId=datasets\\_4&\\_lang=en&\\_ts=246366688395](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ECN&_tabId=ECN1&_submenuId=datasets_4&_lang=en&_ts=246366688395)

Minnesota IMPLAN Group, <http://implan.com/V4/Index.php>

PricewaterhouseCoopers and National Venture Capital Association  
*Money Tree Report* <https://www.pwcmoneytree.com/MTPublic/ns/index.jsp>

Archstone Consulting, *The Biopharmaceutical Sector's Impact on the Connecticut Economy, 2011*, <http://www.phrma.org/sites/default/files/connecticut.pdf>

*FY 2012-FY 2013 Economic Report of the Governor*, Office of Policy and Management, February 16, 2011,  
[http://www.ct.gov/opm/lib/opm/budget/2012\\_2013\\_biennial\\_budget/economic.report.final.pdf](http://www.ct.gov/opm/lib/opm/budget/2012_2013_biennial_budget/economic.report.final.pdf)

JR:ro

### Attachment 1: Description of Connecticut's Major Industry Sectors

<b>Sector</b>	<b>NAICS Code</b>	<b>Number of Establishments</b>	<b>Number of Paid Employees</b>	<b>Annual Payrolls</b>	<b>Total Sales, Shipments, Receipts, Revenue or Business Done</b>
Mining, quarrying, and oil and gas extraction	21	62	2,130	84,438	387,986
Utilities	22	151	10,210	997,251	Q
Construction	23	9,004	71,649	3,830,483	18,056,306
Manufacturing *	31-33	4,924	190,790	10,345,092	58,404,898
Wholesale Trade	42	4,620	75,993	4,923,315	143,639,691
Retail Trade	44-45	13,807	196,133	5,160,385	52,165,480
Transportation and Warehousing	48-49	1,714	44,117	1,739,203	5,273,473
Information	51	1,834	40,345	2,556,452	N
Finance and insurance	52	6,431	137,353	16,598,295	N
Real estate and rental and leasing	53	3,609	22,455	994,032	5,686,560
Professional, scientific, and technical services*	54	9,881	102,071	8,026,524	15,894,944
Management of Companies	55	763	D	D	D
Administrative and Support and Waste Management and Remediation Services	56	5,539	104,294	3,558,239	11,423,973
Educational Services	61	964	8,485	217,243	684,558
Health care and social assistance*	62	10,049	253,360	10,440,001	24,813,183
Arts, entertainment, and recreation	71	1,652	25,179	730,040	2,546,026
Accommodation and Food services	72	7,941	132,001	2,483,091	9,138,437
Other public services (except public administration)	81	7,392	47,992	1,395,375	5,061,346
<b>Total</b>	<b>NA</b>	<b>90,337</b>	<b>1,464,557</b>	<b>74,079,459</b>	<b>353,176,861</b>

\* Sector includes bioscience subsectors.

**Attachment 2: Changes in Bioscience Subsectors: 2002-2007**  
(in \$1,000)

<b>Drugs and Pharmaceuticals</b>			
Pharmaceutical Preparation Manufacturing (325412)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	12	13	-8
Number of Paid Employees	6,266	643	-89
Annual Payrolls	\$399,836	\$41,193	-89
Total Sales, Shipments, Receipts, Revenues or Business Done	\$3,091,122	D	
<b>Medical Devices and Equipment</b>			
Electromedical Apparatus Manufacturing (334510)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	16	13	-19
Number of Paid Employees	1,285	699	-46
Annual Payrolls	\$69,306	\$41,790	-40
Total Sales, Shipments, Receipts, Revenues or Business Done	\$321,290	\$234,306	-27
Analytical Laboratory Instrument Manufacturing (334516)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	13	17	31
Number of Paid Employees	1,445	963	-33
Annual Payrolls	\$76,272	\$126,893	66
Total Sales, Shipments, Receipts, Revenues or Business Done	\$244,573	\$394,373	61
Irradiation Apparatus Manufacturing (334517)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	4	6	50
Number of Paid Employees	e	501	Not Available
Annual Payrolls	e	33,511	Not Available
Total Sales, Shipments, Receipts, Revenues or Business Done	D	D	Not Available
Surgical and Medical Instrument Manufacturing (339112)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	39	45	15
Number of Paid Employees	4,273	4,485	5
Annual Payrolls	\$196,764	\$236,952	20
Total Sales, Shipments, Receipts, Revenues or Business Done	\$1,043,566	\$1,394,231	34
<b>Medical Devices and Equipment, continued</b>			
Surgical Appliance and Supplies Manufacturing (339113)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	28	32	14
Number of Paid Employees	772	667	-14
Annual Payrolls	\$34,721	\$31,629	-9
Total Sales, Shipments, Receipts, Revenues or Business Done	\$147,677	\$108,812	-26
Dental Equipment and Supplies Manufacturing (339114)			
<i><b>Metric</b></i>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	10	11	-10
Number of Paid Employees	552	446	-19
Annual Payrolls	\$23,002	\$19,189	-17

**Attachment 2 (continued)**

Total Sales, Shipments, Receipts, Revenues or Business Done	\$123,083	\$74,396	-40
<b>Ophthalmic Goods Manufacturing (339115)</b>			
<b>Metric</b>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	5	6	20
Number of Paid Employees	232	220	-5
Annual Payrolls	\$7,886	\$6,866	-10
Total Sales, Shipments, Receipts, Revenues or Business Done	\$37,080	\$40,854	10
<b>Dental Laboratories (339116)</b>			
<b>Metric</b>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	84	75	-11
Number of Paid Employees	939	528	-44
Annual Payrolls	\$29,320	\$18,142	-38
Total Sales, Shipments, Receipts, Revenues or Business Done	\$57,861	\$41,708	-28
<b>Research, Testing, and Medical Laboratories</b>			
<b>Testing Laboratories (541380)</b>			
<b>Metric</b>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	98	91	-7
Number of Paid Employees	1,478	1,611	9
Annual Payrolls	\$73,087	\$87,714	20
Total Sales, Shipments, Receipts, Revenues or Business Done	\$167,833	\$211,545	26
<b>Medical Laboratories (621511)</b>			
<b>Metric</b>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	34	57	68
Number of Paid Employees	2,775	2,472	-11
Annual Payrolls	\$137,004	\$144,794	6
Total Sales, Shipments, Receipts, Revenues or Business Done	\$411,033	\$418,277	2
<b>Diagnostic Imaging Centers (621512)</b>			
<b>Metric</b>	<b>2002</b>	<b>2007</b>	<b>% of Change</b>
Number of Establishments	91	133	46
Number of Paid Employees	1,682	2,282	36
Annual Payrolls	\$103,424	\$166,248	60
Total Sales, Shipments, Receipts, Revenues or Business Done	\$232,475	\$440,044	89