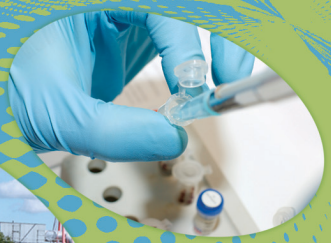
2010 Evidence and Opportunity:

Biotechnology Impacts in North Carolina

Prepared for:
North Carolina Biotechnology Center

Prepared by:
Battelle Technology Partnership Practice

September 2010



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STUDY HIGHLIGHTS

Independent analysis performed by the Battelle Technology Partnership Practice finds that the North Carolina Biotechnology Center continues to be a successful and critically important component in North Carolina's ongoing biotechnology growth.

Biotechnology: An Economic Engine for the State of North Carolina

Over the two years since Battelle's previous impact report, North Carolina's biotechnology sector has continued to grow at a significant rate (Table H-1).

Table H-1: Total (Direct + Indirect) Economic Impacts of Biotechnology in North Carolina

	2010 Reported Impact	2008 Reported Impact	Change 2008-2010
Employment	**226,823**	180,007	46,816 jobs increase
Employee Compensation	**$12.7 billion**	$9.4 billion	$3.3 billion increase
Business Volume (Economic Output)	**$64.6 billion**	$45.8 billion	$18.8 billion increase
State and Local Taxes	**$1.92 billion**	$1.44 billion	$0.48 billion increase

Biotechnology-related employment in North Carolina now stands at more than a quarter-million jobs and supports payroll and benefits totaling $12.7 billion. In terms of total economic impact, biotechnology is responsible for $64.6 billion in North Carolina output, and generates $1.92 billion in state and local taxes. Each of these impact measures has increased significantly over levels recorded in the previous study.[1]

North Carolina's important bioscience research and development base, which underpins innovations and growth in biotechnology, also recorded significant growth. Data show total life sciences R&D expenditures in the state at $1.52 billion, up from the $1.31 billion recorded in the previous impact report. As a result of increasing R&D activity, the annual economic impact of North Carolina's academic bioscience research sector increased to $3.1 billion (up from $2.5 billion) and employment rose from 20,959 to 23,447 (an increase of 2,488 jobs).

Bioscience and biotechnology industry growth in North Carolina is confirmed with 201 additional individual business establishments recorded in the current study, for a total of 1,339. The good news continues with the assessment of North Carolina's biotechnology sector growth rate, which continues to exceed that for the nation as a whole, and substantially exceeds the growth rate for the total North Carolina private-industry sector.

Wages in the bioscience and biotechnology industries continue to be a positive story. Average earnings for sector workers in North Carolina reached $74,829 in the current analysis (up from $69,725 in the 2008 report) and are fully $35,000 greater than the average earnings for North Carolina private-sector workers. Biotechnology provides high-paying jobs and continues to represent a growth sector for North Carolina.

[1] Data used in the 2008 economic impact report were for the 2006 calendar year. Data for the 2010 report are for the 2008 calendar year.

In terms of biotechnology innovation, North Carolina has also seen significant progress. In the 2008 impact report, Battelle/BIO analysis showed North Carolina to be ranked 20th among the U.S. states in bioscience patent activity. For 2010, Battelle reports that North Carolina has risen to a ranking of 14th. Between 2004 and 2009, North Carolina research and development generated more than 2,300 bioscience patents.

On the education and workforce development front, North Carolina's higher-education institutions increased their graduate output. The 4,174 bioscience-related degrees awarded in the state reported in the previous study has grown to 4,473 in the current report—with growth occurring across associate's, master's and Ph.D. degrees.

Battelle benchmarked the performance of North Carolina in biotechnology versus the Top 10 bioscience states (of which North Carolina is one). The benchmarking findings indicate that North Carolina continues to reside in a strong competitive position, with only Massachusetts recording a slightly higher growth rate in the sector. North Carolina outstripped the other leading states in biotechnology employment growth, beating out California, Florida, Indiana, New Jersey, Pennsylvania, Texas, New York and Illinois.

EXECUTIVE SUMMARY

This 2010 report represents an update of a previously completed 2008 assessment of the economic impacts of biotechnology in North Carolina and the specific impact contributions of the North Carolina Biotechnology Center.

The State of North Carolina was among the first U.S. states to recognize the unique economic development opportunities that modern biotechnology would bring. In 1984, the state developed a unique model for biotechnology development, centered on the formation of the North Carolina Biotechnology Center. The Center represented the world's first government-sponsored commitment to targeted biotechnology-based economic development. Observing the nascent opportunities on biotech's horizon, the State stepped forward to initiate a long-term commitment of resources required to place North Carolina among the preeminent locations in the world for biotechnology-sector growth. **As both the 2008 and this 2010 report show, the results achieved for North Carolina and its citizens have been highly significant and pay testament to the foresight of the State and multiple stakeholder partners in committing to the North Carolina Biotechnology Center's mission and to biotechnology as a signature for the North Carolina economy.**

North Carolina's Biotechnology Sector is Large and Growing

As defined by the North Carolina Biotechnology Center's database of companies, **the biotechnology sector in the State in 2010 employs 56,842 personnel. This represents an increase of 3,630 jobs from the 53,212 reported in the 2008 impact report—a significant increase of 6.8 percent in just two years.**[2] Biotechnology employment within North Carolina is highly concentrated in two key sectors—Pharmaceutical and Medicine Manufacturing, and Research and Development[3]—which together account for 65 percent of biotechnology businesses and 64 percent of employment.

Battelle's Technology Partnership Practice (TPP) and the Biotechnology Industry Organization (BIO) have jointly developed a nationally recognized industry definition of biotechnology and the biosciences. **Use of the Battelle/BIO definition facilitates the comparison and benchmarking of North Carolina's bioscience and biotechnology growth versus competing states**. The previously published 2008 Battelle report for the North Carolina Biotechnology Center used 2006 bioscience data, while this 2010 report updates these figures with the latest nationally published data which are for 2008. Using the Battelle/BIO definition it is found that **North Carolina continues to benefit from a large, specialized and growing bioscience sector. The State employed 53,615 in bioscience industry jobs in 2008, up from 49,215 in 2006 (a growth rate of 8.9 percent) spanning 1,339 individual business establishments (a significant increase of 201 business establishments versus 2006's total of 1,138).** North Carolina's large employment base in the biosciences yields a high concentration of jobs in the state relative to the national average. The location quotient (LQ) for the biosciences in North Carolina is 1.28 meaning the State has a 28

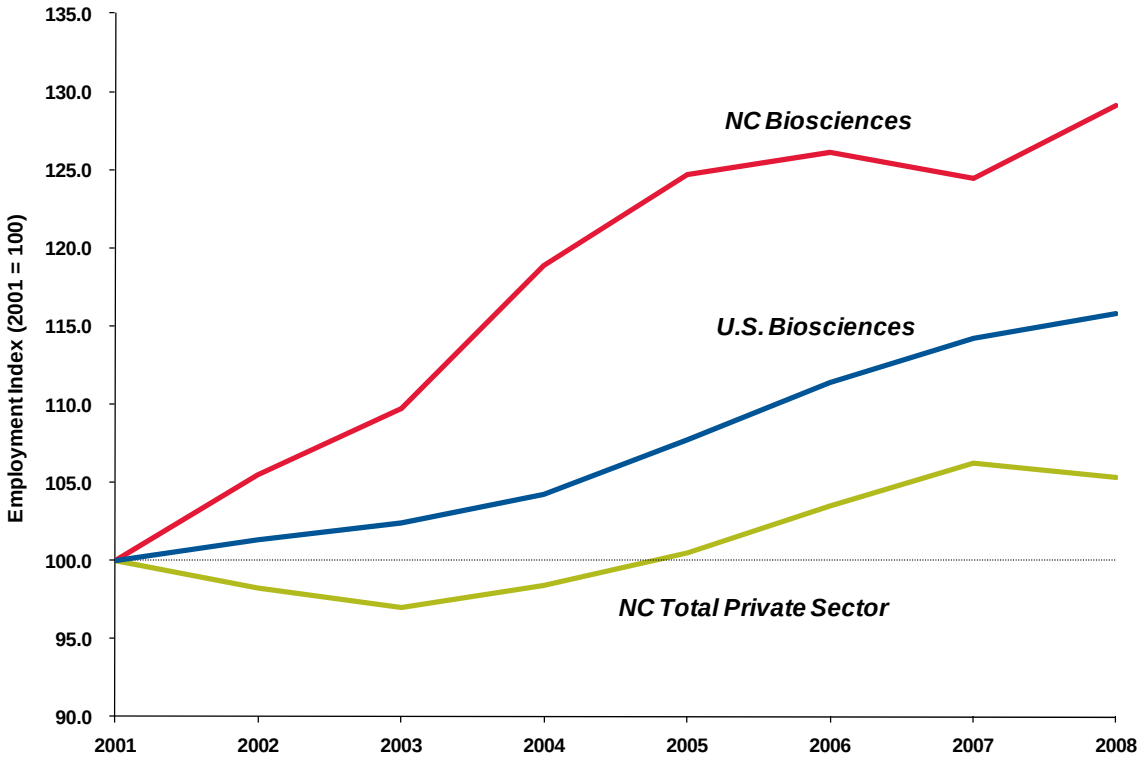
[2] NCBC updates its biotechnology database on a rolling basis so the employment number used here may differ from other NCBC reports as company information was updated.

[3] Many early stage firms are classified as research and development entities rather than by the classification of the product or service they are developing.

percent greater concentration of bioscience jobs compared with the national average. An industry location quotient that exceeds 1.20 is typically referred to as a regionally **specialized** industry.

Clearly the biosciences represent a very important industry sector in North Carolina, and it is a sector which continues to grow—with net job growth of 29 percent during the 2001 to 2008 period. This sector growth rate was nearly twice that for the national bioscience sector, which grew approximately 16 percent during this same period and **more than five times the growth of the State's total private sector**, which increased by 5.3 percent (see Figure ES-1). Total bioscience establishments have grown by a substantial 36 percent during this same seven-year period, outpacing the national growth in sector establishments.

Figure ES-1: Employment Growth in North Carolina's Bioscience Sector, 2001–2008 (Indexed, 2001=100)



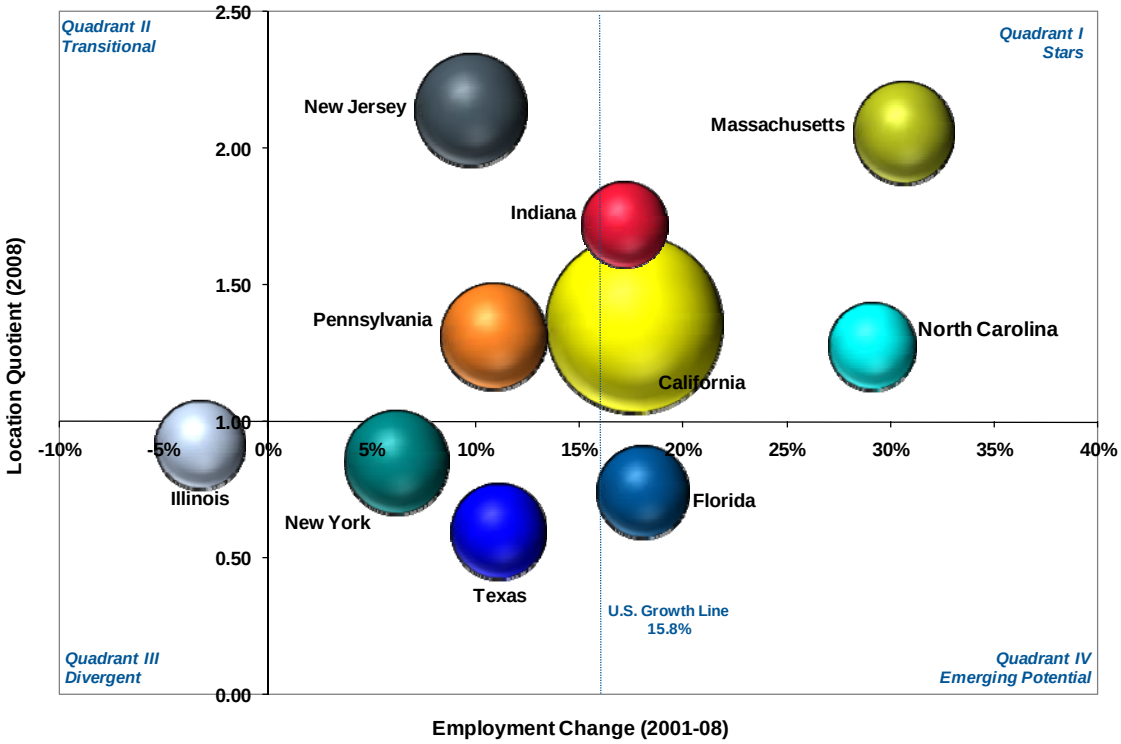
North Carolina enjoys a specialized employment concentration in three of the four main bioscience subsectors—drugs and pharmaceuticals (LQ = 2.04); research, testing, and medical labs (LQ = 1.30); and agricultural feedstock and chemicals (LQ = 1.22). Three of the four major bioscience subsectors contributed to the State's substantial overall job growth during the seven-year period with only drugs and pharmaceuticals having no net employment gains.

North Carolina, Among the Preeminent States in Biotechnology and Bioscience Employment Growth and Specialization

The bubble chart in Figure ES-2 presents the employment position for North Carolina and its fellow top 10 states in overall bioscience employment. **Among the ten largest bioscience employer states, North Carolina's 29 percent job growth since 2001 has been faster than for all states except Massachusetts**. North Carolina shares the distinction of being a "specialized"

bioscience state with Massachusetts, New Jersey, Indiana, California and Pennsylvania (defined by having a location quotient greater than 1.0). Among these states only North Carolina, Massachusetts, California and Indiana are in the elite position of being both specialized and experiencing a bioscience growth rate higher than the national average.

Figure ES-2: Total Bioscience Sector, Degree of Specialization, Employment Growth, and Size, Ten Largest US Bioscience Employer States, 2001–2008



Biotechnology Pays Strong Wages in North Carolina, Significantly Above Private Sector Averages

North Carolina's bioscience workers, like those in the national sector, earn higher wages, on average, than their counterparts in most other major industries and the overall private sector.

Bioscience workers in North Carolina earned $74,829 on average in 2008, or more than $35,000 more than the state's average private-sector worker. This represents a 90 percent wage premium over average private sector wages. It also represents a significant increase in average wage levels of 7.3 percent for the sector versus the 2006 level of $69,725. Within the sector, employees of drug and pharmaceutical manufacturers earn the highest wages—$87,000 in 2008 (up from $81,085 in 2006).

North Carolina Bioscience Patents Continue to Rise

Innovation is a critical element in a research-oriented sector such as biotechnology. The development of new ideas, processes, and products is a key characteristic of commercializing life sciences and propels the industry in new directions. Intellectual property in the form of patents offers legal protections for new ideas and fosters incentive for continued innovation in the U.S.

From 2004 through 2009, 2,307 North Carolina patents were issued relating to the biosciences. Drugs and pharmaceuticals, with 780 patents, accounts for about one-third of all North Carolina bioscience-related patent activity since 2004—the largest single concentration among the major class groups. Patents in biochemistry, with a particular focus in molecular biology and microbiology, account for the 2nd largest group with 565 patents since 2004, or 25 percent of the State total in the biosciences. A relatively diverse array of patents related to surgical and medical instruments combine for 378 patents since 2004 (16 percent). These three groups—drugs and pharmaceuticals, biochemistry, and surgical and medical instruments—account for the majority of U.S. bioscience-related patents as well.

In Battelle's 2010 report for BIO, bioscience-related patents were analyzed for all states, and North Carolina ranked 14th.[4] This represents a substantial rise up the rankings from North Carolina's position of 20th in 2007.

Biotechnology is a Major Economic Impact Engine for North Carolina

Battelle TPP used input/output analysis, the acknowledged gold standard for impact analysis, in quantifying the direct, indirect and induced impacts of biotechnology and biosciences on the economy of the State of North Carolina. **Over the two years since Battelle's previous impact report, North Carolina's biotechnology sector impacts have continued to grow at a significant rate (Table ES-1). Total biotechnology-related employment in North Carolina (both direct plus indirect) now stands at more than a quarter-million jobs and supports payroll and benefits totaling $12.7 billion. In terms of total economic impact, biotechnology is responsible for $64.6 billion in North Carolina output, and generates $1.92 billion in state and local taxes.** Each of these impact measures has increased significantly over the levels recorded in the previous study.[5]

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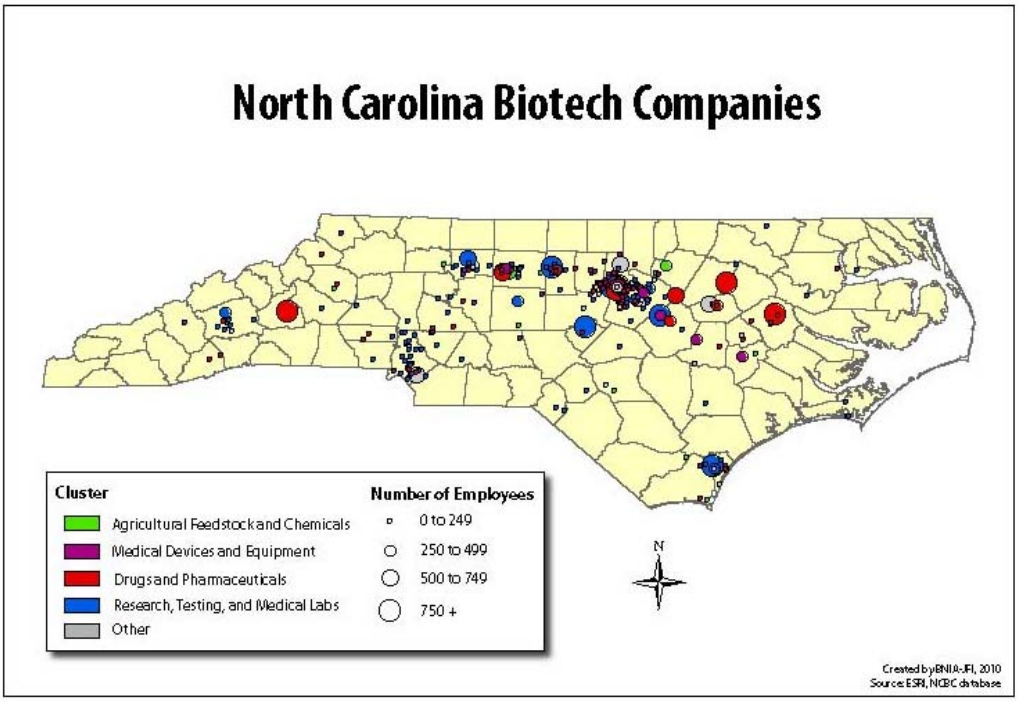
[4] "Battelle/BIO State Bioscience Initiatives 2010," Battelle and the Biotechnology Industry Organization (BIO). To access the full report including a state profile for North Carolina, see: http://bio.org/local/battelle2010/.
[5] Data used in the 2008 economic impact report were for the 2006 calendar year. Data for the 2010 report are for the 2008 calendar year.

Biotechnology: Spreading its Wealth Across North Carolina

It is important to note that the economic impact benefits of biotechnology are experienced across all geographic regions of North Carolina. Biotechnology is a statewide sector of economic activity and Figure ES-3 shows the diverse geographic distribution of biotechnology operations in the state, across five sub-sectors, and shows the size of biotechnology operations by location.

Figure ES-3: North Carolina Biotech Companies Locations



The North Carolina Biotechnology Center – Investing in North Carolina's Biotechnology Future

The North Carolina Biotechnology Center represents a central guiding force for the development of the biotechnology-based economy in North Carolina. The Center operates with the mission ***"to provide long-term economic and societal benefits to North Carolina through support of biotechnology research, business and education."*** The Center addresses this mission via attention to six principal goals:

1. Strengthening North Carolina's academic and industrial biotechnology research capabilities.
2. Fostering North Carolina's biotechnology industrial development.
3. Working with business, government and academia to move biotechnology from research to commercialization in North Carolina.
4. Informing North Carolinians about the science, applications, benefits and issues of biotechnology.
5. Enhancing the teaching and workforce-training capabilities of North Carolina's educational institutions.

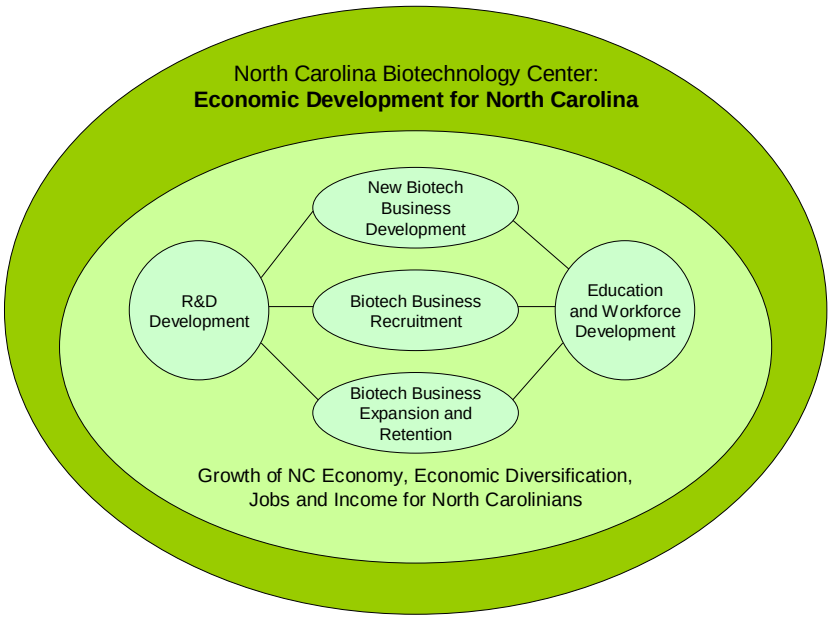
6. Establishing North Carolina as a preeminent international location for the biotechnology industry.

Work on these goals is accomplished by staff located at the Center's headquarters facility in Research Triangle Park and by staff located at five regional offices strategically located across the State (see Figure ES-4):

Figure ES-4: North Carolina Biotechnology Center Headquarters and Regional Office Locations

At its core, the Biotechnology Center is an economic development engine for the State of North Carolina. Via a coordinated suite of programs and initiatives, the Center works to grow the North Carolina economy via: R&D development; biotechnology business development; recruitment, retention and expansion; and education and workforce development (see Figure ES-5).

Figure ES-5: North Carolina Biotechnology Center—An Economic Development Engine for the State



The Center approaches its economic development mission via a series of primary program areas:

- **Science and Technology Development (Bioscience R&D)** – supporting the continuing growth of North Carolina as a leading state for basic and applied bioscience and biotechnology R&D.

- **Business and Technology Development** – supporting biotechnology entrepreneurship, new business formation and biotechnology company growth.
- **Business Recruitment, Retention and Expansion** – proactively working to bring new biotechnology and biomanufacturing company facilities into the state and providing support services to existing NC biotechnology companies to assure their retention and expansion.
- **Education and Workforce Development** – supporting biosciences education along the continuum from K-12 education through to post-secondary education and proactive programs in bioscience workforce development and incumbent worker training initiatives.

Placing the primary activities of the Biotechnology Center into the four simplified categories above helps to explain the operations of the Center but oversimplifies the complex suite of programs, services and initiatives deployed by the Center under these four categories. Figure ES-6 provides a more detailed view of the specific functional activities that the Center deploys in meeting its mission and goals:

Figure ES-6: North Carolina Biotechnology Center Initiatives and Programs and their Functional Benefits for North Carolina

North Carolina Biotechnology Center

Key Themes	NCBC Initiatives and Programs	Functional Benefits
Science and Research Development	Faculty/researcher recruitment aid	Enhanced research climate and infrastructure
	Facilities and infrastructure funding	Enhanced R&D human capital
	Academic research funding	Leveraged federal and private research funds
	Collaborative company-university R&D	New discoveries, innovations and technology
	Multi-institution/multi-disciplinary support	Generation of valuable intellectual property
	Researcher networking/intellectual exchange	New and improved biotech products for industry
	Regional networking	Improved industry processes and productivity
New Biotech Business Development	Loans to start-up biotech companies	Development of new companies in NC
	Access to private risk capital	Enhanced employment opportunities for NC residents
	Tech transfer and licensing support	Growth in NC personal and family incomes
	Facilitation of strategic partnerships	Products and services to improve health/healthcare
	Entrepreneurship education and support	New sub-cluster development and diversification
	Sites/facilities access and development	Business opportunities for NC suppliers to biotech
	Business intelligence/library resources	Business opportunities for service providers
	Business planning/development assistance	Job opportunities and enhanced retention of graduates
	Networking and events	Regional and community growth and sustainability
	Access to PhD scientist fellows for industry	
	Access to professional services	
Economic Development (Recruitment, Expansion & Retention)	Recruitment of biotech firms and plants to NC	Attraction of biotechnology companies to NC
	Expansion assistance to NC biotech companies	Expansion and retention of NC companies
	Services to support retention of biotech firms	Long-term guidance of biotechnology sector development
	Overall biotechnology sector strategic planning	Proactive enhancement of NC business environment
	Biotech sub-sector strategies	Planning for emerging opportunities and change
	New sector and opportunity assessment	Regional guidance and strategy formation
	North Carolina regional strategies	Enhanced public support for economic development
	Public awareness building for biotechnology	Enhanced domestic and international image for NC
	International promotion and marketing support	
Education and Workforce Development	K-12 teacher training and assistance	Improved resources for schools
	Biotechnology educational workshops	Rigor and relevance in education
	Educational materials loan and supply	Student interest & engagement in science and technology
	Grants to support education and training	Access to skilled and productive workforce for industry
	Industry workforce needs analysis	Re-skilling, skills modernization and skills enhancement
	Biotechnology curriculum development	Incumbent worker retention and career progression
	Bio-manufacturing workforce development	Workforce skills enhancement across NC regions
	Workforce recruitment and retention help	Balanced labor supply and demand relationship

This broad range of initiatives, programs and services provided by the Biotechnology Center leads, in turn, to the significant functional benefits and economic impacts for the State of North Carolina. For example, since 1989, when the North Carolina Biotechnology Center started to provide economic development assistance to companies, it has made 177 grants or loans to 125 companies.[6] **Of the 125 companies receiving grants or loans, 83 are currently active as of the time of this analysis (up from 64 in the 2008 impact report).**[7] Battelle estimated the economic impacts of these 83 companies. The 83 companies have total employment of 1,608 and estimated revenues of $832.2 million. The impacts of these companies operations were analyzed using the IMPLAN model.[8] These 83 companies generate $1.35 billion in economic activity in the State, create or support 5,513 jobs earning $302.6 million in salaries, wages and benefits, and generate an estimated $43.6 million in state and local tax revenues (an amount that exceeds the annual funding for NCBC).

It should also be noted that through its own institutional expenditures, the North Carolina Biotechnology generates operating expenditure-based economic impacts. As presented in Table ES-2, the Center's $16.7 million in operational expenditures in 2009 increased economic activity in North Carolina by $35.9 million, supported an estimated 239 jobs earning $12.3 million in salaries, wages, and benefits, and generated nearly $1.6 million in State and local tax revenues.

Table ES-2: The Economic Contribution of NCBC Operational Spending on the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($)	$16,708,042	$9,148,515	$10,073,541	**$35,930,098**
Employment (# of Jobs)[1]	83	68	88	**239**
Employee Compensation ($ M)[1]	$6,917,572	$2,588,935	$2,822,172	**$12,328,679**
State and Local Tax Revenues ($ M)	--	--	--	**$1,636,644**

(1) Direct Employment and Employee Compensation is for NCBC staff only - Jobs and Employee Compensation created by NCBC grants are included in indirect impacts.

Conclusion

Biotechnology, and the biosciences that underpin it, continue to be an important and expanding driver of the North Carolina economy. Outpacing the growth of biosciences in the nation as a whole, North Carolina continues to reinforce its position among the preeminent states for biotechnology employment and growth. Within a state economy challenged by current global economic forces impacting its industries, biotechnology has sustained its position as a star performer for the State—gaining new businesses and generating new jobs and expanding incomes for North Carolinians.

For 2010, at the time of this report's writing, North Carolina enjoys a biotechnology sector that employs 56,842 personnel—representing an increase of 3,660 jobs from the 53,182 reported in the 2008 impact report—an increase of 6.9 percent.[9] **In terms of total economic impact, biotechnology and the biosciences are directly and indirectly generating a total of 226,823 jobs in North Carolina (an increase of 46,816 jobs since the previous impact report) with employee**

[6] Four grants or loans were made to universities. These were excluded from this analysis.

[7] Some of these companies may have been acquired by other companies or have changed their name and, thus, may be active in some form. In cases where a company was known to be acquired the acquiring company was included.

[8] See above description of the IMPLAN model and methodology used.

[9] NCBC updates its biotechnology database on a rolling basis so the employment number used here may differ from other NCBC reports as company information was updated.

compensation totaling $12.7 billion (a $3.3 billion increase) and total economic impact (output) of $64.6 billion (an $18.8 billion increase over 2006 levels reported in the 2008 report).

Other metrics continue to bode well for North Carolina's continued growth as a leading bioscience and biotechnology state through the current decade. The state's academic research institutions have experienced expanding bioscience R&D volumes, while measures of innovation (such as intellectual property) generations have also increased (moving North Carolina to 14th from 20th in bioscience IP generation). Furthermore, North Carolina's position versus peer top ranked bioscience states continues to be very strong, with North Carolina holding the enviable position as both specialized and growing in bioscience and biotechnology employment.

Underpinning this strong biotechnology economy performance is the investment made by the State in the operations and mission of the North Carolina Biotechnology Center. Through an ongoing and long-standing commitment to the North Carolina Biotechnology Center the State and its people are reaping the rewards of biotechnology industry growth.

I. INTRODUCTION

In 2008 Battelle undertook a comprehensive assessment of the economic impacts of biotechnology in North Carolina and the specific impact contributions of the North Carolina Biotechnology Center. This 2010 report updates the economic impact analysis with current data and examines the further progress made in North Carolina's economy through biotechnology growth and investment.

The State of North Carolina was among the first U.S. states to recognize the groundbreaking economic development opportunities that modern biotechnology would bring. In 1984, the state developed a unique model for biotechnology development, centered on the formation of the North Carolina Biotechnology Center. The Center represented the world's first government-sponsored commitment to targeted biotechnology-based economic development. The State observed the nascent opportunities on biotech's horizon and stepped forward to initiate the long-term commitment of resources required to place North Carolina among the preeminent locations in the world for biotechnology-sector growth. As both the 2008 and this 2010 report show, the results achieved for North Carolina and its citizens have been significant and are a testimony to the foresight of the State and multiple stakeholder partners in committing to the North Carolina Biotechnology Center's mission and to biotech as a signature for the North Carolina economy.

2010 Impact Update Methodology

The 2010 impact update project uses the same methodology deployed in 2008. Battelle uses both quantitative and qualitative methods in its economic impact projects, with quantitative analytical techniques favored where facilitated by available data sources. For the analysis of the impact of the biotechnology sector in North Carolina Input/Output (I/O) analysis is used, and this "gold standard" economic impact analysis technique is also used in calculating the current spending impacts of the Center.

This report presents an overview of the current position of North Carolina in biotechnology, with Battelle measuring the size of the biotechnology economy in the State. The report also examines where North Carolina ranks among U.S. states in biotechnology and provides benchmark comparison to other leading biotech states.

Using input/output analysis, Battelle details the overall economic impact of the biotechnology sector on the State of North Carolina—presenting data on direct output and employment in the sector and the total, multiplier-based impacts generated across the economy by indirect and induced impacts. Because of the importance of science and technology research and development to progress in the biotechnology sector, Battelle also examines the specific economic impact in the State from biotechnology, medical and life-sciences research taking place at North Carolina institutions.

One of the key roles of the North Carolina Biotechnology Center is support for biotechnology business commercialization in the State and the provision of capital and services to new and growing biotechnology enterprises. Currently the North Carolina Biotechnology Center has 83 companies in its portfolio of businesses (up from 64 in 2008) supported by loans administered by the Center. The specific economic impact of these 83 companies is measured herein.

In addition, economic impacts are generated directly by the Center through its operations and expenditures. Employing 83 personnel and with an annual budget of $16.7 million[10], the North Carolina Biotechnology Center generates significant expenditure impacts in the State through its ongoing operations. These Center expenditure impacts are also presented in this report.

About Battelle

The Battelle Technology Partnership Practice (TPP) is the technology-based economic development consulting arm of Battelle, the nation's largest non-profit R&D organization. Each year Battelle undertakes more than 4,500 projects for industry, higher education, the public sector, and other clients. In addition to these projects, Battelle manages and operates the Pacific Northwest National Laboratory and co-manages Brookhaven National Laboratory, Idaho National Laboratory, the National Renewable Energy Laboratory, Lawrence Livermore National Laboratory and Oak Ridge National Laboratory for the U.S. Department of Energy. Additional labs operated by Battelle include the National Biodefense Analysis and Countermeasures Center for the U.S. Department of Homeland Security and the United Kingdom's National Nuclear Laboratory.

Battelle's TPP has a national track record in identifying and designing comprehensive biosciences roadmaps and strategies across basic and translational research enhancement, technology development, new-venture development and business development. TPP has completed bioscience strategies for many states and regions including the states of Arizona, Colorado, Georgia, Iowa, Ohio, Michigan, West Virginia and Missouri, and such regions as Central Indiana, Central Ohio, Memphis, Pittsburgh, Oklahoma City, St. Louis, Tucson, and Western Massachusetts. TPP also has considerable expertise in evaluating economic impacts of bioscience and technology-based organizations and programs, including work for individual states, national bodies and organizations such as, most recently, Mayo Clinic.

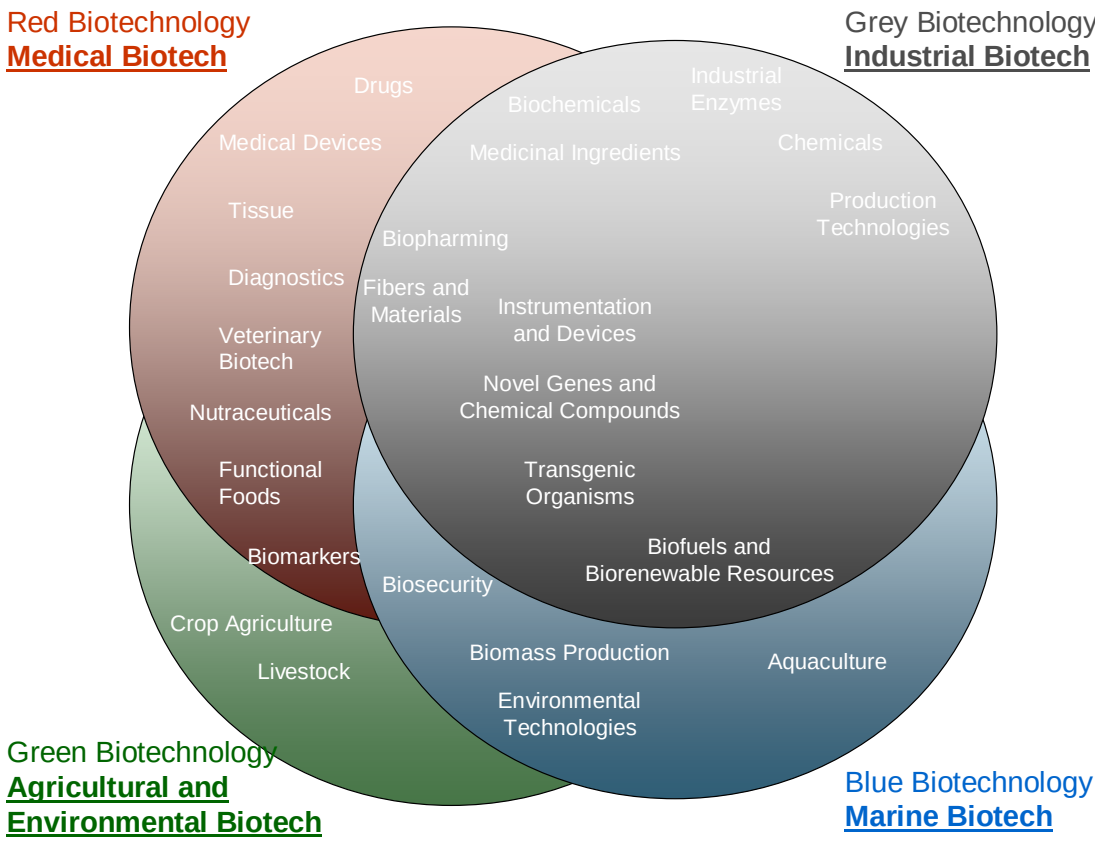
Battelle TPP is also well known nationally for competitive benchmarking capabilities. In addition to conducting benchmarking in all of its technology roadmap and strategic planning engagements, since 2001, Battelle has partnered with the national Biotechnology Industry Organization (BIO) to assess the "state of the states" in biosciences and biotechnology in each of the 50 states. The assessment includes an inventory of all the initiatives pertaining to biotechnology and life sciences within each state, as well as the regulatory environment surrounding these initiatives. The initiative has been repeated for BIO in 2004, 2006, 2008 and most recently in June 2010.

[10] This comprises a conversion from fiscal year to a calendar year basis for the purpose of facilitating the input/output analysis.

II. THE NORTH CAROLINA BIOTECHNOLOGY SECTOR: SIZE OF THE CLUSTER

Biotechnology is a broad field with major applications spread across sectors as diverse as human health care, veterinary care, agricultural and forestry production, marine biotech and industrial bioprocesses. A recent report by BIO[11] (the Biotechnology Industry Organization), partly authored by Battelle, highlights the wide-ranging impacts of biotechnology—emphasizing that biotech makes extremely significant contributions to "healing, fueling and feeding the world"—indicative of the healthcare, industrial biotech and agricultural impacts of applied biotechnology. Figure 1 illustrates many of the technology areas within the key branches of modern biotechnology.

Figure 1: Macro Biotechnology Clusters and Convergence Areas – A World of Opportunity



[11] BIO. "Healing, Fueling, Feeding: How Biotechnology is Enriching Your Life." Biotechnology Industry Organization. Washington DC. May 2010. Available online at www.valueofbiotech.com.

Within North Carolina biotechnology development is occurring across the application spectrum with intensive R&D activity and business operations taking place in medical biotech, industrial biotech, agricultural biotech and marine biotechnology. This broad-spectrum application of biotechnology in North Carolina has created a significant and expanding biotechnology-based economy for the State.

The State of North Carolina had the foresight, more than a quarter of a century ago, to invest in the development of a biotechnology cluster. Objective statistics herein show that this investment has paid off, many times over, in the growth of one of the most dynamic economic engines in the State. In this chapter of the report Battelle examines the current size and scope of the biotech sector in North Carolina.

Defining the Biotechnology Sector in North Carolina

The biotechnology sector in North Carolina is analyzed using two definitions of the sector—one based on the Center's own database and the other based on BIO/Battelle's national data on biotechnology (see sidebar)—which facilitates benchmarking of North Carolina against competing states.

North Carolina Biotechnology Center Database-Based Definition

The North Carolina Biotechnology Center provided Battelle with its database of biotechnology companies and branch locations located in North Carolina.

This regularly updated database contained information on the name, location, industry classification,[12] employment and key operational information on 597 companies and branch locations. Because some companies have multiple locations, a total of 539 of these database records are used to track employment in the biotechnology sector in the State.

Background to the Analysis

In this analysis of the size and impact of the biotechnology cluster on the State of North Carolina, Battelle conducted two complementary analyses (the same process used in the 2008 study). Because a core mission of the North Carolina Biotechnology Center is to track the size and performance of the sector, the Center has developed its own database of biotechnology companies operating in the State. Biotechnology is an industry that cuts across many sectors. Many companies involved in biotechnology are classified in a broad number of industry sectors. While the federal government's official North American Industry Classification System (NAICS) has improved the availability of data on biotechnology and life sciences employment, there is no "official" definition of biotechnology. Thus, the Biotechnology Center has developed its own database of companies that it has identified as active in the biotechnology sector. While these companies are concentrated in the traditional life sciences oriented sectors, such as pharmaceuticals, life sciences research and development, and health care, many of the State's biotechnology companies are classified in a variety of other sectors ranging from chemicals, to engineering and agriculture. This database allows for North Carolina to track, and for Battelle to analyze, the size and impact of the sector using highly accurate, up to date sector information provided by the Center. Thus, the first analysis of the size and impact of the sector is based on the North Carolina Biotechnology Center's own database and information.

Because similar databases do not exist at the national, regional, or state level for comparison to the Center's database, Battelle has also analyzed the size, growth and impact of this sector using its own definition of the biotechnology sector based on national NAICs codes and available national and state-level employment data. In this analysis Battelle uses the same definitional structure used in the national bioscience report produced for the Biotechnology Industry Organization in the May 2010 report "State Bioscience Initiatives 2010."

[12] NCBC had industry classification information for the majority of companies. Where this was missing in the database, wherever possible, Battelle TPP identified industry sectors using commercial databases or available Internet information. In cases where industry classification information was not available from other sources, Battelle classified the company based on the activity description included in the database. In some cases, Battelle reclassified companies in order to better match the biotechnology sector or description of the company from the database.

As presented in Table 1, according to the Center's database, **there are 56,842 persons employed in the biotechnology sector in North Carolina** (an increase of 3,660 jobs from the 53,212 reported in the 2008 impact report—representing a 6.8% increase).[13] Biotechnology employment is highly concentrated in two sectors—Pharmaceutical and Medicine Manufacturing, and Research and Development[14]—which together account for 65 percent of business records and 64 percent of employment. The next largest concentrations of firms and employment are in: Architecture and Engineering (4 percent of business records and 10 percent of employment); Surgical and Medical Instrument (6 percent of business records and 8 percent of employment) and Health Care (4 percent of business records and 6 percent of employment). The remaining biotechnology firms are distributed across a variety of smaller sectors. As Table 1 shows, biotechnology employment grew by 3,630 jobs from 2008–2010, according to Center records, with six out of nine individual biotechnology subsectors in North Carolina gaining employment.

Table 1: Biotechnology Sector Employment, 2010

Sector	2010 Number of records	2010 Percent of Total	2010 Jobs	2010 Percent of Jobs Total	2008 Jobs	Job Change 2008 to 2010
Total	**539**	**100%**	**56,842**	**100%**	**53,212**	**3,630**
Pharmaceutical and medicine manufacturing	75	14%	22,391	39%	21,663	**728**
Scientific research and development services	274	51%	14,086	25%	16,276	**-2,190**
Architectural and engineering services	21	4%	5,689	10%	5,415	**274**
Surgical and medical instrument manuf.	30	6%	4,698	8%	2,134	**2,564**
Health Care	19	4%	3,157	6%	1,962	**1,195**
Other Manufacturing	18	3%	1,905	3%	2,215	**-310**
Pesticide and other agricultural chemical manufacturing	6	1%	1,872	3%	1,190	**682**
Other Chemical Projects	21	4%	1,258	2%	1,839	**-581**
Other	75	14%	1,786	3%	518	**1,268**

Source: North Carolina Biotechnology Center Biotechnology Database and Battelle TPP

Battelle/BIO Definition

Biotechnology has a unique set of industry characteristics. It represents a varied set of companies that span manufacturing, services, and research activities, requires a highly skilled workforce, and produces a broad range of products and services classified among nearly 30 individual classified industries. Much more than other sectors, biotechnology and its associated biosciences are dynamic and evolve with the latest research and scientific discoveries with widespread impact on food, medicines, diagnostics, and industrial products. The common link among this diverse set of firms is an application of knowledge as to how living organisms function—and then using that knowledge to create useful and valued products.

[13] NCBC updates its biotechnology database on a rolling basis so the employment number used here may differ from other NCBC reports as company information was updated.

[14] Many early stage firms are classified as research and development entities rather than by the classification of the product or service they are developing.

Battelle's Technology Partnership Practice, in its work assisting in the strategic planning and development of life sciences initiatives for numerous states and its work with the Biotechnology Industry Organization (BIO) on its biennial state bioscience initiatives report, has developed a nationally recognized industry definition of biotechnology and the biosciences. The definition goes beyond biotechnology research and development to include varied, but highly related industrial applications in the biosciences, while providing an available set of comparable employment metrics across all U.S. states and regions (thereby facilitating benchmarking).

The BIO/Battelle Definition of Biosciences is quite similar to the NCBC definition for biotech. In the 2010 BIO/Battelle "State Biosciences Initiatives 2010" report Battelle notes that:

The biosciences are a diverse group of industries and activities with a common link—they apply knowledge of the way in which plants, animals, and humans function. The sector spans different markets and includes manufacturing, services, and research activities. By definition, the biosciences are a unique industry cluster and are constantly changing to incorporate the latest research and scientific discoveries. The bioscience industry sector is defined as including the following four macro subsectors:

- *Agricultural Feedstock and Chemicals*
- *Drugs and Pharmaceuticals*
- *Medical Devices and Equipment*
- *Research, Testing, and Medical Labs.*

The Battelle industry definition is used in this section of the report to present an overview of current levels and recent trends of bioscience economic activity in North Carolina. The economic analysis focuses not only on the sector at-large but also on its major subsectors. The analysis begins with a focus on North Carolina then goes on to highlight where North Carolina ranks in the subsectors nationally, and to compare the State's recent performance with that of other leading biotechnology states. Lastly, additional metrics are presented for the North Carolina biosciences that provide a different but complementary perspective on the sector's recent performance. These metrics include bioscience-related patents, venture capital, and technology transfer from North Carolina's public and private research universities.

This section of the report provides comparisons with the national sector in order to provide context for the relative performance of the region. Labor market data in this analysis are for 2008, the most current annual data available (the previous impact report used 2006 data). Industry trends are examined over the seven years from 2001 through 2008.

The North American Industry Classification System (NAICS) is the official Federal government system for classifying establishments and their activities into the appropriate sectors. NAICS industries at the most detailed (6-digit) level were selected for this analysis and together make up the major sectors and subsectors. Using this system, 27 industries at the 6-digit level of detail were chosen. These detailed industries were aggregated up to the four major subsectors of the bioscience industry. A full list of bioscience NAICS codes used is shown in Table 2.

Two of the 6-digit NAICS in the industry definition—testing laboratories (NAICS 541380) and research and development in the physical, engineering, and life sciences (NAICS 541712)—were adjusted in this analysis to include only the share of these industries directly engaged in biological or other life sciences activities. To isolate these relevant life science components, Battelle used information and data from the U.S. Census Bureau's Economic Census. The database used for employment analysis relies on employers to classify themselves for records kept under each state's unemployment insurance program. The data are dependent on both employer and state quality control measures and at times employers and government record-keepers may inappropriately classify themselves.

Table 2: The Bioscience Subsector Industries and NAICS Codes

NAICS Code	Industry 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 mfg.
325221	Cellulosic organic fiber manufacturing
325311	Nitrogenous fertilizer manufacturing
325312	Phosphatic fertilizer manufacturing
325314	Fertilizer, mixing only, manufacturing
325320	Pesticide and other ag. chemical mfg.
Drugs & Pharmaceuticals	
325411	Medicinal and botanical manufacturing
325412	Pharmaceutical preparation manufacturing
325413	In-vitro diagnostic substance manufacturing
325414	Biological product (except diagnostic) mfg.
Medical Devices & Equipment	
334510	Electromedical apparatus manufacturing
334516	Analytical laboratory instrument mfg.
334517	Irradiation apparatus 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
541711	Research and Development in Biotechnology
541712*	R&D in the Physical, Engineering, & Life Sciences (except Biotech)
621511	Medical laboratories
621512	Diagnostic imaging centers

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

Size of the North Carolina Biotechnology Sector

Overview

North Carolina continues to benefit from a large, specialized and growing bioscience sector. The State employs 53,615 in bioscience industry jobs in 2008 (up from 49,215 in 2006) that span 1,339 individual business establishments[15] (see Table 3)—a significant increase of 201 business establishments versus 2006's total of 1,138. North Carolina's large employment base in the biosciences yields a high concentration of jobs in the state relative to the national average. The location quotient (LQ) for the biosciences in North Carolina is 1.28 (similar to the 1.30 LQ in 2006), meaning the State has a 28 percent greater concentration of bioscience jobs compared with the

[15] The term "establishment" used throughout this analysis is not synonymous with a "company." A firm or employer can have one or more establishments. 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.

national average. An industry location quotient that exceeds 1.20 is typically referred to as a regionally **specialized** industry.

Table 3: North Carolina and U.S. Bioscience Employment Metrics, 2001–2008

Industry Subsector	2008 Establishments	Percent Change Estab, '01-08	2008 Employment	Percent Change Empl, '01-08	2008 Location Quotient
North Carolina					
Total Biosciences	**1,339**	**36.1%**	**53,615**	**29.1%**	**1.28**
Agricultural Feedstock & Chemicals	61	3.0%	4,138	-8.1%	**1.22**
Drugs & Pharmaceuticals	80	0.0%	18,787	0.0%	**2.04**
Medical Devices & Equipment	401	7.4%	9,331	16.0%	0.73
Research, Testing, & Medical Labs	797	69.3%	21,359	109.3%	**1.30**
United States					
Total Biosciences	**47,593**	**28.3%**	**1,420,324**	**15.8%**	**N/A**
Agricultural Feedstock & Chemicals	2,440	16.0%	114,793	1.9%	N/A
Drugs & Pharmaceuticals	2,771	6.4%	311,882	2.3%	N/A
Medical Devices & Equipment	15,227	0.4%	435,509	2.0%	N/A
Research, Testing, & Medical Labs	27,154	57.7%	558,140	46.1%	N/A

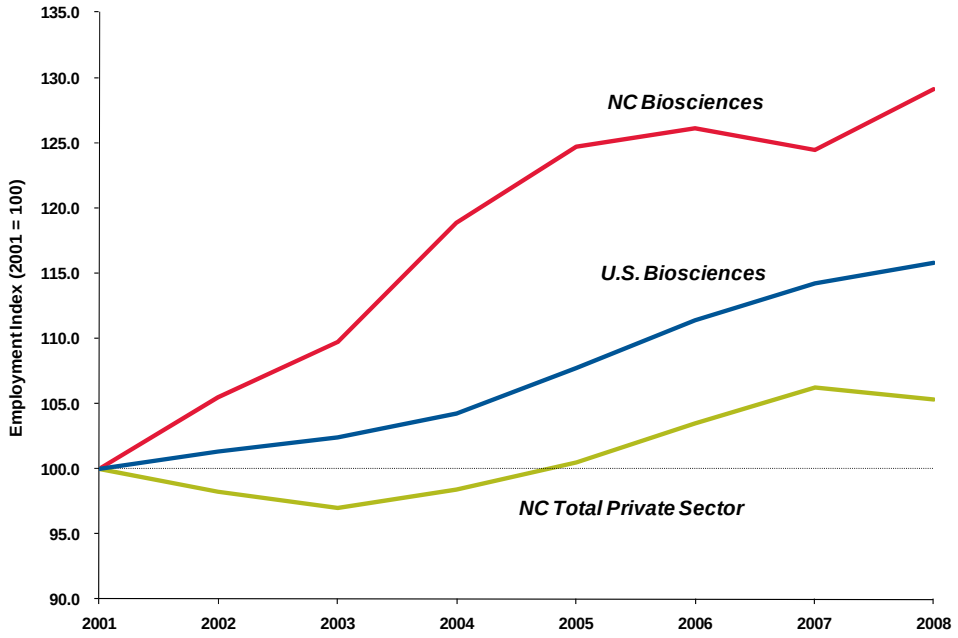
Note: Location quotients in bold red indicate a specialized industry employment concentration.

Source: Battelle analysis of Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) data sourced from the IMPLAN Group.

The biosciences represent a growth industry sector in North Carolina, with net job growth of 29 percent during the 2001 to 2008 period. This sector growth rate was nearly twice that for the national bioscience sector, which grew approximately 16 percent during this same period and more than five times the growth of the State's total private sector, which increased by 5.3 percent (see Figure 2). Total bioscience establishments have grown by a substantial 36 percent during this same seven-year period, outpacing the national growth in sector establishments.

North Carolina has a specialized employment concentration in three of the four bioscience subsectors—drugs and pharmaceuticals (LQ is 2.04); research, testing, and medical labs (LQ is 1.30); and agricultural feedstock and chemicals (LQ is 1.22). Three of the four major bioscience subsectors contributed to the State's substantial overall job growth during the seven-year period with only drugs and pharmaceuticals having no net employment gains.

Figure 2: Employment Growth in North Carolina's Bioscience Sector, 2001–2008 (Indexed, 2001=100)



To understand the recent strong overall performance of the North Carolina bioscience sector, it is necessary to study the underlying composition and recent trends among its major components. The following discussion will focus on the four major subsectors of the State bioscience industry.

Employment in Major Bioscience Subsectors

The nature and composition of a state or region's bioscience sector can vary dramatically based upon regional strengths and economic characteristics such as the presence of academic research institutions, the availability of venture capital and other investment dollars, the regional talent base, and historical industry strengths. Based upon these and other characteristics, clusters of interrelated entities can form niches within regional biosciences that shed light upon what that region does best and where emerging areas of opportunity lie.

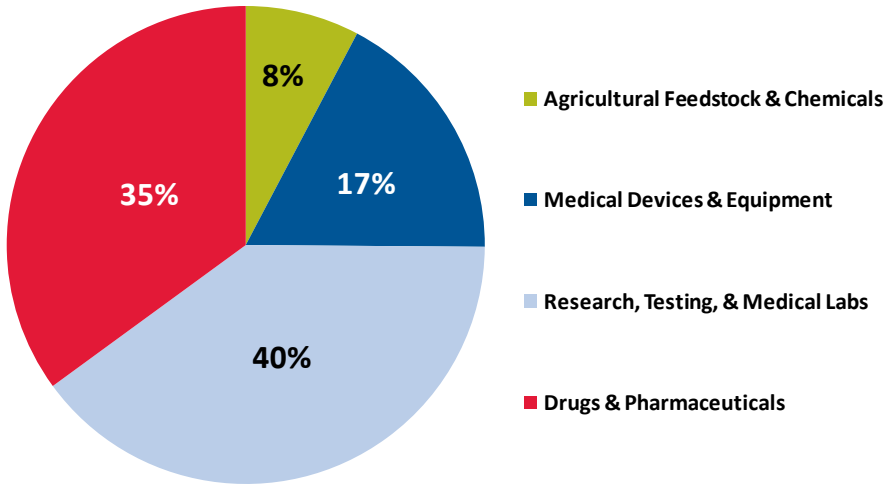
In North Carolina, the composition of the bioscience sector is notably varied. While many states have one or two clearly dominant niches within the sector, North Carolina has a relatively diverse employment composition (see Figure 3). Research, testing, and medical lab employment is now the largest of the four subsectors, surpassing drugs and pharmaceuticals with its recent job growth and in 2008 accounting for four in ten sector jobs. Drugs and pharmaceuticals is second largest accounting for 35 percent. Medical device and equipment manufacturing contributes 17 percent and the agricultural feedstock and chemicals subsector contributes 8 percent.

National Employment Ranking Highlights: North Carolina*

- Drugs & Pharmaceuticals: 7th in employment among all U.S. states and Puerto Rico; 4th in LQ among all states.
- Research, Testing, & Medical Labs: 9th in employment among all U.S. states and Puerto Rico; 11th in LQ.
- Agricultural Feedstock & Chemicals: 11th in employment among all states and Puerto Rico; 21st in LQ.
- Medical Devices & Equipment: 18th in employment among all states and Puerto Rico; 27th in LQ.

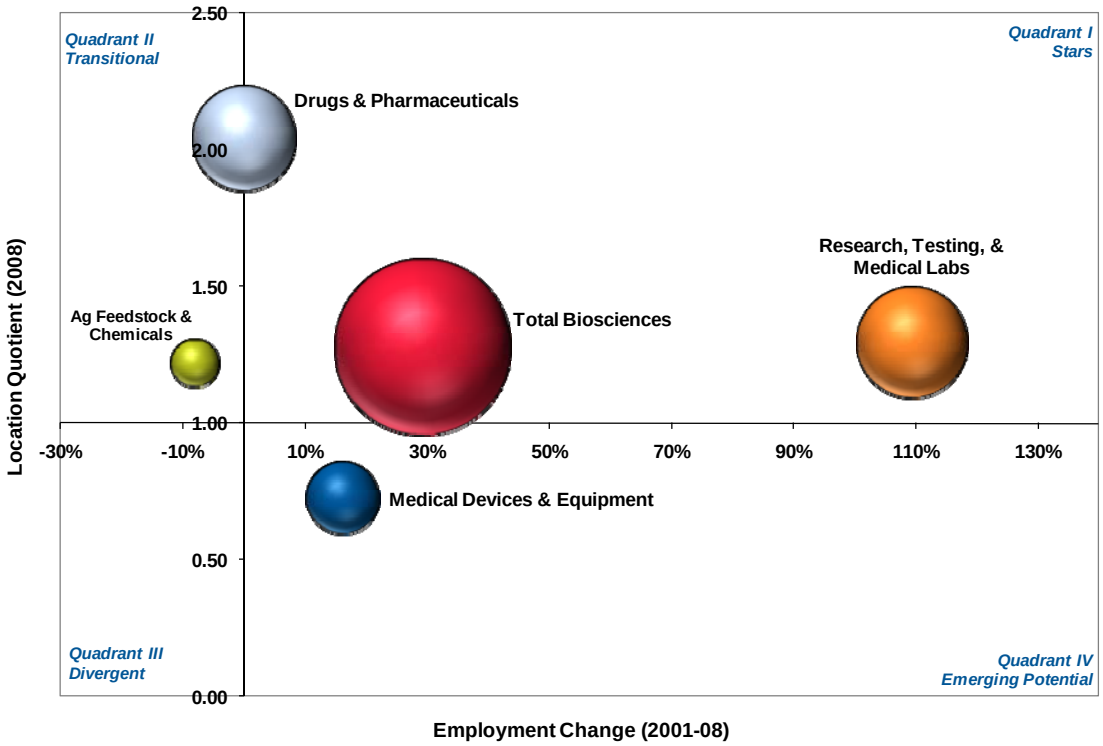
*For reference, NC ranks 10th among all states in population and 9th in total private sector employment.

Figure 3: Employment Composition of the North Carolina Bioscience Subsectors, 2008



The bubble chart in Figure 4 provides a useful snapshot of three key employment variables that track recent performance—employment size (size of bubble), relative employment concentration (LQ), and recent employment growth or decline. The quadrants in which the bubbles lie provide insight into relative performance of each industry subsector and allow for a general characterization based upon these variables.

Figure 4: North Carolina Bioscience Subsectors, Degree of Specialization, Employment Growth, and Size, 2001–2008



North Carolina has a large and highly specialized drugs and pharmaceuticals sector, but has experienced employment declines since 2003. Pharmaceutical manufacturers operated 80 business establishments in the State, employing nearly 19,000 in 2008. These establishments are typically the largest among the bioscience subsectors and with an average of 235 employees per establishment in North Carolina – twice the U.S. average (113 employees per establishment). Firms operating these establishments tend to be large, multinational concerns with large investments in R&D and manufacturing working to bring drugs to market. These are also firms with the significant investment resources required to install automated, high-productivity equipment in order to sustain competitiveness. As such, a reduction in overall employment does not necessarily indicate any issues in the North Carolina operating environment.

Nationally, North Carolina ranked seventh among all states and Puerto Rico in drugs and pharmaceuticals employment in 2008. The subsector had a very high location quotient in 2008 which, at 2.04, represents more than twice the national average concentration of drug and pharmaceutical industry jobs. Similar to its employment level, this high subsector LQ ranks North Carolina 4th among all U.S. states.

In drugs and pharmaceuticals, net job growth in North Carolina was flat from 2001 through 2008, while the national subsector grew overall by 2.3 percent. Employment in the State subsector peaked in 2003 and has steadily declined since then—dropping 11 percent. Nationally, the industry grew in 2006 and 2007 after remaining relatively flat during the early part of the decade, then shed 2.3 percent of its job base during the first year of the recession from 2007 to 2008. The subsector has clearly been affected by the severe economic downturn, but in North Carolina, job reductions began earlier.

Like the national drugs and pharmaceuticals sector, the largest detailed component industry in North Carolina is the broad "pharmaceutical preparation manufacturing" industry (NAICS 325412). This specialized component (LQ is 2.10) has contributed to the moderate job losses in recent years. Another key component is the smaller but highly specialized (LQ is 6.01) "biological product manufacturing industry" (NAICS 325414).

Research, testing, and medical laboratories, the largest of the North Carolina bioscience subsectors, is large, specialized, and <u>has more than doubled its employment base since 2001</u>. With nearly 800 individual business establishments in North Carolina, firms in this subsector operate more establishments than the other three subsectors combined. State employment reached 21,359 in 2008 and is highly concentrated compared with the national subsector. The location quotient for research, testing, and medical labs in North Carolina is 1.30 for 2008, and is considered specialized. These results bode well for North Carolina, since it is the R&D sector that drives innovation and potential new business formation and technology commercialization.

As the bubble chart in Figure 4 shows, employment growth in the State's research, testing, and medical laboratories subsector has been dramatic and is helping to drive the overall bioscience industry. Overall, the sector added more than 11,000 jobs, or 109 percent, in the most recent 7-year period. This rapid growth rate has exceeded even the fast-paced national subsector, which grew by 46 percent during this same period and has accounted for 9 of every 10 new bioscience jobs created in the U.S. Employers in both the research and testing and medical labs components have increased employment and contributed to the overall impressive growth. This sector recorded 16,005 jobs in the previous impact report, and has now grown to 21,359 direct jobs—a gain of 5,354 jobs in just two years.

The research component of this subsector focuses on the core aspects of research and development in the life sciences. This crucial private sector R&D component typically is made up of smaller firms engaged in cutting-edge research and new-product development that drive the overall bioscience sector. In North Carolina, the biotech/bioscience R&D component accounts for nearly 15,000 jobs or a large 70 percent of the overall subsector. This share is especially large compared with the U.S. subsector where, on average, this R&D component industry accounts for about 60 percent of jobs. North Carolina is highly specialized in this industry irrespective of the broader specialization when medical labs are included, with a 2008 location quotient of 1.51.

Clinical research organizations (CRO's) provide a range of clinical research and development services critical to supporting a vibrant, efficient biotechnology and drug development sector. These organizations play a key role in the entire spectrum of drug development from early stage development and recruiting for clinical trials, to laboratory services, to regulatory guidance and submission, and finally through to sales and marketing. North Carolina has a leading concentration of CRO firms, although it is not possible to determine exact employment figures for this set of companies from an "industry" perspective as they are typically embedded within the life sciences R&D industry or even sometimes coded outside of the Battelle industry definition in the much broader "professional, scientific, and technical services" industry (NAICS 5419) or as a specific unit within public or private hospitals or universities. To the extent these companies are captured within the life sciences R&D component industry, they contribute to the highly specialized industry.

The remaining component of the research, testing, and medical laboratories subsector in North Carolina is in the medical labs and diagnostic imaging centers industries. Medical labs employ about 4,900 in North Carolina. Medical lab facilities provide an array of analytic and diagnostic services to patients. Diagnostic imaging centers represent a smaller, but growing subsector component. These operations employ about 1,300 in the state, a figure that has increased substantially since 2001.

The agricultural feedstock and chemicals subsector in North Carolina is sizable and specialized, but in transition as employment has contracted somewhat over the seven-year period since 2001. The State has 61 business establishments that employ more than 4,100 workers in 2008. Its location quotient is 1.22, signifying a specialized concentration relative to the national subsector. In recent years, however, the subsector has contracted with respect to jobs. Employment peaked in 2002 and has since declined by 22 percent as State employment has fallen each year. Since the peak, the subsector has shed about 1,200 jobs.

North Carolina's presence in the agricultural bioscience subsector reflects a relatively diverse set of production industries related to agricultural and industrial chemicals. State firms employ more than 1,000 in two detailed industries—pesticides and other agricultural chemicals; and the catch-all "all other basic organic chemical manufacturing." North Carolina also has a sizable and specialized presence in phosphatic and nitrogenous fertilizers and in cellulosic organic fiber manufacturing.

After shedding jobs in 2006, the U.S. agricultural feedstock and chemicals subsector regained its momentum heading into the recent recession with job gains in both 2007 and 2008. The employment total is up 8.5 percent since 2006 and 1.9 percent overall since 2001. Nationally, the agricultural feedstock and chemicals subsector is experiencing growth in its biofuels components with ethanol and biodiesel plants becoming operational. It is likely that this growth, especially among more agriculture-focused states, will accelerate given the strong national and global focus on alternative fuels. Employment in ethanol production increased steadily over the decade through 2008, and while

there was little presence in the early 2000s, the sector increased jobs by more than 180 percent to over 9,000 jobs.

Many of the component industries of the ag biosciences are reducing employment levels yet increasing value-added output as technology advances and key capital investments are boosting productivity. In a just-published report for Central Ohio, for example, Battelle found the ag bioscience sector had greater value-added output per worker compared with the overall private sector and though jobs had declined in the regional sector, output per worker had significantly increased. In North Carolina, this could be the case and perhaps warrants future investigation.

Though not considered specialized, North Carolina's emerging medical device and equipment subsector has experienced double-digit job growth in recent years. Medical device manufacturers operated 401 establishments in North Carolina employing 9,331 in 2008. Since 2001, these employers increased their payrolls by 16 percent compared with just 2 percent overall growth for the national sector during this same time period. The national subsector has, however, been on a steady growth trajectory since 2004, with jobs increasing 6 percent or 1.5 percent average annual growth rate. North Carolina has increased jobs nearly every year since 2003.

North Carolina's LQ in the medical device equipment subsector was 0.73 in 2008, or less than the national average concentration of jobs; however, the subsector can clearly be characterized as "emerging" given its recent growth and its gain in market share nationally. In North Carolina, the largest employers in the medical device subsector include manufacturers of surgical and medical instruments; surgical appliances and supplies; electromedical apparatus; and dental labs.

Bioscience Wages

North Carolina's bioscience workers, like those in the national sector, earn higher wages, on average, than their counterparts in most other major industries and the overall private sector. Comparisons of annual wages by industry provide insight into the relative demand for—and supply of—workers within a regional labor market. Specifically, wage premiums paid to workers in industries like the biosciences signal the strong demand for highly skilled and well-educated workers that drive the high-value innovation and commercialization in the sector.

Bioscience workers in North Carolina earned $74,829 on average in 2008, or more than $35,000 greater than the state's average private-sector worker (Table 4). This represents a 90 percent average wage premium for the skills and high-value-adding jobs in the industry. It also represents a significant increase in average wage levels for the sector versus the 2006 level of $69,725. Within the sector, employees of drug and pharmaceutical manufacturers earn the highest wages—$87,000 in 2008 (up from $81,085 in 2006).

North Carolinians earn just below the national average wage in the biosciences ($77,595). Workers in North Carolina's agricultural feedstock and chemicals subsector earn more than their counterparts nationally—$75,197 versus $72,279, respectively (up from $69,061 in 2006).

Table 4: Average Annual Wages in North Carolina for Biosciences and Other Major Industries, 2008

Major Industries & Bioscience Subsectors	Avg. Annual Wages, 2008	
Drugs & Pharmaceuticals	**$**	**87,057**
Management of Companies and Enterprises	$	83,715
Agricultural Feedstock & Chemicals	**$**	**75,197**
Research, Testing, & Medical Laboratories	**$**	**75,191**
Total Biosciences	**$**	**74,829**
Finance and Insurance	$	70,616
Professional, Scientific, and Technical Services	$	60,799
Information	$	58,710
Medical Devices & Equipment	**$**	**49,221**
Manufacturing	$	47,646
Construction	$	39,722
Total Private Sector	**$**	**39,373**
Health Care and Social Assistance	$	37,739
Arts, Entertainment, and Recreation	$	29,859
Agriculture, Forestry, Fishing and Hunting	$	27,685
Retail Trade	$	24,190

Source: Battelle analysis of BLS, QCEW data from the Minnesota IMPLAN Group.

Beyond Industry Employment: Additional Performance Metrics for the N.C. Bioscience Sector

Data analysis in this section looks beyond employment to an additional, but complementary set of metrics to further gauge the performance of the North Carolina bioscience sector. From venture capital to intellectual property and innovation metrics, from occupational employment to bioscience-related degree graduates, this section highlights trends, strengths, and emerging opportunities in North Carolina's bioscience industry.

Bioscience-related Patents

Innovation is a critical element in a research-oriented sector such as the biosciences. The development of new ideas, processes, and products is a key characteristic of commercializing life sciences and propels the industry in new directions. Intellectual property in the form of patents offers legal protections for new ideas and fosters incentive for continued innovation in the U.S. An analysis of bioscience-related patents in North Carolina signals the allocation of life sciences resources, both in money and time investments, and the extent to which the citizens and firms of the State are driving innovation.

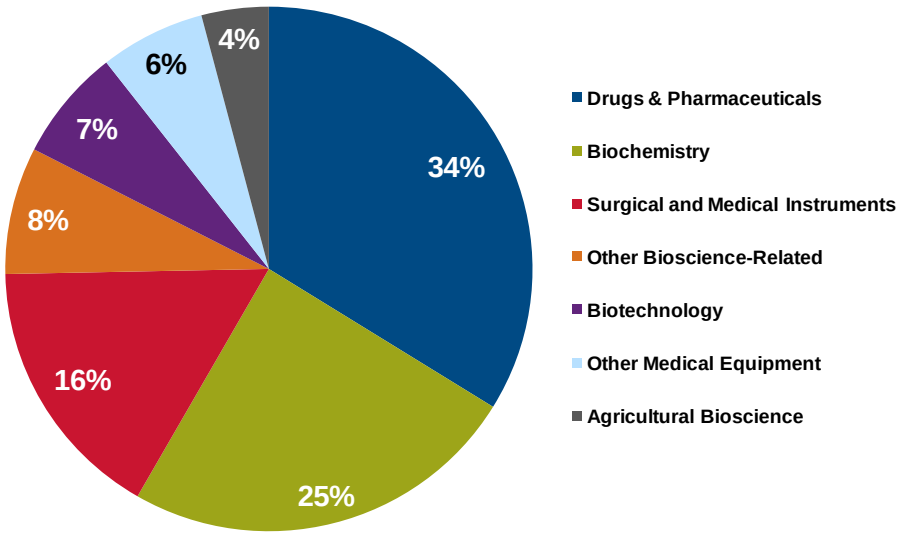
The U.S. Patent and Trademark Office (USPTO) assigns each patent with a specific numeric primary patent "class." By combining relevant patent classes across the wide array of bioscience-related activity, these class designations allow for an aggregation specific to the biosciences. Battelle has grouped these relevant patents into broader patent groupings for this analysis. The data presented here represent cumulative patent activity during the 2004 through 2009 period.

North Carolina's recent activity in bioscience-related patents is presented in Table 5. In the table, detailed patent classes are grouped with related classes in their appropriate bioscience context. From 2004 through 2009, 2,307 North Carolina patents were issued relating to the biosciences.

Drugs and pharmaceuticals, with 780 patents, accounts for about one-third of all North Carolina bioscience-related patent activity since 2004—the largest single concentration among the major class groups (see the pie chart in Figure 5). Patents in biochemistry, with a particular focus in molecular biology and microbiology, account for the 2nd largest group with 565 patents since 2004, or 25 percent of the State total in the biosciences. A relatively diverse array of patents related to surgical and medical instruments combine for 378 patents since 2004 (16 percent). These three groups—drugs and pharmaceuticals, biochemistry, and surgical and medical instruments—account for the majority of U.S. bioscience-related patents as well.

In Battelle's 2010 report for the Biotechnology Industry Organization (BIO), bioscience-related patents were analyzed for all states, and North Carolina ranked 14th.[16] **This represents a very significant rise up the rankings from North Carolina's position of 20th in 2007.** Given where North Carolina ranks in both population (10th) and total private-sector employment (9th), and its position as a leader in the biosciences, North Carolina is moving closer to where it needs to be in IP and innovation levels.

Figure 5: Composition of North Carolina's Bioscience-related Patents, 2004–2009



[16] "Battelle/BIO State Bioscience Initiatives 2010," Battelle and the Biotechnology Industry Organization (BIO). To access the full report including a state profile for North Carolina, see: http://bio.org/local/battelle2010/.

Table 5: North Carolina Bioscience-related Patents by Patent Class and Class Group, 2004–2009

Main Patent Class	NC
Drugs & Pharmaceuticals	
Drug, bio-affecting and body treating compositions	780
Biochemistry	
Chemistry: molecular biology and microbiology	362
Chemistry: natural resins or derivatives; peptides or proteins	88
Organic compounds: Carbohydrates and related	74
Chemistry: analytical and immunological testing	41
Surgical and Medical Instruments	
Surgery: surgical instruments and devices	91
Surgery: diagnostic/therapy testing, techniques, or devices	89
Surgery: blood/fluid-related devices	80
Surgery: in vitro devices and respiratory devices	54
Surgery: splint, brace, or bandage	32
Surgery: light, thermal, and electrical application	24
Surgery: kinesitherapy	8
Other Bioscience-Related	
Total, other bioscience-related	181
Biotechnology	
Multicellular living organisms and unmodified parts	159
Other Medical Equipment	
Medical and laboratory equipment	68
Prosthesis parts, aids, and accessories	50
Chemical apparatus and process disinfecting	20
Optics: eye examining, vision testing and correcting	7
Dentistry	4
Agricultural Bioscience	
Plants	66
Plant protecting and regulating compositions	25
Chemistry: fertilizers	4
Total Bioscience-Related Patents	
Total, all bioscience-related	**2,307**

Source: Battelle analysis of U.S. Patent and Trademark Office/Delphion data.

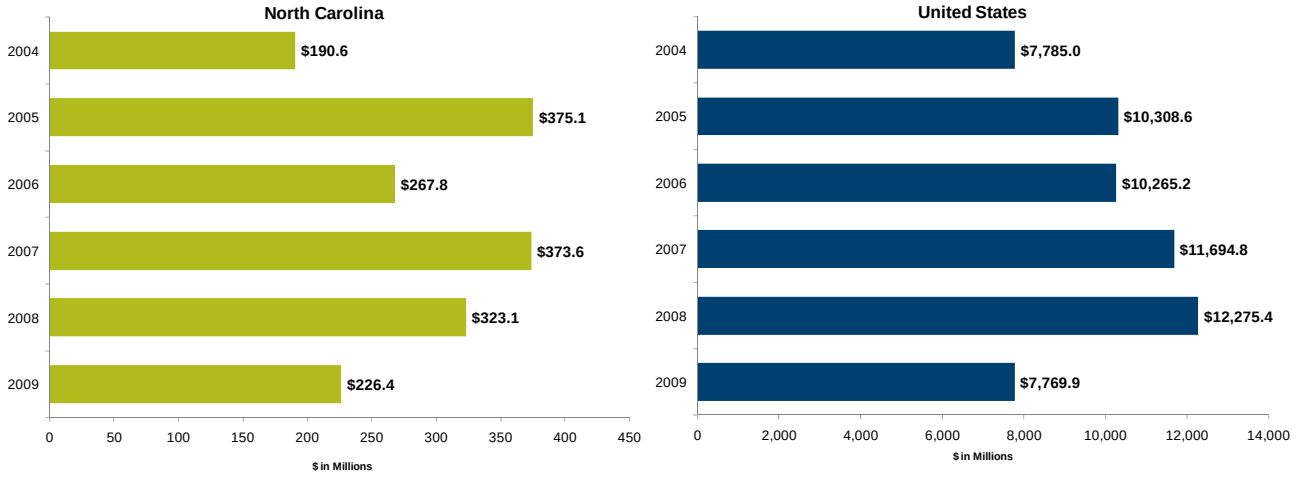
Venture Capital

Business development in the biosciences requires not only significant research and development dollars, but also substantial funds necessary to bring a new product or service to market. Major costs beyond the research stage include full assessments of the market (pricing, competition, prototypes, sales plans), followed by actual production, distribution, and sales. Sufficient capital is necessary in order to grow a business. Venture funding is one avenue for fulfilling this much-needed capital requirement, especially in the critical seed and early stages.[17]

Given the relative volatility in venture funding and investments over time, much of the data presented here are aggregated over the most recent six-year period and cover 2004 through 2009. Data presented here are from the Thomson One online database.

Since 2004, $1.8 billion in venture capital has been invested in North Carolina bioscience companies, although both the State and the nation have understandably seen significant recent declines amidst the recession. The recent trend for North Carolina is shown in Figure 6 against the overall national trend for this same period. National VC funding in the biosciences hit a recent peak in 2008 at $12.3 billion before falling precipitously in 2009 amidst the severe recession and capital scarcity. North Carolina has experienced a two-year decline. Since their recent peaks, both the U.S. and North Carolina have seen similar overall declines in venture funding, down 37 percent and 39 percent, respectively. In the Battelle/BIO report, North Carolina ranks 8th in bioscience-related VC funding (versus 7th in 2007).

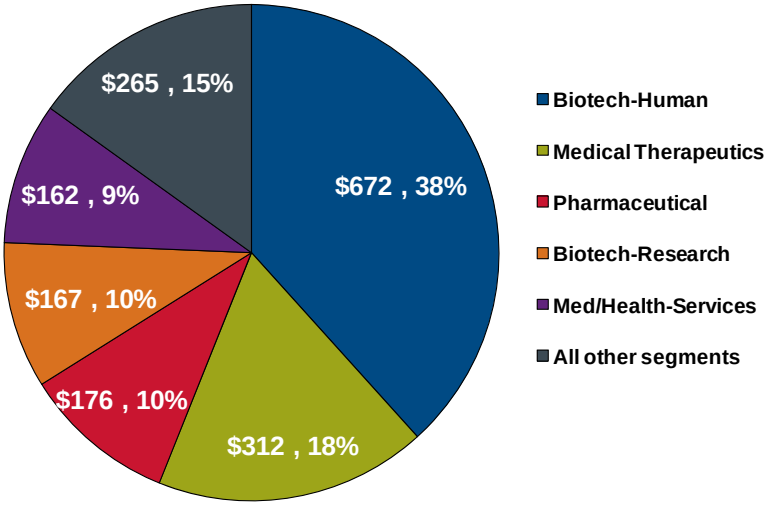
Figure 6: Venture Capital investments in N.C.and U.S. Bioscience Companies, 2004 – 2009



[17] Venture capital is by no means the only funding mechanism for bioscience companies. "Angel" and other investments made by individuals are also important, but typically less public (and therefore more difficult to track). To some extent, the Thomson One database does pick up large angel investments when funds are co-invested with a venture capital entity.

The focus of these venture investments in North Carolina are shown by segment in the pie chart in Figure 7. Among the major segments, human biotechnology accounts for the largest share in North Carolina with $672 million invested since 2004 or 38 percent of all VC funding in the biosciences. Medical therapeutics and pharmaceutical segments follow, with 18 percent and 10 percent of VC funding, respectively. The biotech research segment in North Carolina, also accounting for 10 percent, is especially large as a share of total bioscience funding compared with the nation which claims just a 2 percent share of all VC.

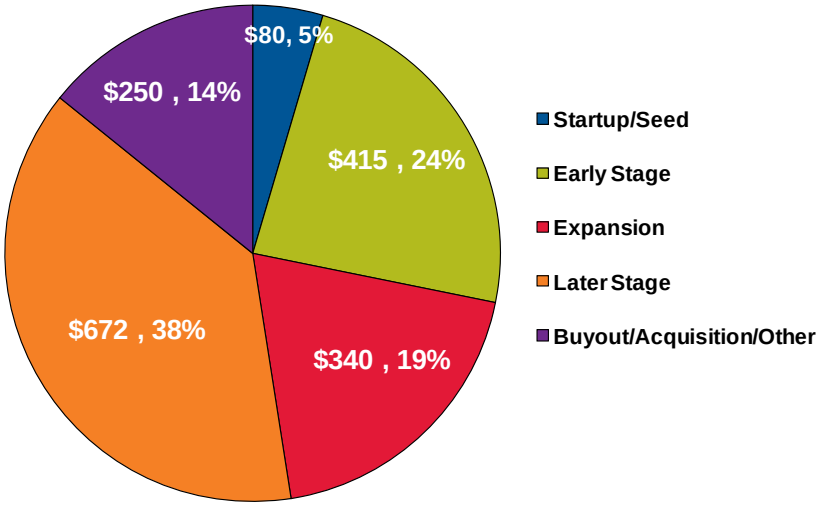
Figure 7: N.C. Bioscience Venture Capital Investments by Segment, 2004–2009 (Dollars in millions)



The stage at which North Carolina bioscience firms received rounds of venture funding is important to understand in order to assess whether funding is sufficient or to address gaps in the nature of State funding. Figure 8 shows venture capital investments by stage for North Carolina bioscience companies.

North Carolina fares well in terms of its share of funds invested in the often critical startup/seed and early stages. When combined and compared with the U.S., North Carolina's 24 percent in early stage funding is greater than for the U.S. at 18 percent.

Figure 8: N.C.Bioscience Venture Capital Investments by Stage, 2004–2009 (Dollars in millions)



The Bioscience Workforce: Occupations and Degree Graduates

Critical to developing and growing a region's bioscience industry and research base is a core of talent spanning a wide range of highly skilled occupations. In the biosciences, states must often develop talent around several distinct niches and subsectors addressing talent needs from skilled technicians and production workers in medical device manufacturing to Ph.D. scientists and researchers working to develop the next generation of therapeutics or other pharmaceuticals. States must nurture and develop both their home-grown talent as well as that which they "import" from other regions in order for the overall sector to thrive well into the future.

While industry employment is useful in assessing the broad reach and impacts of a state's bioscience sector on the economy; from a workforce perspective, the more appropriate analytical framework involves focusing on occupational employment. The broad bioscience industry employs individuals across a wide spectrum of often vastly different occupations—from administrative staff and information technology professionals, to finance and accounting workers and the scientists we typically think of when we refer to the biosciences. By homing in on the "core" bioscience occupations (scientists, biomedical workers, etc.), the analysis is both refined from an occupational sense as well as expanded to track these workers across all industries.

Battelle's bioscience strategy and core competency work across the country has led to an identified core set of key bioscience-related occupations. These occupations typically account for the range of core innovation activities in most non-clinical bioscience companies and while numerous other occupations are important to the full operations and activities of bioscience companies, the focus of this analysis is on this base of talent. The 17 occupations come from the Standard Occupational Classification (SOC) system used by the Federal statistical system and are shown along with their major groupings in Table 6.

Table 6: Bioscience-related Non-clinical Occupations, Major Groups, and SOC Codes

Bioscience Occupations & Groups	SOC Code
Agricultural, Food and Nutrition Scientists and Technicians	
Animal scientists	19-1011
Food scientists and technologists	19-1012
Soil and plant scientists	19-1013
Agricultural and food science technicians	19-4011
Biological Scientists and Technicians	
Microbiologists	19-1022
Biological scientists, all other	19-1029
Epidemiologists	19-1041
Medical scientists, except epidemiologists	19-1042
Life scientists, all other	19-1099
Biological technicians	19-4021
Biomedical and Biochemical Scientists and Engineers	
Biomedical engineers	17-2031
Biochemists and biophysicists	19-1021
Medical and Clinical Laboratory Technicians	
Medical and clinical laboratory technologists	29-2011
Medical and clinical laboratory technicians	29-2012
Dental laboratory technicians	51-9081
Medical appliance technicians	51-9082
Ophthalmic laboratory technicians	51-9083

For the detailed bioscience-related occupations, employment levels and concentration relative to total employment (location quotient) were tabulated in order to identify state specializations in North Carolina. Data are from the Occupational Employment Statistics (OES) program and were provided by the U.S. Bureau of Labor Statistics (BLS).

Table 7 presents the occupational distribution of the nearly 24,000 core non-clinical bioscience workers in North Carolina in 2008 (up from 22,000 in 2006). **Overall the state has a highly concentrated bioscience talent base with a 10 percent greater concentration of bioscience employment relative to the national average**—its statewide location quotient is 1.10.

Similar to other states, much of the workforce consists of medical and clinical lab technicians and technologists and biological technicians, all supporting the work of the fewer in number but highly skilled and innovative scientific workforce. In total, seven of the 17 bioscience-related occupations can be considered to have a specialized industry concentration (LQ that exceeds 1.20, highlighted in bold in Table 7). The specialized occupations are primarily among the scientific occupations, with six out of seven in these high-skilled jobs. The seventh specialized group is biological technicians. Nearly 3,000 are employed in laboratories statewide, reflecting the broad base of talent from which the industry breeds innovation in North Carolina.

Table 7: Detailed Bioscience-related Occupational Employment in North Carolina, 2008

Occupation	North Carolina	
	2008 Employment	LQ
Total Employment, All Occupations	**4,063,420**	**1.00**
Medical and clinical laboratory technologists	5,230	1.04
Medical and clinical laboratory technicians	4,700	1.04
Medical scientists, except epidemiologists	4,450	**1.48**
Biological technicians	2,980	**1.37**
Dental laboratory technicians	1,170	0.91
Biological scientists, all other	1,090	**1.28**
Biochemists and biophysicists	680	1.02
Microbiologists	650	**1.37**
Soil and plant scientists	620	**1.91**
Life scientists, all other	470	**1.30**
Biomedical engineers	430	0.94
Food scientists and technologists	350	1.11
Medical appliance technicians	270	0.69
Ophthalmic laboratory technicians	260	0.26
Animal scientists	150	**1.81**
Epidemiologists	130	0.99
Agricultural and food science technicians	0	0.00
Total Biosciences	**23,630**	**1.10**

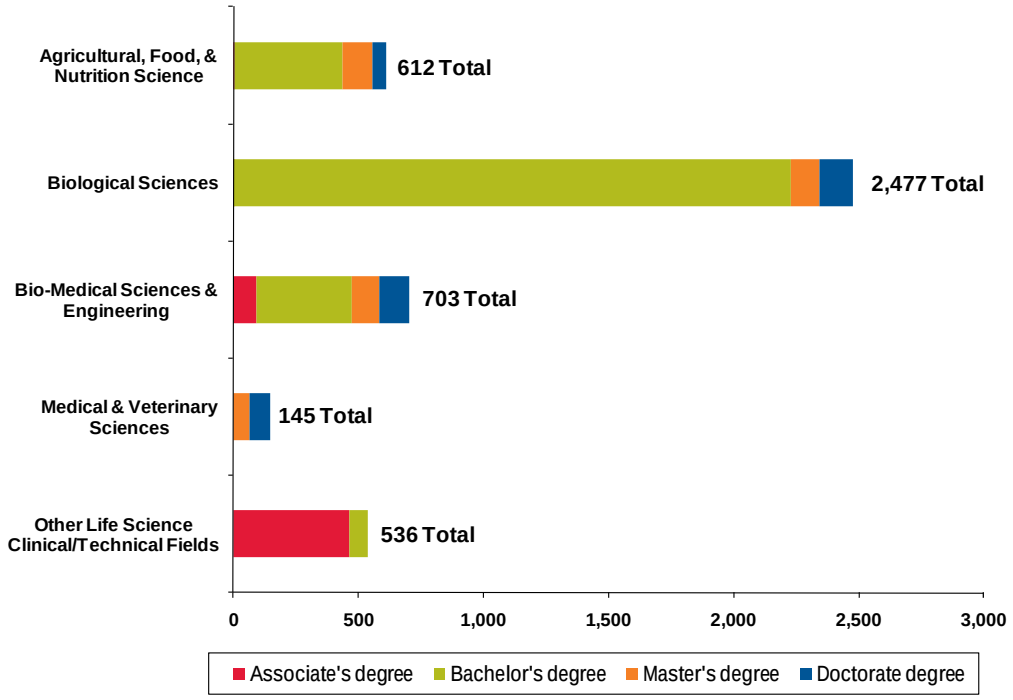
Note: Location quotients in bold indicate a specialized occupational employment concentration.

Source: Battelle analysis of BLS, Occupational Employment Statistics (OES) data.

The current occupational snapshot presented in Table 7 above alludes to the sizable demand for bioscience-related occupations that firms require in North Carolina for any given year. Measuring the available or "new" supply of workers to meet this labor force demand on an annual basis is challenging. A substantial pipeline of students in postsecondary institutions is one critical component for supplying a state's bioscience workforce and talent base. One can assess to some degree the annual growth and replacement needs that can be met by graduating students, although the vast majority of these graduates will have little to no practical work experience. Likewise, not all graduates will remain in the state following graduation or completion of a formal credential; however, they represent a primary source of talent to fill both new and replacement jobs. Conversely, the "in-migration" of skilled workers adds to the state's labor pool on the supply side, but is virtually impossible to calculate. Though the analysis is limited in these ways, the following provides some insight into the available annual workforce for one year of recent higher-education graduates (2008).

For academic year 2008, North Carolina higher education institutions generated 4,473 total degree graduates in bioscience-related fields (up from 4,174 in 2006) spanning associate's through Ph.D. Among all states, North Carolina ranks 10th in generating bioscience-related degree graduates (the same ranking as in 2006). Degree data for 2008 are presented in Figure 10 by both subject area and degree type.

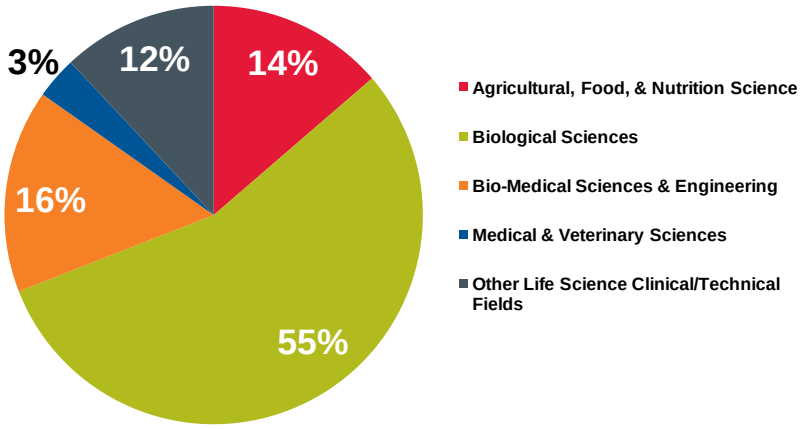
Figure 9: North Carolina Higher Education Bioscience-related Degrees by Discipline, Academic Year 2008



While the large numbers of bachelor's degrees in life science fields are apparent from the distribution in Figure 9 and make up 70 percent of all degree types, with respect to meeting the demand for the bioscience workforce it is often important to look at the ends of the education spectrum—associate's degrees and graduate degrees. Associate's-degree graduates often fill the large needs for the bioscience technician workforce. In North Carolina, these associate's degrees totaled 562 in 2008 (13 percent of degrees) (up from 497 in 2006), primarily among the "other life science" fields. At the higher end of the degree spectrum, master's and Ph.D. graduates must contribute significantly to the demand for highly skilled scientists. In 2008, these state graduates totaled 800 combined (up from 697 in 2006) in the life sciences or 18 percent of all degrees.

The composition of bioscience-related degrees generated by North Carolina institutions in 2008 is presented in Figure 10. The majority of degrees (55 percent) are in the broad biological sciences category, with roughly equal shares spread among agricultural, food, and nutrition science (14 percent); biomedical sciences and engineering (16 percent); and other life sciences clinical/technical fields (12 percent).

Figure 10: Composition of N.C.Bioscience-related Degrees by Discipline, Academic Year 2008



Technology Transfer and Commercialization

Successful commercialization and transfer of technologies from universities, hospitals, and other institutions to industry play a major role in economic development and growth. By licensing or transferring cutting-edge technologies from institutions to industry, the innovation begun in the lab or at the drawing board can be more fully realized in a full-scale commercial application. With respect to the biosciences, technologies can not only translate into commercial success but also have broader societal and global impact by improving or saving lives.

Table 8 summarizes information for seven individual North Carolina institutions collected by the Association of University Technology Managers (AUTM) in its annual survey of members (2008). The annual survey by AUTM has limitations with respect to a specific, bioscience-focused analysis as its members are not asked to provide information that would allow for the coding of responses by industry sector. Thus, **the data presented here are not for the biosciences exclusively**; nevertheless, they shed light on the overall climate for the transfer of technologies and commercialization in North Carolina. The North Carolina institutions are compared in Table 8 to specific institutions in the U.S. that are highly focused in the life sciences and may provide useful benchmarks in that respect.

Table 8: Technology Transfer Data for N.C.Institutions and Other Selected Institutions, 2008

Institution	2008 Invention Disclosures	2008 Startups	Metrics Per $10M in Research Expenditures				
			2008 Invention Disclosures	2008 New Patent Applications	2008 U.S. Patents Issued	2008 Licenses & Options Executed	2008 License Income
Duke University	195	7	2.88	1.50	0.47	1.42	$229,901
East Carolina University	12	1	7.41	4.32	2.47	1.24	$565,286
North Carolina State University	154	5	4.21	2.90	1.01	1.88	$0
University of North Carolina, Greensboro	19	2	5.74	1.51	0.60	1.51	$60,600
University of North Carolina, Chapel Hill	122	5	1.97	0.89	0.27	0.94	$44,859
University of North Carolina, Charlotte	46	3	15.43	14.09	2.01	0.67	$36,688
Wake Forest University	50	2	3.36	0.00	0.67	0.74	$6,053,388
Comparison U.S. Universities							
Johns Hopkins University	306	12	2.58	3.27	0.38	0.78	$95,986
University of Massachusetts	162	2	3.72	1.52	0.57	0.80	$826,715
University of Michigan	306	13	3.49	1.51	0.86	1.04	$285,560
University of Pennsylvania	332	2	4.97	7.16	0.66	0.81	$122,874

Source: Battelle analysis of Association of University Technology Managers (AUTM) Survey, 2008.

The data presented in Table 8 assess university technology transfer efforts across an array of commercial outcomes for research. Given the highly variable size of university research budgets, five of the metrics are normalized in the table per $10 million in total research expenditures. This normalization allows for a comparable assessment of research outcomes per dollar of expenditures.

Two North Carolina universities are in the upper echelon of research institutions in terms of overall annual research expenditures—Duke University at $678 million (up from $590 million in 2006) and the University of North Carolina at Chapel Hill with $620 million (up from $584 million in 2006)). North Carolina State University is also a major research center, with $366 million in expenditures for 2008 (up substantially from its $207 million in 2006 research expenditures).

Compared with the selected large and leading research institutions in Table 8, North Carolina's universities have a mixed record in technology transfer. Per $10 million research dollars, both Duke and UNC at Chapel Hill lag to some extent in patents issued and license income. N.C. State stands out positively across several of the metrics—invention disclosures, patents issued, and licenses executed. In 2008, Wake Forest clearly had a blockbuster license deal with the extremely high reported license income over the year.

Conclusion: Key Findings

Key findings from this economic analysis include the following:

- North Carolina has a large, specialized and growing bioscience sector. The State's bioscience sector growth rate was nearly twice that for the national bioscience sector since 2001.
- Research, testing, and medical laboratories, the largest of the North Carolina bioscience subsectors, is large, specialized, and has more than doubled its employment base and largely driven bioscience job growth since 2001.
- North Carolina has a large and highly specialized drugs and pharmaceuticals sector, but has seen steady employment declines since 2003.

- The agricultural feedstock and chemicals subsector in North Carolina is sizable and specialized, but in transition as employment has contracted over the 7-year period since 2001.
- Though not considered specialized, North Carolina's emerging medical device and equipment subsector has experienced steady, double-digit job growth in recent years.
- Bioscience workers in North Carolina earned nearly $75,000, on average, in 2008, or more than $35,000 greater than the State's average private-sector worker
- Analysis of bioscience-related patent activity in North Carolina shows strength in some areas, but overall, the State is lagging somewhat in recent bioscience patents issued.
- North Carolina bioscience companies have attracted significant levels of venture capital in recent years. Since 2004, $1.8 billion in venture capital investments have gone to North Carolina bioscience companies and a recent Battelle/BIO study showed North Carolina ranked 7th among all states in bioscience VC funding.
- From a workforce perspective, North Carolina has a highly concentrated bioscience talent base with a 10 percent greater concentration of bioscience occupational employment relative to the national average.

III. BENCHMARKING THE NORTH CAROLINA BIOTECHNOLOGY SECTOR

Competitive Benchmarking: Comparing North Carolina with Other States

North Carolina's bioscience sector is highly ranked among all states, specialized in its concentration of jobs, and has grown by nearly twice the national growth rate. Despite its obvious broad strengths and recent accomplishments, however, it is useful to compare its competitive position relative to states competing for biotechnology and bioscience growth both regionally and nationally. The analysis in this section examines employment data and corresponding trends in the bioscience subsectors in North Carolina and two sets of benchmark states:

1) The top 10 states in the nation, of which NC is one (as ranked by total bioscience employment)

2) Five southern/eastern seaboard states: Florida, Georgia, Maryland, South Carolina, and Virginia.

Comparing North Carolina to the Ten Largest Bioscience Employer States

The bubble chart in Figure 11 presents the current employment position for North Carolina and its fellow states ranked in the top 10 in terms of overall bioscience employment. **Among the ten largest bioscience employer states, North Carolina's 29 percent job growth since 2001 has been faster than for all states except Massachusetts**. Five of the comparison states exceed the 1.28 location quotient for North Carolina in 2008—New Jersey (2.14), Massachusetts (2.06), Indiana (1.72), California (1.36), and Pennsylvania (1.31).

Figure 11: Total Bioscience Sector, Degree of Specialization, Employment Growth, and Size, Ten Largest US Bioscience Employer States, 2001–2008

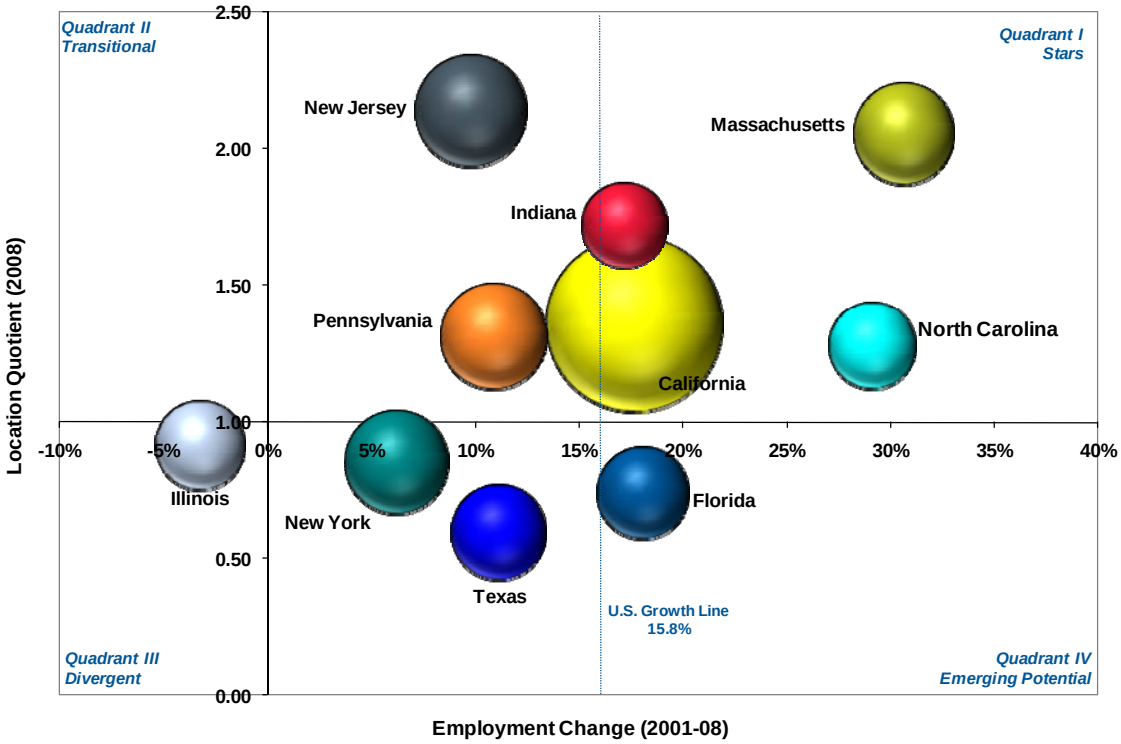


Table 9 presents the overview of total bioscience employment metrics presented in the preceding bubble chart for North Carolina and the leading bioscience employer states. Figure 12 shows the bioscience employment composition by bioscience subsector across the top 10 states.

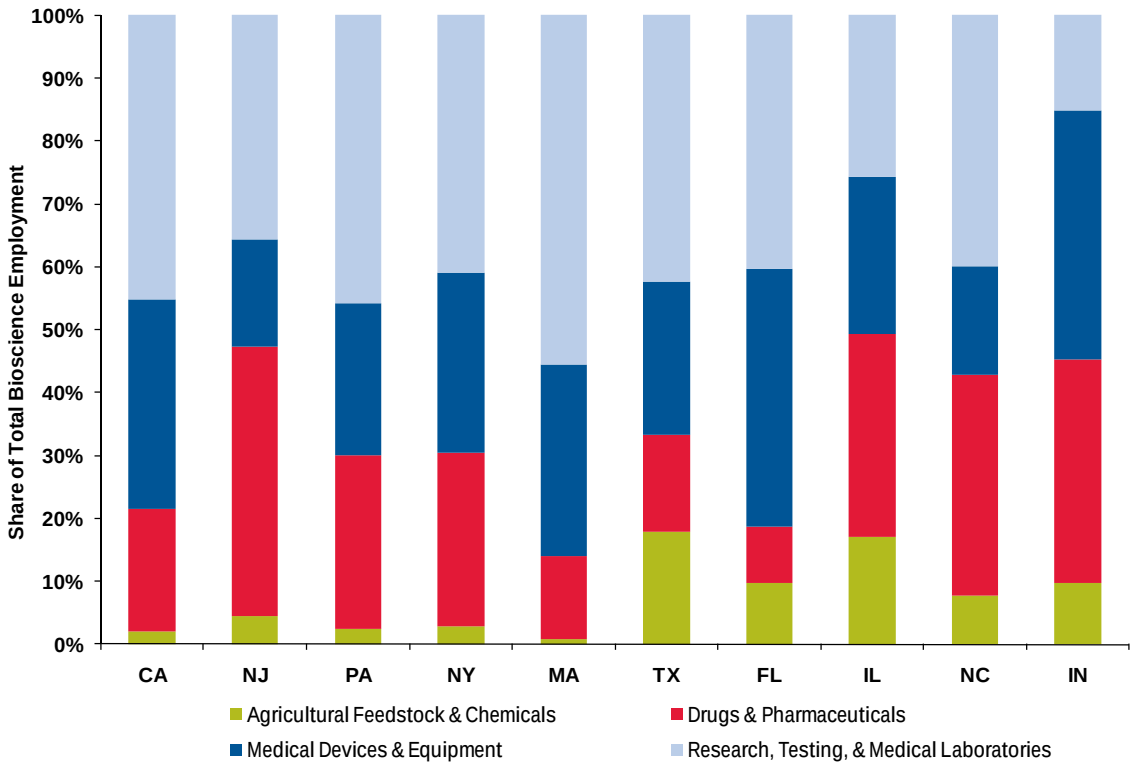
Table 9: North Carolina and Leading Bioscience Employer States, Total Bioscience Employment Metrics, 2001–2008

State	2008 Establishments	Percent Change Estab, '01-08	2008 Employment	Percent Change Empl, '01-08	2008 Location Quotient
North Carolina	**1,339**	**36.1%**	**53,615**	**29.1%**	**1.28**
California	6,066	11.1%	221,096	17.6%	**1.36**
New Jersey	2,004	35.8%	88,854	9.7%	**2.14**
Pennsylvania	1,895	10.7%	80,929	10.9%	**1.31**
New York	2,639	21.1%	76,195	6.2%	0.85
Massachusetts	1,743	39.8%	72,627	30.7%	**2.06**
Texas	2,938	35.5%	64,964	11.1%	0.60
Florida	3,385	40.5%	60,896	18.0%	0.74
Illinois	1,962	30.9%	57,345	-3.3%	0.92
Indiana	798	26.5%	52,832	17.2%	**1.72**

Note: Location quotients in bold red indicate a specialized industry employment concentration.

Source: Battelle analysis of BLS, QCEW data from the Minnesota IMPLAN Group.

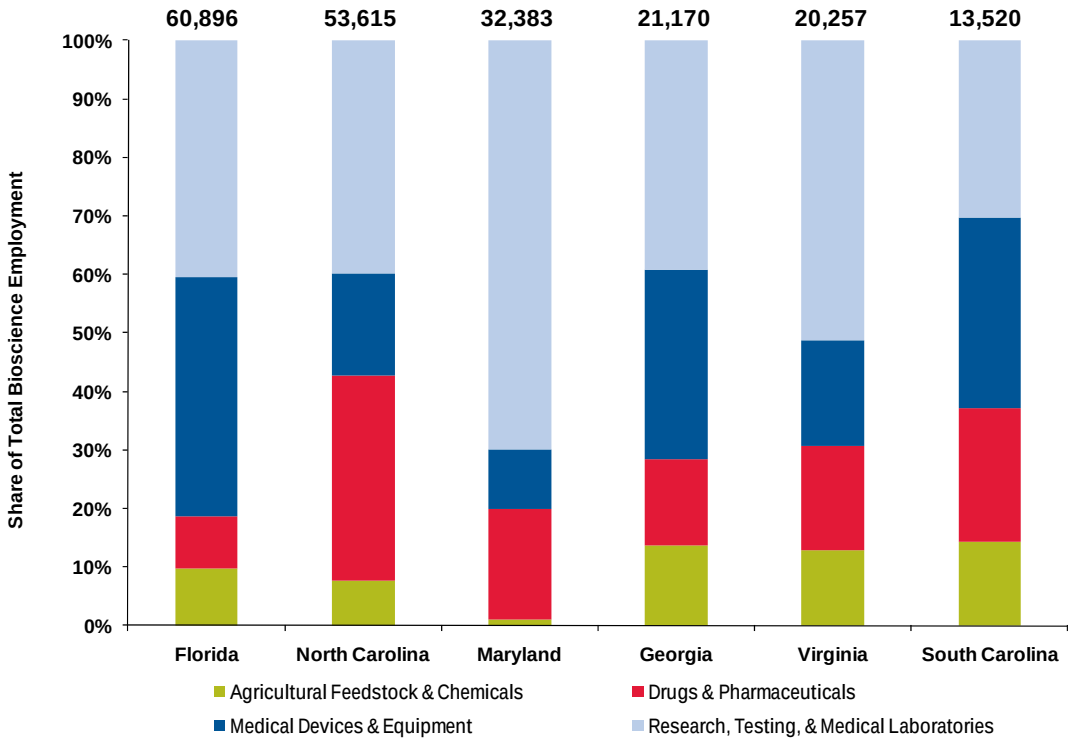
Figure 12: Composition of Bioscience Employment in the Top 10 Bioscience States



Comparing North Carolina to Southern/Eastern Seaboard States

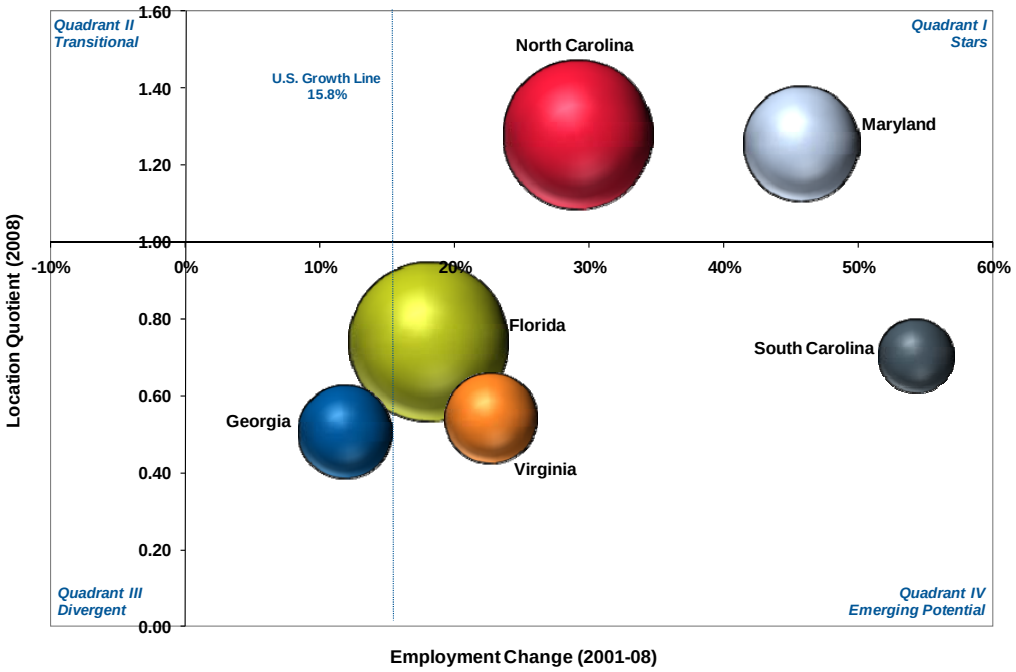
Battelle also compared the employment composition of North Carolina to five comparison states located on the Eastern Seaboard of the U.S. (Maryland, Virginia, South Carolina, Georgia and Florida) See Figure 13. Though the size of each state sector varies, the stacked columns provide a snapshot of the niche industries and broad composition of each by subsector. North Carolina's specialized presence in drug and pharmaceutical production is apparent in the size of its red bar. The State's large research, testing, and medical labs subsector is also evident, though not as large a component as in Maryland, where life sciences R&D plays a dominant role in its bioscience economy. Florida employs more in the biosciences but has much more of a focus and niche in medical devices.

Figure 13: Composition of Bioscience Employment in NC and Selected States, 2008



The bubble chart in Figure 14 presents the current employment volume, employment growth trend and degree of specialization for North Carolina and selected Eastern Seaboard states. Both North Carolina and Florida have the largest bioscience employment levels (as reflected in the size of each bubble) —although between 2001 and 2008 North Carolina outpaced Florida in terms of bioscience job growth.

Figure 14: Total Bioscience Sector, Degree of Specialization, Employment Growth, and Size, NC and Selected States, 2001–2008



Both Maryland and South Carolina had a higher rate of 2001-2008 bioscience job growth than North Carolina, but these states have far lower overall employment levels in biosciences versus North Carolina. Overall it is important to note that the peer eastern Seaboard states, including North Carolina, outpaced the overall U.S. bioscience growth rate of 15.8% during the 2001-2008 period (except for Georgia which lagged behind with an 11.9% growth rate). Among the states analyzed, only North Carolina and Maryland have reached the level of "specialized" in bioscience employment, by virtue of location quotients greater than 1.0 (with North Carolina's the highest at 1.28). Table 10 presents the overview of total bioscience employment metrics presented in the preceding bubble chart.

Table 10: North Carolina and Comparison States, Total Bioscience Employment Metrics, 2001–2008

State	2008 Establishments	Percent Change Estab, '01-08	2008 Employment	Percent Change Empl, '01-08	2008 Location Quotient
North Carolina	**1,339**	**36.1%**	**53,615**	**29.1%**	**1.28**
Florida	3,385	40.5%	60,896	18.0%	0.74
Maryland	1,271	43.6%	32,383	45.7%	**1.26**
Georgia	1,199	41.5%	21,170	11.9%	0.51
Virginia	981	55.2%	20,257	22.7%	0.54
South Carolina	572	65.1%	13,520	54.2%	0.70

Note: Location quotients in bold red indicate a specialized industry employment concentration.

Source: Battelle analysis of BLS, QCEW data from the Minnesota IMPLAN Group.

IV. ECONOMIC IMPACT OF THE BIOTECHNOLOGY SECTOR ON NORTH CAROLINA

Direct and Indirect Economic Impact of the Biotechnology Sector in North Carolina

The biotechnology sector is more than a simple source of jobs; it has grown to become a critical driver of the State's economy. The biotechnology sector has a diverse and varied impact across the North Carolina economy. Not only does the sector directly account for an estimated 1 percent of all jobs in the State;[18] the biotechnology sector impacts other sectors though its purchases of goods and services from other businesses and business sectors across the State and through the wages and salaries it pays its workers. The impacts of the biotechnology sector and these purchases can be estimated using an economic model.

Economic Impact Methodology

Using the information on the size and composition of the North Carolina biotechnology sector described above, Battelle prepared an analysis of the economic impact of the biotechnology sector on the State of North Carolina's economy using the IMPLAN input-output model.[19] IMPLAN is one of the most widely used models in the nation, and can be used to analyze the impacts of companies, projects, or of entire industries. An input-output analysis examines the relationships among businesses and among businesses and final consumers. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity, in this case the jobs and activities of companies in the biotechnology sector in North Carolina.

The economic activity generated in a state is greater than the simple total of spending associated with the event or activity being studied. This is because as this money is earned it is, in turn, spent, earned and re-spent by other businesses and workers in the regional economy through successive cycles of spending, earning and spending. However, the spending in each successive cycle is less than in the preceding cycle because a certain portion of spending "leaks" out of the economy in each round of spending. Leakages occur though purchases of goods or services from outside of the region and federal taxation. The IMPLAN multipliers used in this analysis capture the effects of these multiple rounds of spending.

This report measures the economic impact of the biotechnology sector using the IMPLAN model. This analysis focuses on three measures of economic impact:

- **Output**. The total value of production or sales in all industries;

[18] The U.S. Bureau of Economic Analysis state employment data is only available through 2008. Current employment was estimated based on this data projected to current levels based on recent growth trends from U.S. Bureau of Labor Statistics data.

[19] See www.implan.com for a description of the model.

- **Employment**. The total number of full and part time jobs in all industries; and
- **Employee Compensation**. The wages and salaries, including benefits, earned by the workers holding the jobs created.

Four measures of the economic activity and impact of the jobs supported by the biotechnology sector program are included in this report:

- **Direct effects**. The change in economic activity being analyzed—in this case the business activities of the biotechnology sector. For this analysis, Battelle used the employment data from the Center's database and the IMPLAN model estimated business activity based on these employment figures;
- **Indirect effects**. The changes in inter-industry purchases, for example the purchase of raw materials by a biotechnology manufacturer, in response to the change in demand from the directly affected industries;
- **Induced effects**. The changes in spending from households as income and population increase due to changes in production; and
- **Total effects**. The combined total of direct, indirect and induced effects.

Economic Impacts of the Biotechnology Sector—Based on the North Carolina Biotechnology Center's Database

The biotechnology sector in North Carolina has total estimated revenues[20] of $41.2 billion (up from $28.7 billion in 2006) and employs 56,842 workers (up from 53,182 in 2006) earning an estimated $5.3 billion (up from $4.5 billion) in employee compensation (Table 12 Direct Impact column). As described above, Battelle estimated the economic contribution made by the biotechnology sector to the larger North Carolina economy using the IMPLAN model. The biotechnology sector generates an additional $13.7 billion in *Indirect Impacts* (up from the 2006 figure of $10.2 billion) through its purchases of goods and services from other companies in the State and $9.8 billion (up from $6.9 billion) in *Induced Impacts* through local spending by the State residents employed in or impacted by the sector.[21] In aggregate, the biotechnology sector in North Carolina generates $64.6 billion in economic activity in the State (a substantial increase over the 2006 impact total of $45.8 billion), supports 226,823 jobs (versus the 2006 figure of 180,007 jobs) earning $12.7 billion in employee compensation (up from the $9.4 billion in 2006), and generates $1.9 billion in State and local tax revenues (an increase over the $1.4 billion in 2006). The 226,823 jobs created or supported by the biotechnology sector account for 4 percent of all employment in the State (up from 3 percent in 2006).[22]

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[20] IMPLAN can estimate output or business volume based on employment, this was estimated based on biotechnology employment from the NCBC database.

[21] Because Battelle is analyzing the impact of an entire sector of the economy, estimated indirect and induced impacts were reduced by the share of total State biotechnology sector employment in each industry in the model that was included in the direct impacts. This adjustment was made in order to eliminate double counting of impacts. Many biotechnology firms purchase goods, services and production inputs from other biotechnology firms. Including these purchases in the indirect or induced effects estimated by IMPLAN would lead to double counting—as the activities of these companies were already included in the direct impacts.

[22] See Note 4.

Table 11: The 2010 Economic Contribution of Biotechnology Sector to the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($ M)	$41,156	$13,664	$9,822	$64,642
Employment (# of Jobs)*	56,842	85,494	84,487	226,823
Employee Compensation ($ M)	$5,324	$4,591	$2,778	$12,694
State and Local Tax Revenues ($ M)	—	—	—	$1,918

The Economic Impact of Biotechnology, Medical and Life Sciences Research in North Carolina

North Carolina is not only the third largest state in terms of its concentration of biotechnology companies;[23] it is also a leading center for life sciences research. According to a Battelle TPP analysis of academic life science expenditures by state, North Carolina had a total of $1.5 billion in academic life sciences research expenditures(up from $1.3 billion in 2006). With its high concentration of nationally ranked medical schools, medical sciences is the largest area of academic research expenditures, accounting for 55 percent of 2008 expenditures, followed by Biological Sciences at 34 percent.

Table 12: Life Sciences Research and Development Expenditures in North Carolina 2005 to 2008

	2005		2006		2007		2008	
Life Science Field	**($1,000s)**	**%**	**($1,000s)**	**%**	**($1,000s)**	**%**	**($1,000s)**	**%**
Agricultural Sciences	$75,451	6%	$90,197	7%	$91,534	6%	$103,380	7%
Bioengineering/ Biomedical Engineering	$17,416	1%	$22,981	2%	$22,853	2%	$22,374	1%
Biological Sciences	$341,006	27%	$378,745	29%	$391,715	27%	$509,952	34%
Medical Sciences	$780,984	62%	$776,591	59%	$913,685	63%	$834,304	55%
Other Life Sciences	$41,667	3%	$41,976	3%	$41,767	3%	$47,408	3%
Total	**$1,256,524**	**100%**	**$1,310,490**	**100%**	**$1,461,554**	**100%**	**$1,517,418**	**100%**

Source: Battelle TPP

North Carolina's academic life sciences research resources not only contribute to the State's competitive position in biotechnology and life sciences through the development and commercialization of new technologies; as described above they contribute to the strength of the State's economy though their purchases of goods and services from other businesses and business sectors across the State economy. The impacts of the academic life sciences expenditures were estimated using the IMPLAN model.

The results of the analysis of the economic impact of academic life sciences research expenditures on the State of North Carolina are presented in Table 13 for overall expenditures and in Table 14 by research area. The $1.5 billion in academic life science research expenditures directly creates an estimated 10,443 jobs with $714.4 million in employee wages, salaries and benefits. Including multiplier effects, academic life science research expenditures generate nearly $3.1 billion in economic activity in North Carolina (up from $2.5 billion in 2006), support 23,447 jobs (versus 20,959 in 2006) earning an estimated $1.2 billion in employee wages, salaries and benefits (an increase

[23] See North Carolina Accolades http://www.ncbiotech.org/resource_center/accolades/index.html

over the 2006 figure of $0.9 billion. This also generated an estimated $120.7 million in State and local tax revenues. Academic life science research expenditures generate an additional $582.6 million in *Indirect Impacts* through purchases of goods and services from North Carolina suppliers and $952.8 million in *Induced Impacts* through local spending by the State residents employed in or impacted by the sector.

Table 13: 2008 Economic Impact of Life Science Research and Development Expenditures on the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($)	$1,517,418,000	$582,642,496	$952,837,248	$3,052,897,744
Employment (# of Jobs)	10,443	4,865	8,139	23,447
Employee Compensation ($ M)	$714,362,624	$176,286,983	$268,271,672	$1,158,921,279
State and Local Tax Revenues ($ M)	–	–	–	$120,680,434

Source: NCBC and IMPLAN

Table 14: 2008 Economic Impact of Life Sciences Research and Development Expenditures in North Carolina by Life Sciences Field

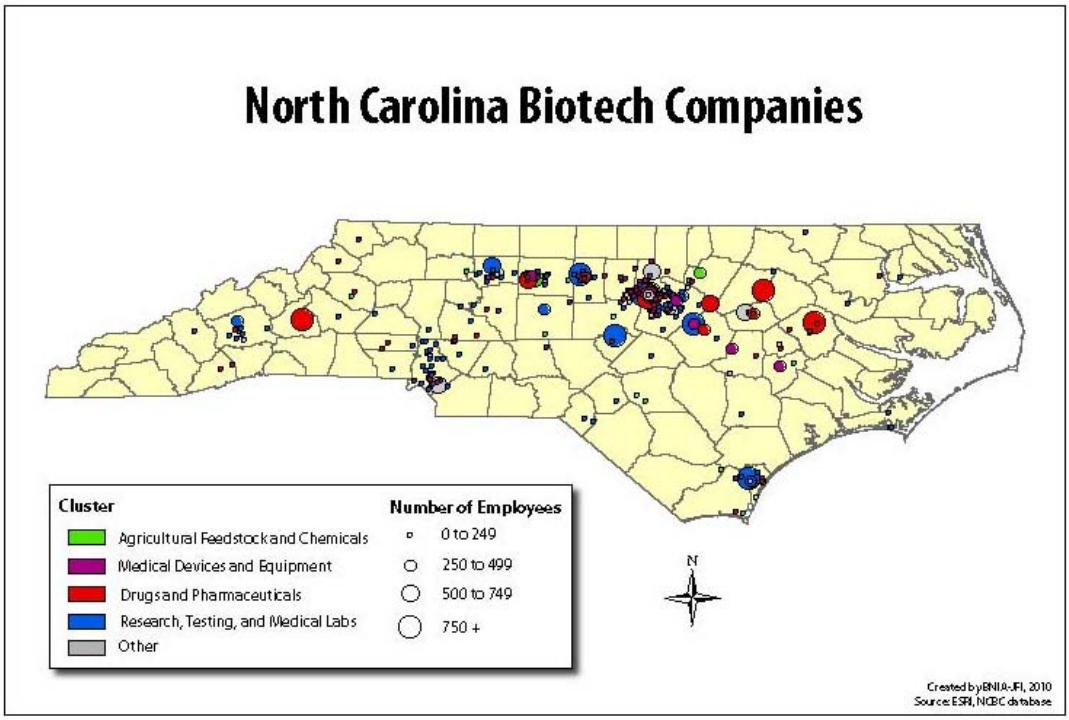
	Estimated		Total Impacts			
Life Science Field	Direct Impact ($)	Estimated Direct Employment (# of Jobs)	Output ($)	Employment (# of Jobs)	Employee Compensation ($)	State and Local Government Revenues ($)
Agricultural Sciences	$103,380,000	711	$207,990,527	1,597	$78,956,017	$8,221,824
Bioengineering/Biomedical Engineering	$22,374,000	154	$45,014,317	346	$17,088,043	$1,779,407
Biological Sciences	$509,952,000	3,510	$1,025,973,931	7,880	$389,473,582	$40,556,543
Medical Sciences	$834,304,000	5,742	$1,678,538,675	12,892	$637,195,986	$66,352,296
Other Life Sciences	$47,408,000	326	$95,380,295	733	$36,207,650	$3,770,364
Total	**$1,517,418,000**	**10,443**	**$3,052,897,744**	**23,447**	**$1,158,921,279**	**$120,680,434**

Source: Battelle and IMPLAN

Distribution of Biotechnology in North Carolina

Biotechnology is a statewide sector of economic activity in North Carolina. Figure 15 shows the distribution of biotech operations in the state across five sub-sectors and shows the size of biotechnology operations by location.

Figure 15: North Carolina Biotech Companies Locations



V. INSTITUTIONAL EXPENDITURE IMPACTS OF THE NORTH CAROLINA BIOTECHNOLOGY CENTER

Introduction

Battelle analyzed the economic impact of the operations of the Biotechnology Center in two areas:

- Operational Spending – includes the operating costs, wages and salaries of Biotechnology Center staff, R&D grants, statewide development efforts, various educational spending and other non-economic development related spending by the Center; and
- Economic Development Grants and Loans – includes the grants and loans made to support the growth, research and operations of biotechnology companies.

Data, Methodology, and Impact Measures Used to Estimate North Carolina Biotechnology Center Impacts

The expenditure data used to estimate the economic impact associated with the Center's *programmatic spending* was based on the Fiscal 2009 and Fiscal 2010 annual report data provided by the Center. This spending was analyzed by spending area, using IMPLAN.

Table 15: North Carolina Biotechnology Center Operating Budget for Calendar Year 2009(1) Not Including Economic Development Grants and Loans

Program Area/Year	2009
Total	**$16,708,042**
Science and Technology Development	**$5,280,745**
Statewide Development	**$1,544,578**
Business and Technology Development	**Modeled Separately**
Education and Training Grants	**$782,393**
Hamner Conference Center	**$639,790**
Library and Information Services	**$544,350**
Biotechnology Event Grants/Sponsorships	**$135,002**
Other Programs	**$714,025**
Genomics and Bioinformatics Program	**$25,001**
Program Management	**$4,640,803**
General and Administrative	**$2,401,357**

(1) NCBC budgets were converted from Fiscal into Calendar years.

Source: NCBC

The analysis of the economic impact of the Center's *economic development grants and loans* was based on detailed grant and loan data provided by the Center. The economic impacts of economic development grants and loans were calculated separately from the operational spending impacts because—especially for loans—these differ in their impact on the economy from operational spending. Operational spending represents a flow of money spent in an economy. Economic development spending, especially loans, represent a source of capital to the borrowing company, not an annual stream of spending. Furthermore, loans must be re-paid to the Center.

As presented in Table 16 the North Carolina Biotechnology Center made a total of 12 loans for $626,750 in 2009 and 22 loans for $2,046,710 in 2008. The economic impacts of the Center's economic development grants and loans were calculated as follows:

- For research oriented loans, the Small Business Research Loans, the loan amount was modeled as a research expenditure for the borrowing company; and
- For business development loans – Company Inception Loans and Strategic Growth Loans, which are focused on assisting the growth of the borrowing company, the loan was treated as a source of capital to fund operations and expansion. The economic impact of these loans was estimated based on jobs projected to be created by the loan, projected using U.S. Small Business Administration guidelines for its loan programs. Small business loans are assumed by the SBA to create one job per $50,000 in loan amount.[24]

Table 16: North Carolina Biotechnology Center Economic Development Grants and Loans 2004–2009

Loan	2004	2005	2006	2007	2008	2009
Total Amount	**$304,825**	**$765,275**	**$901,115**	**$910,200**	**$2,046,710**	**$626,750**
Business Development Loan	$30,000	$49,050	$171,115	$95,131	$107,500	
Company Inception Loan					$195,000	$239,000
SBIR Bridge Loan		$147,600		$67,500		
Small Business Research Loan	$274,825	$568,626	$570,000	$361,029	$1,336,210	$75,000
Strategic Growth Loan			$160,000	$250,000	$358,000	$312,750
Technology Enhancement & Accel. Model Loan				$136,540	$50,000	
Total Number	**4**	**10**	**13**	**13**	**22**	**12**
Business Development Loan	2	4	8	5	5	
Company Inception Loan					5	8
SBIR Bridge Loan		2		1		
Small Business Research Loan	2	4	4	3	9	2
Strategic Growth Loan			1	1	2	2
Technology Enhancement & Accel. Model Loan				3	1	

Source: NCBC

[24] According to the SBA "Generally, a business must create or retain one job for every $50,000 provided by the SBA" see http://www.sba.gov/smallbusinessplanner/plan/getready/SERV_LT_504.html.

The Economic Impact of North Carolina Biotechnology Center Operations

The operating budget and economic development grants and loans data were analyzed using the IMPLAN model in order to estimate the economic impacts associated with each activity.[25] The economic impacts of the North Carolina Biotechnology Center 2009 operations on the State of North Carolina are as follows:

- As presented in Table 17, the Center's $16.7 million in operational expenditures in 2009 increased economic activity in North Carolina by $35.9 million, supported an estimated 239 jobs earning $12.3 million in salaries, wages, and benefits, and generated nearly $1.6 million in State and local tax revenues;
- As presented in Table 18, the $795,458 in the Center's economic development loans made in 2009 created 12 jobs and supported $1.7 million in activity in the borrowing companies.[26] This increased activity expanded economic activity in North Carolina by $3.4 million, supported an estimated 26 jobs earning $1.3 million in salaries, wages, and benefits, and generated over $136,108 in State and local tax revenues; and
- As presented in Table 19, the Center's combined $16.7 million in calendar 2009 operational expenditures and the Center's $795,458 in economic development grants and loans made in 2009 increased economic activity in North Carolina by $39.4 million, supported an estimated 265 jobs earning $13.7 million in salaries, wages, and benefits, and generated nearly $1.8 million in State and local tax revenues.

Table 17: The Economic Contribution of NCBC Operational Spending on the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($)	$16,708,042	$9,148,515	$10,073,541	**$35,930,098**
Employment (# of Jobs)[1]	83	68	88	**239**
Employee Compensation ($ M)[1]	$6,917,572	$2,588,935	$2,822,172	**$12,328,679**
State and Local Tax Revenues ($ M)	--	--	--	**$1,636,644**

(1) Direct Employment and Employee Compensation is for NCBC staff only - Jobs and Employee Compensation created by NCBC grants are included in indirect impacts.

Source: NCBC and IMPLAN

[25] See discussion above for a description of IMPLAN and a discussion of the economic impact methodology.

[26] The loan figures stated in this report includes money that has actually been drawn down by the loan recipient company and does not reflect the total allocated amount of the loan.

Table 18: The Economic Contribution of NCBC Economic Development Grants and Loans to the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($)	$1,707,433	$655,603	$1,075,090	**$3,438,126**
Employment (# of Jobs)[1]	12	6	9	**26**
Employee Compensation ($ M)[1]	$806,508	$198,362	$302,692	**$1,307,562**
State and Local Tax Revenues ($ M)	--	--	--	**$136,108**

Source: NCBC and IMPLAN

Table 19: The Combined Economic Contribution of NCBC Operational Spending and Economic Development Grants and Loans on the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output ($)	$18,415,475	$9,804,118	$11,148,631	$39,368,224
Employment (# of Jobs)[1]	95	74	97	265
Employee Compensation ($ M)[1]	$7,724,080	$2,787,297	$3,124,864	$13,636,241
State and Local Tax Revenues ($ M)	--	--	--	$1,772,752

Source: NCBC and IMPLAN

It is not possible to determine the extent to which the economic development grants and loans provided by the Biotechnology Center generated new or facilitated the growth and expansion of existing biotechnology companies. It is, however, possible to measure the economic impacts made by the companies that have received economic development assistance from the Center.

Since 1989, when the Center started to provide economic development assistance to companies, it has made 177 grants or loans to 125 companies.[27] Of the 125 companies receiving grants or loans, 83 are currently active as of the time of this analysis (up from 64 in the 2008 impact report).[28] Battelle estimated the economic impacts of these 83 companies. As presented in Table 20, these 83 companies had total employment of 1,608 and estimated revenues of $832.2 million. The impacts of these companies operations were analyzed using the IMPLAN model.[29] These 83 companies generate $1.35 billion in economic activity in the State, create or support 5,513 jobs earning $302.6 million in salaries, wages and benefits, and generate an estimated $43.6 million in state and local tax revenues (an amount that exceeds the annual funding for NCBC).

[27] Four grants or loans were made to universities. These were excluded from this analysis.

[28] Some of these companies may have been acquired by other companies or have changed their name and, thus, may be active in some form. In cases where a company was known to be acquired the acquiring company was included.

[29] See above description of the IMPLAN model and methodology used.

Table 20: The Economic Contribution of the 83 Currently Active Companies that Received Economic Development Grants or Loans to the North Carolina Economy

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Total Impact of Biotechnology Sector				
Output (Mil. $s)	$41,155,907,128	$13,663,842,868	$9,822,216,611	**$64,641,966,607**
Employment (# of Jobs)	56,842	85,494	84,487	**226,823**
Employee Compensation (Mil. $s)	$5,324,240,372	$4,591,125,273	$2,778,373,295	**$12,693,738,940**
State and Local Tax Revenues (Mil. $s)	--	--	--	**$1,918,245,052**
Impact of the 83 Currently Active Companies that Received Economic Development Grants or Loans				
Output (Mil. $s)	$832,196,893	$285,856,139	$236,444,531	**$1,354,497,563**
Employment (# of Jobs)	1,608	1,870	2,034	**5,513**
Employee Compensation (Mil. $s)	$139,467,182.3	$96,241,481.1	$66,877,662.7	**$302,586,326**
State and Local Tax Revenues (Mil. $s)	--	--	--	**$43,572,612**
Share of Total Industry Impact				
Output (Mil. $s)	**2.0%**	**2.1%**	**2.4%**	**2.1%**
Employment (# of Jobs)	**2.8%**	**2.2%**	**2.4%**	**2.4%**
Employee Compensation (Mil. $s)	**2.6%**	**2.1%**	**2.4%**	**2.4%**
State and Local Tax Revenues (Mil. $s)	**--**	**--**	**--**	**2.3%**

Source: NCBC and IMPLAN

VI. THE NORTH CAROLINA BIOTECHNOLOGY CENTER – FUNCTIONAL ACTIVITIES IN BUILDING NORTH CAROLINA'S BIOTECHNOLOGY CLUSTER

The Biotechnology Center Today – Organizational Structure and Mission

Today the North Carolina Biotechnology Center's mission is:

To provide long-term economic and societal benefits to North Carolina through support of biotechnology research, business and education.

The Center addresses this mission via dedicated attention to six principal goals:

1. Strengthen North Carolina's academic and industrial biotechnology research capabilities.
2. Foster North Carolina's biotechnology industrial development.
3. Work with business, government and academia to move biotechnology from research to commercialization in North Carolina.
4. Inform North Carolinians about the science, applications, benefits and issues of biotechnology.
5. Enhance the teaching and workforce-training capabilities of North Carolina's educational institutions.
6. Establish North Carolina as a preeminent international location for the biotechnology industry.

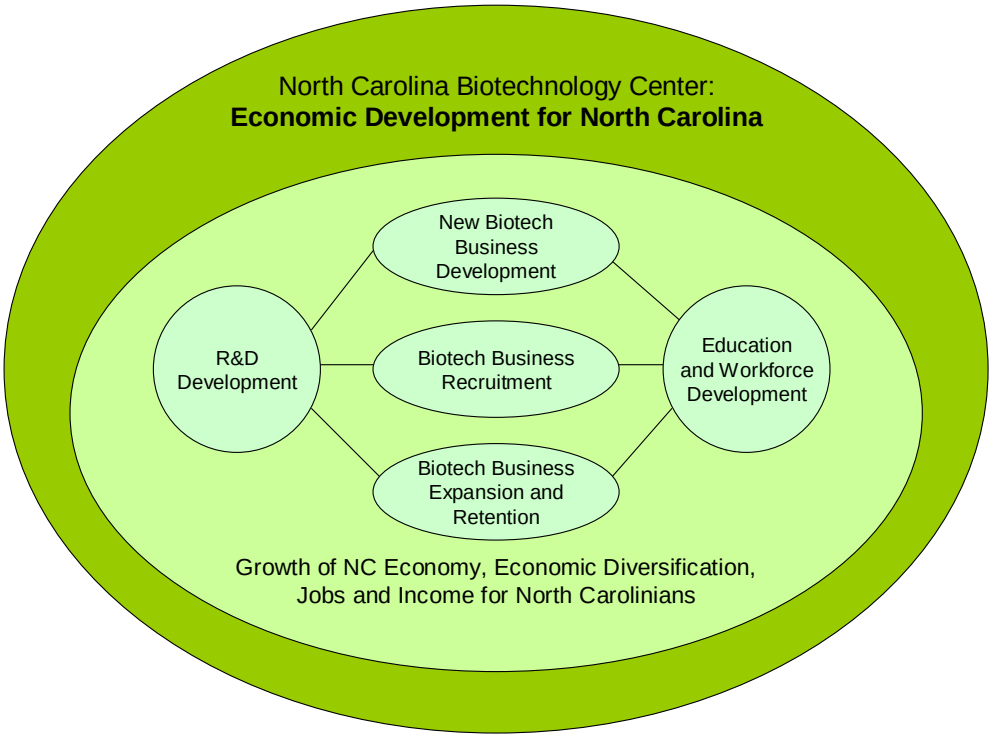
Work on these goals is accomplished by staff located at the Center's headquarters facility in Research Triangle Park and by staff located at five regional offices strategically located across the State (see Figure 16):

Figure 16: North Carolina Biotechnology Center Headquarters and Regional Office Locations

The regional offices were opened beginning in 2003 with the first located in the Piedmont Triad Region (Winston-Salem). Today the regional offices have expanded to encompass all regions of the state with additional locations established in Western NC (Asheville), the Greater Charlotte Region (Charlotte), Southeastern NC (Wilmington), and Eastern NC (Greenville). These five regional offices, in concert with the HQ of the Biotechnology Center at RTP are intended to constitute a permanent footprint encompassing the entire state for biotechnology-based regional economic development. At each location Center staff work in collaboration with regional leaders and development organizations to create events, programs and initiatives that build upon the inherent strengths and opportunities in each region. As will be discussed in the final chapter of this report, the Center now has focused sub-sector biotechnology initiatives designed to help build specific areas of biotechnology R&D and industry in each of the regions—these include specialized initiatives in natural products, marine biotechnology, medical devices and agricultural and forestry based biotechnology. Using dedicated programs, such as the Regional Development Grant and Regional Exchange Group programs, the Biotechnology Center is working to assure biotechnology is an industry sector that grows and adds to the economic base and sustainability of all regions within the state.

At its core, the Biotechnology Center is an economic development engine for the State of North Carolina. Via a coordinated suite of programs and initiatives, the Center works to grow the North Carolina economy via: R&D development: biotechnology business development, recruitment, retention and expansion; and education and workforce development (see Figure 17).

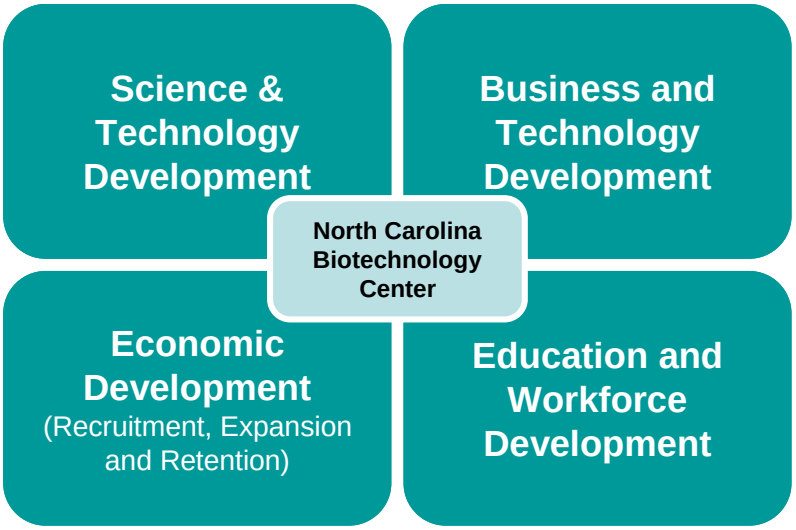
Figure 17: North Carolina Biotechnology Center—An Economic Development Engine for the State



The Center approaches its economic development mission via a series of primary program areas:

- **Science and Technology Development (Bioscience R&D**) – supporting the emergence of North Carolina as a leading state for basic and applied scientific R&D focused on fundamental and translational discoveries in biotechnology and its applications.
- **Business and Technology Development** – supporting entrepreneurship, new business formation, and biotechnology company growth.
- **Business Recruitment, Retention and Expansion** – proactively working to bring new biotechnology and biomanufacturing company facilities into the state and providing support services to existing NC biotechnology companies to assure their retention and expansion in the state. This economic development task also incorporates the provision of strategic insight and direction in furthering development of biotechnology in North Carolina and building public and key stakeholder awareness of the importance of the sector to the State's economic future. Via strategic planning and guidance, the Center helps to build and sustain a positive business climate for biotechnology in North Carolina.
- **Education and Workforce Development** – supporting biosciences education along the continuum from K-12 education through to post-secondary education and proactive programs in bioscience workforce development and incumbent worker training initiatives.

Figure 18: North Carolina Biotechnology Center Primary Program Areas



The North Carolina Biotechnology Center: Scope of Services and Functional Benefits

Placing the primary activities of the Biotechnology Center into the four simplified categories above helps to explain the operations of the Center but oversimplifies the complex suite of programs, services and initiatives deployed by the Center under these four categories. Figure 19 provides a more detailed view of the specific functional activities that the Center deploys in meeting its mission and goals:

This broad range of initiatives, programs and services provided by the Biotechnology Center leads, in turn, to significant functional benefits and economic impacts for the State of North Carolina. These positive impacts are the subject of analysis in subsequent chapters of this report.

Figure 19: North Carolina Biotechnology Center Initiatives and Programs and their Functional Benefits for North Carolina

Key Themes	NCBC Initiatives and Programs	Functional Benefits
Science and Research Development	Faculty/researcher recruitment aid	Enhanced research climate and infrastructure
	Facilities and infrastructure funding	Enhanced R&D human capital
	Academic research funding	Leveraged federal and private research funds
	Collaborative company-university R&D	New discoveries, innovations and technology
	Multi-institution/multi-disciplinary support	Generation of valuable intellectual property
	Researcher networking/intellectual exchange	New and improved biotech products for industry
	Regional networking	Improved industry processes and productivity
New Biotech Business Development	Loans to start-up biotech companies	Development of new companies in NC
	Access to private risk capital	Enhanced employment opportunities for NC residents
	Tech transfer and licensing support	Growth in NC personal and family incomes
	Facilitation of strategic partnerships	Products and services to improve health/healthcare
	Entrepreneurship education and support	New sub-cluster development and diversification
	Sites/facilities access and development	Business opportunities for NC suppliers to biotech
	Business intelligence/library resources	Business opportunities for service providers
	Business planning/development assistance	Job opportunities and enhanced retention of graduates
	Networking and events	Regional and community growth and sustainability
	Access to PhD scientist fellows for industry	
	Access to professional services	
Economic Development (Recruitment, Expansion & Retention)	Recruitment of biotech firms and plants to NC	Attraction of biotechnology companies to NC
	Expansion assistance to NC biotech companies	Expansion and retention of NC companies
	Services to support retention of biotech firms	Long-term guidance of biotechnology sector development
	Overall biotechnology sector strategic planning	Proactive enhancement of NC business environment
	Biotech sub-sector strategies	Planning for emerging opportunities and change
	New sector and opportunity assessment	Regional guidance and strategy formation
	North Carolina regional strategies	Enhanced public support for economic development
	Public awareness building for biotechnology	Enhanced domestic and international image for NC
	International promotion and marketing support	
Education and Workforce Development	K-12 teacher training and assistance	Improved resources for schools
	Biotechnology educational workshops	Rigor and relevance in education
	Educational materials loan and supply	Student interest & engagement in science and technology
	Grants to support education and training	Access to skilled and productive workforce for industry
	Industry workforce needs analysis	Re-skilling, skills modernization and skills enhancement
	Biotechnology curriculum development	Incumbent worker retention and career progression
	Bio-manufacturing workforce development	Workforce skills enhancement across NC regions
	Workforce recruitment and retention help	Balanced labor supply and demand relationship

The Center's Partners in Success

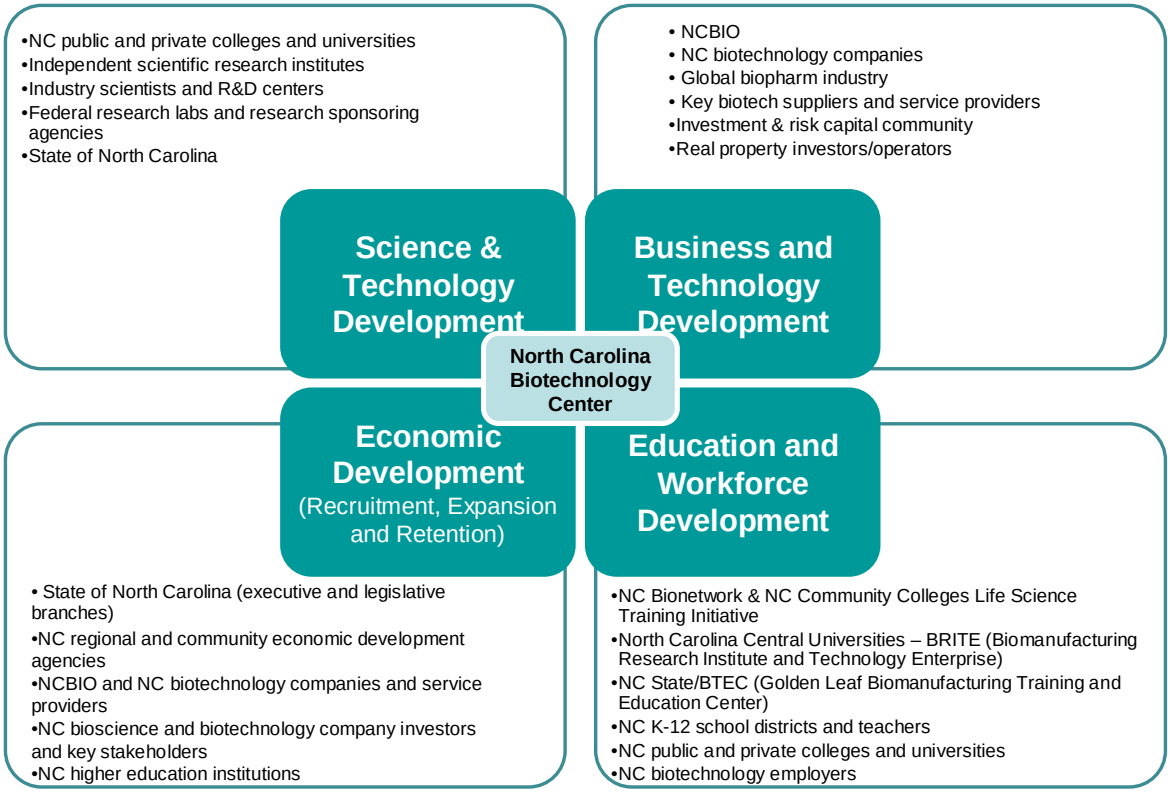
Seldom is it the case in economic development, especially technology-based economic development, that a single organization can take credit for the growth of a cluster or the winning of significant new projects. This holds true in North Carolina, where the activities and functional impacts if the Center are supported, added-to and magnified by the ongoing operations and contributions of a broad range of supporting and partner organizations.

The North Carolina Biotechnology Center certainly plays a central role in guiding strategy for biotechnology development in the State and coordinating its own activities, and the activities of key stakeholders and partners in biotechnology development, but multiple other organizations and agencies provide support for biotechnology cluster growth in North Carolina.

Upstream of the Biotechnology Center, of course, is the State of North Carolina and the State Legislature which provides annual financial support that sustains the operations of the Center.

Since the Center acts as a central coordinating entity for comprehensive approaches to biotechnology development in the State it leverages and benefits from a broad range of additional organizations across North Carolina. Leading partner organizations include:

Figure 21: North Carolina Biotechnology Center partners in progress



Conclusion

Biotechnology, and the biosciences that underpin it, continue to be an important and expanding driver of the North Carolina economy. Outpacing the growth of biosciences in the nation as a whole, North Carolina continues to reinforce its position among the preeminent states for biotechnology employment and growth. Within a state economy challenged by current global economic forces impacting its industries, biotechnology has sustained its position as a star performer for the State – gaining new businesses and generating new jobs and expanding incomes for North Carolinians.

For 2010, at the time of this report's writing, North Carolina enjoys a biotechnology sector that employs 56,842 personnel—representing an increase of 3,660 jobs from the 53,182 reported in the 2008 impact report—an increase of 6.9 percent.[30] In terms of total economic impact, biotechnology and the biosciences are directly and indirectly generating a total of 226,823 jobs in North Carolina (an increase of 46,816 jobs since the previous impact report) with employee compensation totaling $12.7 billion (a $3.3 billion increase) and total economic impact (output) of $64.6 billion (an $18.8 billion increase over 2006 levels reported in the 2008 report).

Other metrics continue to bode well for North Carolina's continued growth as a leading bioscience and biotechnology state through the current decade. The state's academic research institutions have experienced expanding bioscience R&D volumes, while measures of innovation (such as intellectual property) generations have also increased (moving North Carolina to 14th from 20th in bioscience IP generation). Furthermore, North Carolina's position versus peer top ranked bioscience states continues to be very strong, with North Carolina holding the enviable position as both specialized and growing in bioscience and biotechnology employment.

Underpinning this strong biotechnology economy performance is the investment made by the State in the operations and mission of the North Carolina Biotechnology Center. Through an ongoing and long-standing commitment to the North Carolina Biotechnology Center the State and its people are reaping the rewards of biotechnology industry growth.

[30] NCBC updates its biotechnology database on a rolling basis so the employment number used here may differ from other NCBC reports as company information was updated.

Battelle

The Business *of* Innovation