



**Building the Life Sciences Community in the NC
BioEast Alliance Region**

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North Carolina's Eastern Region
www.nceast.org

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BioAbility, LLC
Strategic Information for the Life Sciences

EXECUTIVE SUMMARY

The NC BioEast Alliance is a recently formed partnership of five central-eastern North Carolina counties: Edgecombe, Nash, Pitt, Wayne, and Wilson. The purpose of this alliance is to act as a unified group to develop and build the life sciences and biotechnology industry in the Region. Current strengths of the NC BioEast Alliance Region (“the Region”) include a few locally grown firms, several mid-size facilities of national and international companies, and a limited number of support and service providers. Additional strengths in the Region include East Carolina University (ECU) with its Brody School of Medicine, three four-year colleges, and five community colleges. In all, approximately 5,000 people are employed in life science companies within the Region. Given an excellent quality of life, access to a skilled workforce, close proximity to the renowned Research Triangle Park area, and strong economic development activities, the growth of the life sciences community in the Region is not only possible, but is reasonable to expect.

To catalyze this growth, strategies that promote the attractiveness and strengths of the Region can be implemented. The purpose of this study is to understand the current situation in the Region and to provide real, executable strategic actions for the Region to undertake. A group of 30 stakeholders from within the Region were assembled to provide expert input to this process, and an analysis of strengths and weaknesses of the region was completed. Based on this analysis and dozens of additional interviews, BioAbility developed five recommendations for expanding the life sciences community in the Region.

The first three strategies aim to bolster current efforts and encourage existing companies to locate facilities in the Region. This is a near-term set of strategies. The strategies recommended herein for this purpose are to:

1. Unite the five counties into a functional marketing unit.
2. Foster a ‘repatriation’ program.
3. Create virtual representations for new life sciences sites and facilities.

The other two strategies aim to build more homegrown technology-based companies by strengthening ECU’s R&D efforts. BioAbility sees ECU as the strongest potential generator of

technologies, intellectual property, and ultimately new companies in the Region. ECU has an excellent reputation for teaching, but external forces have limited its research efforts in the past. Strengthening ECU's research efforts will not only add jobs and revenues to ECU and Pitt County, but will also lead to the development of new technologies and the creation of new companies. Employees of the new companies could be drawn from the entire Region. In addition, as new companies grow and expand, those companies may develop facilities in neighboring counties. These are longer-term strategies. Specifically:

4. Expand the faculty recruitment grant program to enhance the ECU research faculty.
5. Create a research institute at ECU to serve as an employer, attractant for additional grants, and developer of new technologies.

While certain larger strategies, such as improving K through 12 education or building a strong regional airport, would have also been highly supportive of the goal, they were not specific to the life sciences and were beyond the scope of this project. BioAbility attempted to limit its focus to strategies that it believes are reasonable and can be implemented, while having the desired impact on the Region.

BioAbility believes the Region has the potential to meet its life science expansion goals. With the right resources in place and key strategies followed, we would expect to see a significant increase in local employment and a substantial boost to the local tax base within the next five to ten years. The synergy from this Alliance will have a dramatic impact on the development of the life science industry in this Region.

This report is an information tool and the user should make business decisions based on an independent investigation, verification and evaluation of this as well as other information relevant to the user's business interests. BioAbility has gathered information for this work from many different sources and quotes information which has been gathered by other sources. Although BioAbility has taken reasonable steps to ensure the accuracy of this report, due to the tremendous amount of information, and the third party control of some information, BioAbility cannot verify the accuracy of all information that it gathers and reports and thus does not warrant that the information is error-free. AS A RESULT, BIOABILITY DISCLAIMS ALL WARRANTIES OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE.

TABLE OF CONTENTS

| | |
|---|----|
| Executive Summary | ii |
| I. Introduction of Project and Process..... | 1 |
| II. The Purpose: Building the Biotechnology and Life Sciences Community in the NC BioEast Alliance Region | 3 |
| Existing Life Sciences Resources in Eastern NC | 4 |
| III. Established Ways to Grow the Community..... | 9 |
| IV. The SWOT Analysis..... | 11 |
| Strengths and Weaknesses | 11 |
| 1. Existing industry base..... | 11 |
| 2. Available and affordable facilities | 12 |
| 3. Quality of life..... | 13 |
| 4. Access to transportation..... | 14 |
| 5. Critical mass of cutting-edge research..... | 15 |
| 6. Access to capital | 16 |
| 7. Experienced entrepreneurs..... | 17 |
| 8. Entrepreneurial support mechanisms..... | 17 |
| 9. Business friendly environment | 18 |
| 10. Skilled workforce..... | 18 |
| Opportunities and Threats..... | 19 |
| V. Recommended Strategies..... | 23 |
| The Five Strategies | 25 |
| Strategy 1. Unite the five counties into a functional marketing unit. | 25 |
| Strategy 2. Foster a repatriation program. | 29 |
| Strategy 3. Create virtual representations for new life sciences sites and facilities. | 32 |
| Strategy 4. Expand the Faculty Recruitment Grant (FRG) program. | 35 |
| Strategy 5. Build research institutes at ECU..... | 41 |
| VI. Beyond Our Strategies: The Ideal World | 48 |
| Appendix I. Participants in this Project | 51 |
| Appendix II. BioScience Companies in the NC BioEast Alliance Region..... | 55 |
| Appendix III. NCBC Faculty Recruitment Grant Spin-out Companies | 56 |
| Appendix IV. Education Level and Median Earnings of Selected Counties..... | 58 |
| References..... | 59 |

I. INTRODUCTION OF PROJECT AND PROCESS

The five central-eastern North Carolina counties that are the subject of this report (called herein “NC BioEast Alliance Region” or “the Region”) are situated approximately halfway between the Research Triangle Park (RTP) area and the Atlantic coast. There is a small contingency of life sciences-related companies already existing within these counties, and the goal of this project is to create a set of strategies that would strengthen and grow the life sciences industry and community in the five counties. These strategies will focus on both the short/mid-term growth as well as longer-term approaches for building technology and entrepreneurship in the Region.

The process used was to gather local information from the key stakeholders in the Region, apply BioAbility’s life sciences development experience, and collect information from other regions in order to create viable and reasonable strategies. It was our intent to create four to five strategies or action items that can be reasonably implemented, have a good chance of success, and have a method for each strategy of measuring that success. The main tool used to identify the strategies is the Strengths, Weaknesses, Opportunities and Threats Analysis (SWOT Analysis). We were, however, not looking at all strengths and weaknesses in the area, rather the strengths and weaknesses in ten categories that have been determined by BioAbility over the last 15 years to be important for developing a regional life sciences community.

The general timeline and tasks for this project were as follows:

- Identify and build Stakeholders Group ✓
- Initial interviews ✓
- Tour of the Region and its assets – September 2007 ✓
- SWOT meeting One, strengths and weaknesses – September 2007 ✓
- SWOT meeting Two, build initial strategies – October 2007 ✓
- Additional interviews – November/December 2007 ✓
- Initial plan – December 2007 ✓
- Feedback meeting for economic developers – December 2007 ✓
- Final plan draft – January 2008 ✓
- Final presentation to Stakeholders Group and others – February 2008

Additional information on interviewees and SWOT meeting attendees is provided in Appendix I.

The 13 counties representing North Carolina’s Eastern Region are shown in Figure 1 in yellow. The five counties of the NC BioEast Alliance Region — Edgecombe, Nash, Pitt, Wayne, and Wilson — are bounded in red in this map. Each of the counties has its own Community College, and one county, Pitt, contains the Region’s only university and medical school, East Carolina University (ECU). In addition, there are three four-year colleges in the Region: Mt. Olive College in Wayne County, Barton College in Wilson; and NC Wesleyan College in Rocky Mount. There are four economic development offices in the five counties, with Edgecombe/Nash sharing one office. Also in support of the Region is North Carolina’s Eastern Region, an economic development consortium for 13 counties in Eastern North Carolina (the yellow-shaded area in the map). The NC BioEast Alliance counties represent the northern and western borders of this region.

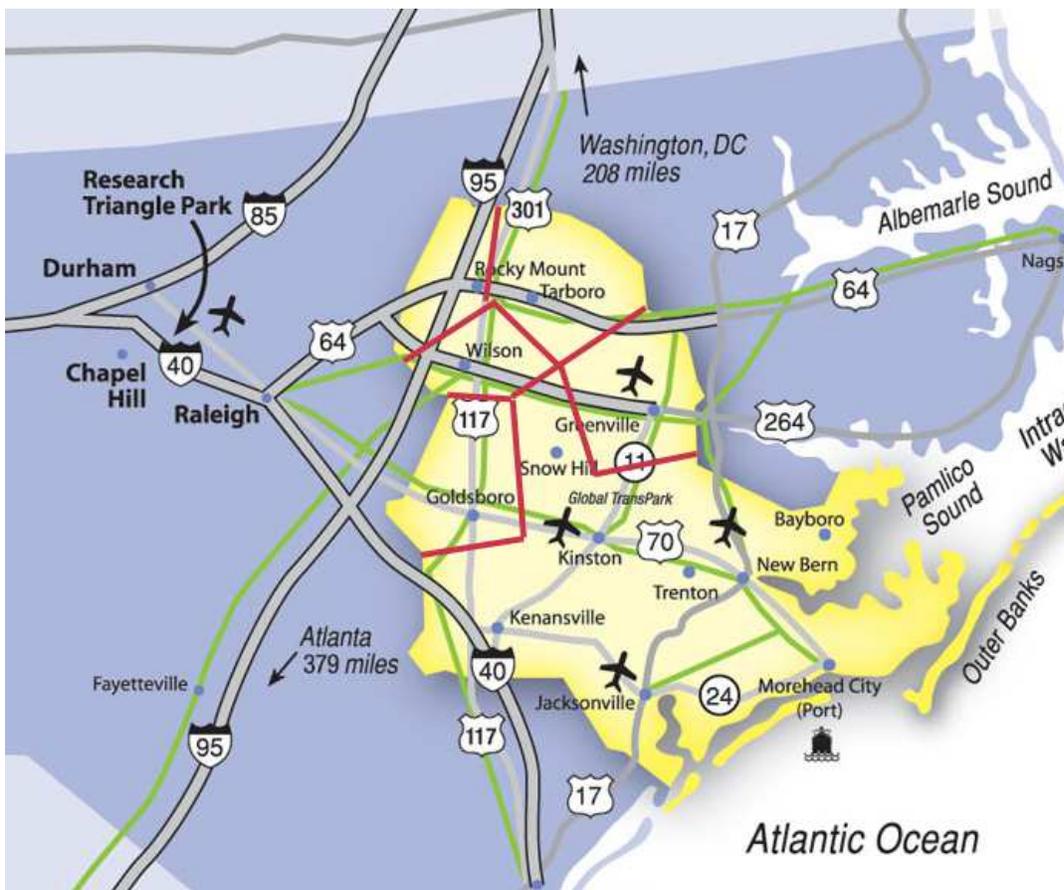


Figure 1. The five-county target region. Note that part of US 117 is now called I-795.

II. THE PURPOSE: BUILDING THE BIOTECHNOLOGY AND LIFE SCIENCES COMMUNITY IN THE NC BIOEAST ALLIANCE REGION

The purpose of this project is to build the life sciences community within the five eastern counties that make up the NC BioEast Alliance Region. The community in question is comprised of numerous components including:

- New biotechnology and life sciences companies
- Sites of existing companies doing life sciences work, including manufacturing and warehouse facilities
- Research and Development, Industry
- Research and Development, Academia
- Research and Development, Private
- Research and Development, Government
- Healthcare provision
- Support organizations such as suppliers of equipment, chemicals and other goods
- Service organizations specializing in the life sciences, such as patent lawyers and regulatory consultants

The state of North Carolina is the third leading state in the country in terms of the number of bioscience firms and employees, according to Ernst & Young.¹ In November 2007, the North Carolina Biotechnology Center (NCBC) reported that North Carolina had 436 bioscience firms employing 52,277 people. A May 2007 report by CCbenefits and Economic Modeling Specialists reported that the state's biotech sector employed 60,682 in 2006. This group divided the biotech companies into four segments: agricultural feedstock and chemicals, pharmaceuticals, medical devices, and research, testing and medical laboratories. The segment including research, testing and medical laboratories is currently the largest, employing 23,117 or 38 percent of all biotech employees. CCbenefits and Economic Modeling Specialists project that the number of biotech employees will grow 25 percent by 2016, an increase of 15,000 jobs. The pharmaceuticals segment is forecast to be the fastest growing segment.²

The NC BioEast Alliance Region may have suffered historically in its ability to build a life sciences community because of its proximity to the Research Triangle area of North Carolina, which is 45-100 miles away. The Research Triangle area is home to three research universities, two medical schools, and an international airport. As Table 1 shows, there are more than 300 bioscience companies in the RTP region and 27,449 employees. While the Research Triangle

area has often been viewed as a formidable competitor to attracting life sciences companies to the NC BioEast Alliance Region, it can also be seen as an ally and resource. As these companies grow and expand, they are potential targets for recruitment by the NC BioEast Alliance. In addition, the pool of employees in RTP can be accessed to expand the existing employee base in the five-county region. Proximity to RTP may be particularly advantageous as a source of life-science entrepreneurs, engineers (until more can be trained at ECU), and scientists at the doctoral level. Appendix II catalogs the 19 bioscience companies in the NC BioEast Alliance Region by county.

Table 1. Bioscience companies and employees in selected regions as of December 2007

| Bioscience companies (totals may include multiple sites of the same company) | Number |
|---|---------------|
| RTP region as defined by NCBC – includes 13 counties (Person, Granville, Chatham, Durham, Franklin, Harnett, Johnston, Lee, Moore, Orange, Vance, Wake, Warren) | 328 |
| 5 NC BioEast Alliance counties (Edgecombe, Nash, Pitt, Wayne, and Wilson) | 19 |
| 13 Eastern counties (Includes NC BioEast Alliance – Edgecombe, Nash, Wayne, Wilson, Pitt, Greene, Lenoir, Craven, Duplin, Pamlico, Jones, Onslow, and Carteret) | 23 |
| Eastern region as defined by NCBC – includes 27 counties | 28 |
| Bioscience employees | |
| RTP region | 27,449 |
| BioEast Alliance counties | 4,754 |
| 13 Eastern counties, including BioEast Alliance counties | 5,013 |
| Eastern region | 5,072 |

Source: NCBC Research Library 12/9/07 and 1/3/08

Note: These numbers only include bioscience companies that have a primary activity of R&D, Contract Research and Testing, or Production and Manufacturing and their employees. The total does not include Service and Support companies.

Existing Life Sciences Resources in Eastern NC

The proximity to RTP has not prohibited the development of life sciences resources in Eastern North Carolina, and the Region has many current organizations that support and perform life sciences/biotechnology research, development, and manufacturing. In order to support the expansion of life sciences/biotechnology economic development across the state, NCBC opened a satellite office in Greenville in 2005 after determining that this region has the existing resources and capabilities to develop biotechnology as an industry. Two 2007 highlights that are key to the Region for this office include:³

1. The organization of two Regional Exchange Group meetings with ECU's Division of Research and Graduate Studies in order to encourage more interaction between university and corporate researchers and to increase clinical trial activity in Eastern North Carolina
2. The support of two regional initiatives leading to the creation of the BioEast Alliance to expand bioprocessing opportunities in Eastern North Carolina

Pharmaceutical and healthcare-related manufacturing are well-established in the Region. Companies such as Hospira (formerly Abbott Labs), Merck, DSM Pharmaceuticals, Purdue Pharmaceuticals, and Novartis (Sandoz Division) are located within the five county area. The largest sites are primarily performing manufacturing, packaging, warehousing, and logistical tasks. Smaller biotech/pharma/life sciences research and contract organizations in the area include Craft Technologies, PhytoMyco Research Corp., CTMG Inc., Metrics, and Pioneer Surgical Orthobiologics (formerly Encelle), which emphasizes the breadth and width of the corporate infrastructure within the five county region (Table 2). Pitt County is also home to the Technology Enterprise Center of Eastern Carolina, a small technology business incubator which offers office, laboratory, and light manufacturing space on a short-term lease basis. Financial and technical advice for clients is also available as the center is supported by ECU's School of Business, School of Industry and Technology, and School of Medicine. Five biotechnology companies are currently in the Technology Enterprise Center of Eastern Carolina.

Table 2. Current life sciences community in NC BioEast region

| Type of company | Currently in NC BioEast | Comments |
|---|--|--|
| Homegrown biotech/life sciences firms | A few. Most are based on ECU technology. | Low NIH/other grant funding at ECU limit technology, disclosures and companies |
| Sites of firms based outside the counties | The largest source of employees. | Not R&D based – packaging, warehousing, manufacturing |
| Healthcare provision and life sciences research | Medical School, Dental School, Hospitals, other. Large employer. | A large component, but low R&D level at ECU is limiting |
| Supplier companies | Few | With little R&D, less need for local suppliers |
| Support organizations | Few | With little R&D, less need for support organizations |

Workforce development in the Region is well supported by the community college system and the NC Community College System (NCCCS) BioNetwork that provides the specialized training, curricula, and equipment through the community college system. The NC General Assembly has appropriated recurring funds of \$7.1 million for the NCCCS BioNetwork Program to provide specialized education and training for biopharmaceutical workforce development at community colleges statewide. Each of the five counties has a community college that supports workforce development, as 67 percent of employees in pharmaceutical and biomanufacturing have less than a baccalaureate degree and are trained at the community college level. An Associate of Applied Science (AAS) degree in biotechnology can be obtained by taking the first year at any of 13 community colleges in the greater region and completing the second year at Pitt Community College. Both Pitt Community College and Wilson Community College offer NCCCS BioNetwork's introductory BioWork course, a 128-hour course of study designed to prepare workers to become entry-level technicians in the biotech/pharmaceutical/life sciences fields. In addition, Pitt Community College is offering an Industrial Systems Associate Degree with a specialization in clean room maintenance to prepare employees for maintenance technician jobs in FDA-regulated biomanufacturing facilities. Other BioNetwork courses offered at community colleges include Bioprocessing in the Workplace[®] for preparing workers for an entry-level position in the biomanufacturing industry.

The BioNetwork also operates the BioNetwork Bioprocessing Center in Greenville in the Technology Enterprise Center of Eastern Carolina. The Bioprocessing Center coordinates specific training requests and requirements between industry leaders and the local community colleges to meet these training needs. The Bioprocessing Center provides support to the community colleges to develop new courses and improve existing courses, as well as offering workshops in the following areas:

- Environmental Monitoring/Aseptic Practices
- Fermentation Protocols
- Protein Assays
- Downstream Processing Techniques
- Filtration Techniques
- Filter Integrity Testing
- Media Preparation

- Fundamentals of HPLC
- Food Safety and Sanitation
- Mold Identification
- How to Conduct a Summer Biotechnology Boot Camp

The BioNetwork also provides grants to community colleges for curriculum development. For 2007 – 2008, the BioNetwork funded grants at Nash Community College and at Wayne Community College. The Nash Community College grant of nearly \$195,000 was entitled “Establishing a Liquid & Gas Chromatography Module and Integrating GC & LC Techniques into the Curriculum.” The Wayne Community College grant for \$155,000 was entitled “Wayne Community College Agriculture Biotechnology (Animal Science) Program: Phase I.” A new AAS program in agricultural biotechnology with an animal health focus will begin in the fall of 2008 at Wayne Community College.

Other educational opportunities for worker training and higher education exist in the Region as well. The Gateway Technology Center in Rocky Mount offers a state-of-the-art distance learning facility so that local residents can complete degrees from either ECU or North Carolina State University (NCSU). While the students must register at one of the respective schools, they can utilize the computer labs and classrooms and high-speed Internet at the Gateway Technology Center to complete distance learning courses. Students in the Region can complete the first two years of their bachelor’s degree through one of four area community colleges (Edgecombe, Halifax, Nash, or Wilson) and then complete their degrees through distance learning courses. The Gateway Technology Center is located on the campus of NC Wesleyan College. It is operated by The Gateway Technology Center, Inc., a nonprofit corporation comprised of representatives from the City of Rocky Mount, Nash County, NC Wesleyan College and the Carolinas Gateway Partnership. Sponsors include The Carolinas Gateway Partnership, The Golden LEAF Foundation, e-NC Authority, The City of Rocky Mount, Nash County, Honeywell, Nash Healthcare Systems, DeLeon Carter Foundation, and the Mims Charitable Trust.

ECU serves as a major educational resource for the Region. ECU is the third largest member of the Greater University of North Carolina system with over 25,000 students. ECU offers 104

bachelor's degree programs, 74 master's degree programs, four specialist degree programs, one M.D. program, and 17 doctoral programs. Some of the life science related doctoral programs include: Biochemistry and Molecular Biology, Biological Sciences, Microbiology and Immunology, and Pharmacology and Toxicology. New fields and courses of study are being added annually, with the university's engineering department awarding its first degrees in May 2008. ECU offers a Bachelor of Science in engineering with four possible concentrations: Biomedical Engineering, Systems Engineering, Engineering Management, and Bioprocess Engineering. A team of engineering professors was awarded a grant from the National Science Foundation in January 2008 to design and develop new teaching methods and materials for the undergraduate bioprocess engineering program. ECU is also home to the Brody School of Medicine, which is currently accepting 76 M.D. students annually. The school and the associated Pitt County Memorial Hospital are internationally known for excellence and groundbreaking research in minimally invasive and robotic cardiac surgery. Further health and life sciences education opportunities are offered by the ECU School of Nursing and College of Allied Health Sciences.

III. ESTABLISHED WAYS TO GROW THE COMMUNITY

There are four primary ways to grow a life sciences community:

1. **Form new companies.** Small businesses have created 60 to 80 percent of the net new jobs in the United States for the past decade.⁴ New company formation can be a slow process. New firms, especially in the life sciences, typically do not hire many people to start nor do they typically grow rapidly. Although the employee count can be lower in R&D-based companies, the jobs tend to be higher-paying than in warehousing, logistics, and manufacturing.

In biotechnology and the life sciences, new businesses are often spun out of a university as a result of technology developed at that university. Spin outs are most often located near the university. These companies can be catalyzed and fostered, but recruitment is difficult.

A discussion of factors impacting companies' location selection process follows (on the next page).

2. **Attract sites of companies.** Bringing a manufacturing, warehousing, packaging, logistics or other facility of an existing company into the Region often can add hundreds of jobs. These jobs tend to require less education than R&D jobs and often provide a lower pay scale.
3. **Grow the academic community.** This can result in significant employment at the faculty, graduate student, technical support and other levels. Faculty and researchers typically have a higher salary level. Growth of the academic community also provides sources of higher-level employees to match growth of the local industry and help fuel the formation of new local companies. This is not a typical focus for economic developers.
4. **Ancillary growth.** The development of new jobs in the life sciences industry will lead to enhanced economic impact on the local community. This will be seen in the growth of related service providers and suppliers.

Why companies locate where they do

A quality research institution is the key to good growth in technology industries.

JSJ Pharmaceuticals is a specialty pharmaceutical company focusing on topical products for the dermatologic community. In 2006, JSJ Pharmaceuticals moved its corporate headquarters from Philadelphia, PA to Charleston, SC. Chief Operating Officer Jonathon Alba cited the excellent dermatologic research being conducted at the Medical University of South Carolina (MUSC) as a vital point to the company's relocation in Charleston, "Having access to the well-renowned research staff in the Dermatology department at MUSC is critical to a rapidly growing company like JSJ," he stated.⁵

"The biggest issue is labor availability, because pharmaceutical plants typically require a fairly high skill level in their technician and scientist work forces," said Ron Jones, director of pharmaceuticals and biotechnology for Lockwood Greene, which manages many construction and site location projects. "Historically, these facilities have been located in proximity to universities or research centers. They tend to cluster in certain geographies, because you have that critical mass of labor resources." ⁶

Headquarters are good for bragging rights but little else, "Having a headquarters is low on my list of things important to a community," says Mike Walden, an economics professor at NCSU. Nucor Corporation, America's biggest steel maker with sales of \$11.3 billion last year, has been headquartered in Charlotte for nearly 40 years. Although having a headquarters of a company this size in Charlotte is a point of pride for the city, Nucor does little to help boost the economy. With only 53 employees in Charlotte Jim Coblin, Nucor's VP of Human Resources states, "We're not a big-impact player in Charlotte." Compared to the company's only steel mill in North Carolina, which employs 400 workers whose average pay is \$60,000 a year and has drawn in at least 23 additional supporting companies to the area, the headquarters does not provide a significant economic impact.⁷

An intangible issue that affects where companies locate is quality of life. Quality of life encompasses a variety of factors including cost of living, recreational opportunities, quality of education, crime rates, healthcare availability, climate, and other factors.

IV. THE SWOT ANALYSIS

BioAbility has identified ten attributes as being integral in developing a life sciences community (See Box). The SWOT analysis is designed to assess the strengths and weaknesses of eastern NC counties vis-à-vis these ten attributes. BioAbility held two Stakeholders Group SWOT meetings to discuss this subject, and also conducted visits and telephone surveys within the Region. Based on the information collected, a picture of strengths and weaknesses was developed and is presented herein.

| |
|---|
| 10 KEY LIFE SCIENCES GROWTH FACTORS IDENTIFIED BY BIOABILITY |
|---|

- | |
|---|
| <ul style="list-style-type: none">• Existing industry base• Available and affordable facilities• Quality of life• Access to transportation• Critical mass of cutting-edge research• Access to capital• Experienced entrepreneurs• Entrepreneurial support mechanisms• Business friendly environment• Skilled workforce |
|---|

Strengths and Weaknesses

Specific strengths and weaknesses of the five-county region are detailed below. BioAbility has found that the strategies to grow the local bioscience community are best based on strengths and weaknesses of the Region as it currently is. Opportunities and threats are typically external to the Region, and will be examined in the following section.

1. *Existing industry base*

Strengths

- + Some larger sites – e.g., Goldsboro Milling, Merck, Sandoz, Hospira, DSM Pharmaceuticals
- + A few homegrown companies – e.g., Metrics, CTMG, Pioneer Surgical Orthobiologics (formerly Encelle) and PhytoMyco Research Corporation
- + Some R&D companies such as SePro and Goldsboro Milling, Pioneer Surgical Orthobiologics and PhytoMyco Research Corporation
- + Reasonable number of jobs

+ Proximity to RTP allows “mining” the companies in RTP for possible expansion sites

Weaknesses

- Only 19 bioscience companies currently in the 5-county region
- Of these 19, very few homegrown firms
- Very few R&D based companies
- Relatively few high-paying jobs (4,754 bioscience jobs in the Region according to NCBC)

*Related comments, ideas and issues**

- R&D is perceived as “sexy” but those jobs can quickly disappear with the failure of a start-up company or the failure of a particular project. Manufacturing jobs will be around for many years, because of the initial start-up costs involved.
- This region has the opportunity to build on its manufacturing base using RTP as the R&D base.
- Other regions in the state are attempting to build a biotechnology and life sciences focus, and are competing for attention of state funds and support (e.g., the biotech park in Kannapolis vs. the Triad and other regions).
- The five counties do have specific individual strengths, although there is some overlap.
- The Region should catalog its resources to better direct outside companies to a specific county.

2. Available and affordable facilities

Strengths

- + There are some facilities available to occupy and develop
- + Land is available for this type of growth in each county
- + Technology Enterprise Center in Greenville offers office, laboratory, and light manufacturing space to technology-based companies

Weaknesses

- Some existing facilities are old and limited in size
- Smaller and larger facilities are more available than mid-size
- Facilities in the area would be affordable, but few are readily available

Related comments, ideas and issues

- Different types of life science companies need different types of facilities, but in general, they are very expensive and specialized.
- Companies seeking to move, or the consultants working for those companies, look more at the regional level instead of at the county level.
- Building a spec facility suitable for biotech is too expensive for any individual county.

*Note, the “related comments, ideas, and issues” are other items that arose during the meetings and interviews.

- Before building spec facilities, regions/counties need to determine the type of company or technology they want to attract so that the facilities are appropriate.
- To encourage the expansion of existing companies in this region, the state may need to provide an incentive package.
- One problem is that existing incentives for economic development are based on the number of jobs as well as salaries. In the biotech industry, the number of jobs is initially small, and the companies can take as many as 5-10 years (or more) to grow.
- One company expanded a facility in Montreal instead of Greenville in part because of the incentive package (although it was a small factor and Montreal was going to penalize the company for expanding elsewhere) and the availability of direct flights from Montreal to Amsterdam.
- Note that the type of incentives that would be attractive depends on the type of company being courted. Large companies may take the incentive package, but that is not likely to be what drives their decision.
- BioAbility cannot comment on what facilities are missing in the Region because there is not yet critical mass of life sciences industry. In general, BioAbility believes that the availability of spec buildings, either shells or with some laboratory areas built out is low and it would be highly useful to have some spaces that the economic developers can ‘show’ (either ready, as a shell, or virtually). This last point was confirmed by the Region’s economic developers.

3. *Quality of life*

Strengths

- + Overall a very nice place to live
- + Highly affordable housing and reasonable taxes
- + Increasing arts/culture facilities and activities
- + Strong community college/college presence
- + Friendly people

Weaknesses

- K-12 education is viewed as extremely weak, despite a few high-performing schools
- Small town lifestyle may not appeal to everyone

Related comments, ideas and issues

- This region can be described as small town living.
- One high school in the area was recently cited as among the highest in NC by a national magazine, but these ratings were based on “making the most of what you have.” The Junius H. Rose High School in Greenville received a Siemens Award for Advanced Placement in 2006-2007. These awards recognize one high school in each state that is leading the nation in terms of advanced placement participation and performance in science, math and technology. In general, however, the K-12 education system in the NC BioEast Alliance Region is a deterrent to strengthening the economy and relocation of businesses.

4. Access to transportation

Strengths

- + In general, the road systems are good. Proximity to interstate highways as well as other limited access highways reduces commute times.
- + Rail system is available (e.g. in Rocky Mount and Wilson). This includes the Amtrak passenger system which links the area with Washington DC, Baltimore, Philadelphia, and New York.

Weaknesses

- RDU airport is one to two hours away
- VERY limited regional airports
- No good road connection from Goldsboro to Greenville

Related comments, ideas and issues

- In all of BioAbility’s regional development experiences, the presence of a railway system has not been seen as anything but neutral. It is not an attractant.
- There was much discussion about the proximity to RDU, with some – especially those in the western part of the Region – seeing nothing negative about the distance. RDU is perceived more negatively for people traveling internationally compared to within the United States, but there is no other alternative in the Region.
- Corporate executives from the eastern part of the Region whom BioAbility interviewed, on the other hand, felt the distance to RDU was a difficulty. It added hours to a one-day business trip or required them leaving the house at 4:00 am for a 7:00 am flight.
- The Region needs to understand the perception by outsiders of distance to the airport as a negative and prepare marketing materials appropriately, e.g., it is possible to trade a short daily commute with a longer less frequent commute to the airport.
- Flying into RDU or Greenville may be a bigger problem for investors or company representatives coming into the area than for people living here traveling outbound.
- A limo service for executives to/from RDU would be desirable.

Distances in the NC BioEast Alliance Region

| RDU airport distance | Inter-city distance |
|--|---|
| <ul style="list-style-type: none"> • Wilson 62 mi 1hr 10min • Rocky Mt. 71 mi 1hr 13min • Goldsboro 84 mi 1hr 24min • Greenville 97.5 mi 1hr 39min | <ul style="list-style-type: none"> • Wilson to Greenville 38 mi • Rocky Mt. to Wilson 20 mi • Rocky Mt. to Greenville 42 mi • Goldsboro to Greenville 60 mi |

Source: Google Maps

5. Critical mass of cutting-edge research

Strengths

- + ECU has a medical school and life sciences doctoral research programs
- + Potential for growth
- + Partnerships with NCSU etc., but not currently in research

Weaknesses

- Beyond ECU, no other significant source of research/technology in the area
- Level of extramural funding at ECU is extremely small (see below)
- Limited life sciences department sizes and faculty at ECU and other four-year colleges in the Region
- Little commercialization has come out of ECU

Related comments, ideas and issues

- NCSU and UNC-CH have received significantly more state funding for capital improvements compared to ECU.
- Pitt County Memorial Hospital (PCMH) has been privatized, although it remains affiliated with the Brody School of Medicine at ECU. PCMH is part of University Health Systems of Eastern Carolina.
- Brody School of Medicine has strengths in family medicine and cardiovascular services, but does not contain many key training departments such as anesthesiology, neurology, etc.
- Clinical trials have not been generally supported.
- There are three four-year colleges in the Region: Barton College in Wilson, Mt. Olive College in Wayne County, and NC Wesleyan College in Rocky Mount. These schools confer some undergraduate degrees in the biological sciences, but have small faculty in biology and no laboratory research.

Table 3. Grant and contract funding for selected NC universities (all figures in \$ millions/yr)

| | 2005 NIH | 2006 NIH | Total grant/ contract 2005 / FY 04/05 | Total grant/ contract 2006 / FY 05/06 |
|--------------------|----------|----------|---|---|
| ECU | 4.51 | 6.42 | 33.08 | 37.97 |
| UNC-CH | 296.57 | 289.21 | 579.59 | 593.39 |
| NCSU* | 16.34 | 14.89 | 199.42 | 206.96 |
| Duke | 391.20 | 407.54 | 652.81 | 683.42 |
| Wake Forest Univ** | 125.54 | 106.88 | 231.50 | 238.97 |

*NCSU does not have a medical school so NIH funding is lower

**includes WFU Health Services

Sources: Office of Extramural Research - NIH web site and university web sites

In BioAbility's understanding, ECU's ability to become a significant research university (i.e., with over \$100 million in NIH funding) and build a research-based medical school has been hampered in the past by decisions by the State and University that had the effect of inhibiting research activity.

Some examples of this are:

- Allocation of faculty positions is based on teaching not on research. This is a detractor to bringing in good research faculty and keeps departments small in the sciences.
- Inability to form an engineering school or have the word engineering in the name of the college, as opposed to the department currently offering degrees. An initial small enrollment of engineering students at ECU is in place, but engineering faculty and resources need to be built up.
- At ECU, health insurance for doctoral students in the sciences is underwritten from the university's own operating funds. NCSU students are paid from a fund that was set up in 1998 expansion funds from the state legislature. Those monies cover tuition and insurance. UNC-CH also pays its students from well funded internal sources. This limits ECU's ability to recruit the better students.
- Insufficient buildings and laboratory space are available for new faculty, while other campuses get multi-million dollar expansion funds. Space for the dental school and chemistry department is limited at ECU due to lack of funding, while NCSU's Centennial Campus recently requested \$114 million for a library and has already been awarded \$17 million for planning of this facility.

It is BioAbility's opinion that ECU could be the strongest generator of new technologies and life sciences businesses in the Region, but this is far from being realized. ECU has moved to enhance its research by programs such as providing faculty research start-up funds to assist in recruitment, as well as funding internal competitive research programs.

6. Access to capital

Strengths

- + Some angel investors in the area
- + Strong local banking industry in the area
- + Local developers might help
- + Potential access to other funds from state, Golden LEAF, Eastern Region, etc.

Weaknesses

- Angels currently not investing in biotech
- Angels appear to invest in their city or town, but not the whole region

- No local venture capital offices
- Banks do not usually invest in risk enterprises such as biotech/life sciences startups

Related comments, ideas and issues

- The angel network is regional, but each person invests as an individual.
- Local angels have invested in local life sciences companies.
- Venture capital firms will invest where the deals are, so not having any located in the Region is not a problem. There are sufficient firms in the RTP area. The problem is they are not investing in early stage companies.
- Golden LEAF has invested in infrastructure. However, they require retaining some ownership of the intellectual property coming out of a bricks and mortar facility funded.
- For a long-term, high-cost project that would change the nature of the county or region, the staff at Golden LEAF will work with a group on a fundable grant.
- The Eastern Region is working on a micro-angel fund for local investment. The initial fund will be \$1.5 million, and investments will be less than \$300,000.

7. *Experienced entrepreneurs*

Strength

- + A few available in the area

Weakness

- Very few with experience in the biotech or life sciences arena

Related comments, ideas and issues

- There are plenty of entrepreneurs in RTP who might be attracted to the Region.
- The Region may need to be aggressive in recruiting and offer a package to attract people here.
- The level of entrepreneurial experience in the Region depends on what is being developed. For example, clinical trials experience is weak because new pharmaceuticals and vaccines are not being developed here.

8. *Entrepreneurial support mechanisms*

Strengths

- + Support from ECU programs, such as ECU's Entrepreneurial Initiative
- + NCBC regional office
- + Some support from community colleges

Weakness

- Limited experience in life sciences

Related comments, ideas and issues

- NCBC resources located in RTP are available for the entire state.
- The Eastern Regional Office of NCBC can be a catalyst.
- There may be opportunities from Seymour Johnson Air Force Base.
- The availability of support services, such as intellectual property attorneys and scientific reagents and supplies, was described as minimal in the area. However, the proximity of Wake County's resources gives companies in the NC BioEast Alliance Region a reasonable pool of talent.

9. Business friendly environment

Strengths

- + Strong economic development offices
- + Developers willing to go the extra mile
- + Some support for concessions to new businesses

Weaknesses

- History of lack of cooperation between some counties

Related comments, ideas and issues

- Despite a history of the counties not working together, the current reality is that the five counties will cooperate.
- All five counties have invested into this strategic planning study.
- The competition that does exist is friendly.
- Even under the current drought conditions, much of the five-county region has an adequate or even excess water supply. The Region would be capable of handling any expansion or new project that demands a large water supply. In addition, many of the municipalities have excess wastewater treatment capacity.

10. Skilled workforce

Strengths

- + Strong workforce availability for the basic jobs
- + Good training programs
- + Can draw on the five-county region
- + Can draw on the surrounding counties, especially from Wake County

Weaknesses

- Training and skills are mostly at the AA level and below
- Historically, no engineering school/sources of engineers within the Region
- Limited management availability

- Necessary to seek higher level personnel and executives from elsewhere, which incurs headhunting costs.

Related comments, ideas and issues

- The skilled workforce includes graduates of the five community colleges in the Region and ECU. In addition, there are three four-year colleges in the five counties, but their biology related faculty is minimal, and they have very few bioscience graduates (e.g., Barton College has only four biology faculty members, and at Mt. Olive College only seven of the 569 bachelor's degrees awarded in a recent year were in the biological sciences).
- There is an expressed need for a labor study that could better define the workforce from the Triangle area to Greenville. BioAbility strongly recommends that such a labor study be commissioned to define not only the available workforce vis-à-vis biotechnology/life science jobs, but focus on the needs of different types of life science companies and facilities to understand the capacity of the Region to meet future needs. BioAbility has learned that such a study will soon be commissioned.
- ECU will begin to graduate engineers in 2008. If there are opportunities in the Region, some will likely want to stay in the area.
- Even though ECU has a distance learning program, some life sciences managers we interviewed were not aware of it. This type of educational information may need to be included in marketing efforts.
- The distance learning program could develop courses specifically for enhancing the professional development of employees currently in the industry.
- Someone who relocates to this region for a job is making a big commitment because he or she has few alternatives if the job does not work out.

Opportunities and Threats

The biotech industry, which has been in existence for about 30 years, is entering a maturation phase. The science and technology have advanced to become more reliable and economically viable; there are more products in development; and biotech products are reaching the market in growing numbers. Of the 101 blockbuster drugs with global sales over \$1 billion in 2006, 18 are biotech drugs. By 2010, the global market for biotech drugs is estimated to approach \$70 billion.⁸ The current research and development pipeline contains more than 500 protein and 150 peptide drugs, suggesting that growth in biologics will continue.⁹ In addition, the healthcare model is shifting to a focus on personalized medicine. Growth is anticipated for the diagnostics and genomics companies that are integral components of the personalized medicine model of individualized treatments.¹⁰

As biotechnology companies grow beyond the research and development stages, they have new needs for facilities and support. The contract research organizations (CROs) that provide research services to drugs and devices before, during and after clinical trials have become a thriving business. Indeed, the state of North Carolina is the home to two of the top three CROs and at one time had more CRO related employees than any other state. Quintiles, headquartered in Durham, is the market leader, with 14 percent of the global market. PPD (Wilmington, NC) and Covance (Princeton, NJ), both garner 10 percent of the global market, the next highest market share.¹¹ Contract research, including clinical trial management in hospitals, has become a big business in North Carolina. This represents a large opportunity for the NC BioEast Alliance Region, with its medical school and hospitals.

Further, with company maturation, companies evolve from focusing on inventing things to having to make and sell things. New facilities are needed to manufacture, warehouse, and distribute goods. The five NC BioEast Alliance counties already have some of these types of facilities (e.g., Sandoz and Merck facilities), but there is potential for growth in this segment. These types of facilities require trained personnel that can be educated by North Carolina's community colleges. Additional facilities do not have to be juxtaposed to the R&D facilities or headquarters of a company.

Manufacturing biologics instead of small molecules is challenging and requires more costly equipment, skilled personnel, and specialized capabilities. According to the NCBC, there are at least 16 companies in NC with biomanufacturing facilities, which produce a wide range of products, including enzymes, vaccines, drugs, and amino acids.

Due to the expense, specialized capabilities, and risk inherent in setting up and operating a biomanufacturing facility, the use of contract manufacturing organizations (CMOs) is growing. Currently, CMOs conduct 65 percent of all microbial manufacturing capacity and 25 percent of mammalian cell culture capacity. The contract manufacturing market was estimated at approximately \$3 billion in 2006 and is forecast to reach \$5 billion by 2010.⁹

The counties in the BioEast Alliance have the opportunity to leverage the eligibility of businesses in those counties for certain tax credits. The NC Department of Commerce designated three of the counties in the NC BioEast Alliance Region as Tier 1 counties for 2008: Edgecombe, Wayne, and Wilson. The Tier system ranks the economic well-being of all NC counties, with Tier 1 counties considered the most economically distressed. Pitt and Nash are both designated Tier 2 counties. The purpose of the Tier system is to encourage economic development in the less prosperous counties. Article 3J Credits, a tax credit program created by the NC General Assembly in 2006, are tied to the county's Tier ranking with higher percentage credits in the lower tier counties. Article 3J offers credits for creating jobs, investing in business property, and investment in real property.

There are also a number of external threats to the development of a life sciences community in the NC BioEast Alliance Region. Other regions are developing programs to attract and retain life sciences companies, including several regions in North Carolina. The biotech industry is becoming increasingly global. Companies in the United States are expected to outsource more of their manufacturing needs and clinical trials to India and China.¹²

The general economy can also present a threat. Biotechnology companies have historically enjoyed periods of strong funding and support as well as times where venture capital and funding were scarce. Even within the field of biosciences, different sectors become 'Hot' or 'Cold' from the investment community's standpoint. For example, the so-called platform technology companies, which were funding magnets a dozen years ago, are no longer attractive to many funding sources. As another example, over 100 gene therapy-related companies were once able to readily attract funding. After more than 1,300 clinical trials worldwide, not one gene therapy has received U.S. approval, although a gene therapy product has been approved in China.¹³ Thus, gene therapy companies are not currently considered attractive investments.

While we see certain areas of the biotechnology and life sciences industry in the growth stages as mentioned above, our strategies are not geared to any one sector. Should the NC BioEast Alliance choose to focus on specific sectors using the recommended strategies, the areas of clinical trials management, drug manufacturing, medical device manufacturing, and warehousing

and logistics for life sciences products would be reasonable targets. However, additional targets will evolve with the successful recruitment of faculty members, growth of specific institutes, and repatriation of area 'alumni.' Thus, we have relied on the local strengths and weaknesses, and not external hot spots in the industry, from which to base our five recommended strategies.

V. RECOMMENDED STRATEGIES

Based on the assessment of strengths and weaknesses, interviews, and our experience with other regions, BioAbility recommends five strategies for the NC BioEast Alliance Region that BioAbility believes will contribute to the strengthening of the life sciences community in the Region. As stated earlier, ‘strengthening the life sciences community’ involves a mix of attracting and growing sites of primarily outside companies, while in the longer term increasing the research base and number of internally-grown companies. Our recommendations are a mix of near-term strategies plus some longer-term strategies for the overall strengthening of technology and entrepreneurship in the Region.

BioAbility believes there is potential to build two distinct but interrelated areas of the life sciences community in the NC BioEast Alliance Region. The first three strategies will aim to bolster current efforts and enhance the attraction of sites of existing companies to the Region.

This is a shorter-term set of strategies. The strategies for this will be to:

1. Unite the five counties into a functional marketing unit.
2. Foster a ‘repatriation’ program.
3. Create virtual representations for new life sciences sites and facilities.

The other two strategies aim to build more homegrown technology-based companies by strengthening ECU’s R&D efforts. This will add jobs and revenues to ECU and Pitt County, but will also lead to the development of new technologies and the creation of new companies.

Employees could be pulled from the entire BioEast Alliance Region. In addition, as new companies grow and expand, those companies may develop facilities in neighboring counties.

These are longer-term strategies.

4. Expand the faculty recruitment grant program to enhance the ECU research faculty.
5. Create a research institute at ECU to serve as an employer, attractant for additional grants, and developer of new technologies.

Other strategies might be obvious to help grow the Region’s life sciences community, but BioAbility attempted to limit its focus on strategies that it believes are implementable and reasonable, while having the desired impact on the Region. Thus, while the problems with K-12 education in the Region were the most strongly cited impediment to recruitment and quality of

life during our study, we do not believe it reasonable to make strengthening the K-12 educational system of all five counties a specific strategy for THIS project. Similarly, while access to long-distance transportation was also oft-cited as an issue, creating a major airport for the Region was seen to be beyond the scope of this project. Finally, although the inequities that appear to be experienced by ECU are major and have likely impeded the development of life sciences jobs and revenues in the Region, this problem is beyond our ability to affect a solution. See Section V on the Ideal World.

BioAbility also recommends an assessment and inventory of the availability of labor in the Region for life science related jobs. An important part of a strategy for growth is to commission a study to compare available workforce with the needs of different types of companies and facilities in the industry, from start-up biotech firms to manufacturing to warehousing.

BioAbility understands that an analysis of the workforce will be commissioned shortly by the NC Eastern Region, and we believe that the information that can be garnered from such an analysis will be important to attracting companies (even nearby ones such as from the RTP area) to the Region.

The Five Strategies

Strategy 1. Unite the five counties into a functional marketing unit.

The NEED:

The individual counties each have some resources for economic development, but these resources are limited. If the five counties work together, synergy can be created. The economic development professionals within the counties have all stated they would like to work together in a supportive, rather than competitive, capacity. For example, it is difficult to tout ONE community college or ONE small to medium research park or a few local companies, as one might find in each county. It would be more feasible to tout the whole package of five community colleges, a population significant enough to make a difference on workforce, a medical school, and any other shared resources.

Other regions have done this well, as seen in the examples described at the end of this section.

The STRATEGY:

The economic developers from the five counties have already pledged to work together to help attract companies to the Region. If the counties wish to appoint one person as the primary contact for the Region, this person should be well-versed in the industry and the needs of potential clients. In the life sciences, this will be primarily companies requiring a site for manufacturing, packaging, warehousing, or logistics. These foci are the best near-term targets due to the available employees, facility types, and space.

The exact nature of the strategy should be worked out by the four economic development groups along with North Carolina's Eastern Region, but we envision the final strategy to include much of the following:

- Create a Region-specific web site with a life sciences focus.
- Develop marketing collateral pieces for the Region's resources.
- Produce a video showing current CEOs, tenants, companies and sites.
- Lobby for the Council for Entrepreneurial Development's annual Biotech Conference to be held in the Region within the next three years.

- Presence at biotech/life sciences meetings, including the Council for Entrepreneurial Development's Biotech Conference and the Biotechnology Industry Organization International Convention.
- Possibly place some ads in *Genetic Engineering News*, *Nature Biotechnology*, *BioPharm International* and others.
- Host one to two annual events for the Region. Possibly an annual meeting for the life sciences companies in the Region to promote camaraderie, discussion, and site growth.

Funding for the web site and collateral design could come from the participants, from donations from the companies in the Region who might benefit from strengthening the Region, from NCBC, from North Carolina's Eastern Region, or possibly from a modest grant from the Golden LEAF Foundation. The results of the regional workforce survey will be an important component of the marketing strategy.

Desired OUTCOME:

The desired outcome will be more life sciences related companies moving into the area and creating more jobs. Secondary outcomes will be an increase in prospects, referrals, tours and generally people getting to see the Region first-hand.

Measuring SUCCESS:

Success can be measured by counting requests for literature and literature circulated, corporate inquiries, tours, and ultimately site selection and jobs in the Region. This should be measured annually. The activities suggested above can be altered to boost the outcome over time.

Examples: Regional biotech / bioscience marketing efforts

Florida: iCoast (<http://www.internetcoast.com/>)

Founded in 1998, iCoast (InternetCoast Economic Development Advisory Council) is a regional non-partisan organization of business, government, education, and community leaders in Southeast Florida. This area includes all of Broward, Miami-Dade, Palm Beach and the Treasure Coast. The vision of the organization is to "Create a world-class science and technology-based hub in the Southeast Florida region." The iCoast includes a board and 12 committees: Bio-

Science, CIO Council, Digital Divide, Education, Workforce Development, Entrepreneurship & Venture Capital, Governmental, Infrastructure, International, Marketing, Organization, and Technology Law. These entities address regional issues, track progress, and establish the direction of iCoast, while each committee has a specific role in developing or promoting the Region. Historically, iCoast has been funded through federal, state, local and private foundation grants totaling in excess of \$2.3 million to date. In the future, members will be asked to contribute funds as well.

Pennsylvania: Regional Biotech Council (<http://www.ihvr.org/rbc/>)

The Regional Biotech Council was started in 2000 and serves five counties in Southeastern Pennsylvania - Chester, Montgomery, Delaware, Philadelphia and Bucks. Its mission is to “provide a stimulating networking environment and strategic support for biotech entrepreneurs as well as small and emerging biotech companies” in Southeastern Pennsylvania. Council activities include regular meetings, special events, an annual conference, networking receptions, and access to resources and support services specifically for small biotech companies. Membership includes over 450 individuals and 95 biotech and biotech-related companies and organizations.

Arizona (<http://www.biozona.org>)

A collaborative group led by the governor’s office developed a bioscience identity for the state of Arizona. The result is a name (Biozona), tagline (Advancing Science. Enhancing Life.), and symbol that combine to create a logo. The logo itself may be used by bioscience organizations in the state to represent Arizona's collaborative efforts or by individual institutions. Examples of the types of materials that may include the logo are: collateral material, *PowerPoint* presentations, fact sheets, web sites, trade show banners, promotional giveaway items, and advertisements.

North Carolina’s Triad Region (<http://www.triadbitech.com/>)

The NC Triad web site is another good example of a local regional marketing effort for biotechnology. The web site contains information on the existing biotech and life science companies in the Region, as well as the relevant workforce. In addition, the site provides links to

both local and state support groups. The web site includes a video featuring local people in the biotech and life science industry and provides detailed information about each participant.

Strategy 2. Foster a repatriation program.

The NEED:

If the BioEast Region currently has few technology generators within the Region, then the likelihood of growth through local startups will be slim. This strategy is designed to attract new growth to the area by targeting people who have moved away. There are many individuals who have grown up in the NC BioEast Alliance Region, but have left the area and advanced their careers elsewhere. If the Region can identify these individuals, and remind them of the great quality of life they had in the Region, then some might be persuaded to move back; some might be persuaded to be ‘ambassadors’ for the Region within their own companies or with those of friends; and some might be persuaded to move their businesses or new sites of their companies to the Region.

The STRATEGY:

School records and alumni associations (reunion directories, alumni records, etc.) can help identify ‘alumni’ of the five counties who have left and become successful businesspeople, with a particular focus on those who have worked in the life sciences. In addition to alumni involved in manufacturing or research areas, this strategy can target people in the support services, such as equipment vendors, design and construction services, and validation. Of course, this strategy will help the economic developers in attracting businesses in other fields as well. Letters and emails can be used to contact these key expatriates, inviting them to consider either moving their companies back to the Region they grew up in and loved, or more likely to expand their facilities with a site in the Region. They can also be asked to be an ‘ambassador’ for the Region by talking to their friends and colleagues.

One other idea is to advertise in the local newspapers around the holidays. An ad touting the life sciences growth in the Region and stating that the area intends to expand in this industry might catch the eye of expatriates visiting family for the holidays. It might also catch the eye of the parents, family and friends of expatriates who might be able to contact others in their family or outside the Region.

Desired OUTCOME:

Identification of expatriates with ties to the life sciences industry in other areas of the state or country should open doors to potential economic development. If the Region's economic officers create methods for contacting these individuals, perhaps sharing them by county, and use the marketing collaterals developed in Strategy 1, there is a likelihood that this will lead to contacts, tours and potential site visits.

Measuring SUCCESS:

The success of this program can be measured in expatriates identified, follow-on calls, tours and site visits, and ultimately site development and jobs. These factors should be tracked on an ongoing basis and compiled annually.

Examples: Regional repatriation

A number of states and cities have campaigns to encourage natives to return to the area. These include Montana, Hawaii, South Dakota, Pennsylvania, and Syracuse. The campaigns range from the informal web-based network of volunteers that promotes Syracuse to a program sponsored by Pennsylvania that combines tax credits to new companies with research grants.

South Dakota

In October 2006, a workforce development initiative called Dakota Roots was launched in South Dakota. Dakota Roots is a joint venture between the Department of Labor, Department of Tourism and State Development, and the Governor's Office. Dakota Roots is a web-based program that matches job openings with job candidates. Businesses that participate can post job openings at no charge. Individuals who participate are assigned Department of Labor representatives who match candidates with job openings while maintaining confidentiality. By the end of the first year of operation, almost 1,400 individuals had contacted the program. Of those, 241 participants from 40 states had found employment in South Dakota and moved back to the state. Dakota Roots also assists businesses that are interested in moving to the state. This

initiative resulted in 26 companies expressing an interest in moving to South Dakota. Those businesses are currently working with the Governor's Office of Economic Development.^{14,15}

Pennsylvania

In 2004, Pennsylvania developed a program called Keystone Innovation Zones (KIZ) that was designed to keep top college students from leaving the state and to encourage the creation of science and technology companies. To be designated a KIZ, colleges, universities, and other post-secondary schools partner with local businesses and economic development organizations. The program provides incentives for the schools to transfer technology to companies that establish operations in their zone.¹⁶ By June of 2007, KIZ had awarded \$6 million in grants for research faculty. The program offers \$25 million in tax credits each year to companies in the KIZ that are less than eight years old and in the targeted industry segments. The program also encourages firms to offer paid internships to college students.¹⁷

Hawaii

Economic developers in Hawaii initiated a "Kama'aina Come Home" program in 1996. The efforts include a collaborative program by economic development councils to link employers and potential employees, federal funding to boost the high technology and defense jobs in the state, and networking efforts. There is a dedicated web site to link employees and employers, and job fairs are held periodically on the mainland. The effort is credited with bringing between 2,000 and 5,000 people back to Hawaii each year.¹⁸

Strategy 3. Create virtual representations for new life sciences sites and facilities.

The NEED:

Successful recruitment of businesses or the growth of homegrown businesses requires the availability of well-sited facilities. While suitable land appears to be available in all of the counties in the Region, existing buildings of various sizes, especially mid-size buildings in the 20,000 to 60,000 square foot size, are not readily available. In other regions we have worked with, availability of this size of building was a rate-limiting factor in the attractiveness of a region for biotechnology or life sciences firm growth or site selection. If the economic developers in the NC BioEast Alliance Region are successful in attracting companies to visit the area, there are few facilities they would be able to display. We were unable to see any significant available space in the Region, although one facility in Wilson is being vacated in March 2008 by Leiner Health Products. We believe it would be a viable strategy to enable the spotlighting of facilities for relocation or expansion. This could come in the form of pre-engineering and designing 'virtual' facilities that can be built rapidly.

The STRATEGY:

The Region can create virtual representations for new life sciences facilities, which will give the economic developers facilities to demonstrate to prospective clients, either online or in person. The concept of developing virtual facilities includes preparing sites for construction and developing computer-based virtual buildings that can be visualized on demand with a variety of attributes.

The virtual building option merges high technology with good business development practice. Land sites in a few or each of the five counties could be identified and pre-tested for use as a bioscience facility of various types, ranging from warehouse space to biomanufacturing facility. Sites can be certified using the NC Department of Commerce Life Science Industry Sector Team criteria for defining site attributes and variables. Having sites pre-certified would assist in recruitment by saving incoming companies both time and money. Once the engineering pre-certifications are attained, general drawings of various facility sizes and types could be created using CAD/CAM processes. Potential clients could not only see the physical site, but see

buildings of the size and design they select ‘created’ on the site in a virtual manner. It may also be possible to view the facility in a 3-dimensional virtual tour. Once the visualized site is approved, and more complete specifications are applied, construction can begin almost immediately on the ‘beyond shovel-ready’ site. Most importantly, Alliance members will be able to pique the interest of outside parties who will have attractive facilities to visualize.

As a next step, to promote speculative development of real facilities, the Region can arrange a loan loss guarantee. Key to this step will be the identification of a group or groups willing to guarantee the loans for the spec buildings or subsidize the developers. The State of Connecticut, a regional development project we completed about nine years ago, had almost no available space. At that time, companies were expanding by moving out of state. In order to address this need, we created a strategy whereby the Connecticut Legislature voted to guarantee loans to developers willing to build facilities on speculation. The Legislature approved this request and some 200,000 square feet of facilities were built. To our knowledge, the state never had to pay out for defaults on these loan guarantees. A similar program of loan guarantees would work in the NC BioEast Alliance Region.

Building a speculative life sciences facility is an expensive endeavor. The estimated cost of building office space is \$100/sf to \$150/sf in an existing shell, while new construction offices are typically \$150/sf to \$200/sf. Small projects are typically more expensive per square foot than larger projects. Laboratory space can probably be built for an estimated \$200 to \$350/sf depending on the complexity of the laboratory. Biomanufacturing facilities are typically \$750+/sf, including all offices, warehouse, utilities and biomanufacturing processes.¹⁹ In addition to real facilities, there may be adaptive reuse of existing retail, office, or industrial space. Although the conversion of such space is challenging in the life science industry due to the specific needs for research and manufacturing, this is one approach to compensate for the current limited availability of facilities.

The sources of funding for creating the virtual facilities or for the loan guarantees to build out the facilities can be the State, the Golden LEAF Foundation, or NC Eastern Region.

Desired OUTCOME:

The creation of virtual life science facilities for the local economic developers to ‘show off’ and make part of the marketing campaign should make recruitment more successful. The exact sizes and functions of the virtual facilities can be determined by the perceived demand as the other strategies begin. Loan loss guarantees that promote the speculative development of real facilities will make more square footage of life science facilities available. BioAbility believes that the availability of some facilities will make the Region much more attractive to clients.

Measuring SUCCESS:

Site certification and development of virtual facilities, the impact of these virtual facilities on the perceived attractiveness of the Region, and actual demand for these facilities can be estimated or measured.

Example: Virtual facilities***Knox County Development Corporation, Vincennes, IN***

The Knox County Development Corporation features a virtual facility on its web site: (<http://www.kcdc.com/virtual-bldg.html>) including floor plans, site maps, and a virtual tour. The corporation opted to develop the virtual facility instead of a spec building for several reasons. This concept allows maximum flexibility for modifying the facility at limited additional expense; it does not tie up capital; and it could still be in place before most organizations are ready to occupy. The majority of the cost of the project was the engineering design. The economic development group estimated that a design would cost approximately \$10,000, but received a discounted price of approximately \$5,000 because the design was completed by a member of the not-for-profit entity. To date, the development group has not been able to directly measure the impact of the virtual facility. The web site as a whole, however, sees tremendous activity. The group has received a considerable amount of feedback indicating that the feature attracts interest. At least one local prospect is interested in building the facility featured on the web site.²⁰

Strategy 4. Expand the Faculty Recruitment Grant (FRG) program.

The NEED:

ECU is a major state university and is home to one of the state's four medical schools. At the present time, the amount of life science research being undertaken at ECU is far behind that at Duke and UNC-CH, with only 1.5 percent and 2 percent of the NIH funding of these other schools, respectively. We are told that research departments are small, especially in life science departments in the Brody School of Medicine, where enrollments have been capped for over 30 years at low levels by the UNC General Administration, and funding for new faculty positions has not been tied to student credit hour production. As a result, novel research (as well as disclosures and licenses) is minimal. In the absence of such support, ECU has begun investing a portion of its increase in undergraduate enrollment funding to recruit strong research faculty. There is a strong indication that these investments have been paying off. For example, in the fall of 2001, the Carnegie Classification of Institutions of Higher Learning raised ECU's status to that of a doctoral research-intensive institution, a direct result of growing post-graduate education opportunities and increased research activity. By recruiting strong research faculty, additional faculty, new technology, companies, and funding will follow. For example, NCBC has indicated that \$36 is brought in for each dollar spent on faculty recruited with its FRG program.

The Association of University Technology Managers (AUTM) reports that trends that positively affect research funding also boost the type and number of invention disclosures. In 2006, members of AUTM:²¹

- Managed 18,874 new invention disclosures
- Filed 15,908 total U.S. patent applications
- Had 3,255 U.S. patents issued
- Signed 4,963 new licenses
- Launched 553 new startup companies

To build NC BioEast Alliance's biotechnology and life sciences community for the long term, new technology must be developed that leads to disclosures, patents, licensing and new business formation. Results from research on the U.S. labor market for the years 1990-1999 demonstrate that university R&D expenditures are positively related to the formation of new firms, and the

new firms are positively related to employment level and change.²² Research that results in a product is typically the result of numerous years of funding. According to AUTM, financial support for graduate students is often the defining factor in speed of early-stage technology development.²¹ In association with the economic development strategies listed above, new businesses will mean long-term job growth for the entire region. Technology based businesses would be expected to pay higher salaries than the warehousing or manufacturing jobs.

Without more researchers and research-based faculty at ECU, this effort will be limited. We have been told that ECU's Division of Research and Graduate Studies has initiated a plan to double the University's external grant funding through strategic investments. Over the period of 2005 to 2007, ECU invested \$5,602,180 in faculty research start-up funds to assist in the recruitment of strong research faculty. In addition, internal competitive research programs to enable existing faculty to acquire preliminary data for major grant received an investment of approximately \$760,000 per year.

Working against ECU are three factors that have evolved over a period of thirty years or more. First, with so few research faculty, there is a limited 'critical mass' of researchers, making it harder to attract good faculty. Second, the forces that have kept ECU's research at a low level have limited the attraction of ECU to recruiting other researchers. Third, with historically low levels of research investments, ECU's research faculty have limited means of developing new technologies. The strengths of the Research Triangle universities can be better utilized by the NC BioEast Alliance to drive growth in the Region. However, it would be more desirable to the development of the Region to have a stronger medical school and research faculty at ECU.

The STRATEGY:

In North Carolina and elsewhere (see Kentucky description below) great outcomes have come from statewide programs that provide funds to help recruit strong faculty. The North Carolina FRG program is, in BioAbility's opinion, the NCBC program that has done the most to establish biotechnology in the state of North Carolina. While there have been three faculty recruited at ECU under the FRG program, this is a small fraction of the recruits gained by UNC-CH and NCSU. In addition, two of the ECU recruits were recent. The FRG program that currently exists

specifically excludes Duke, NCSU, and UNC-CH. The current funding limit per school allows only one faculty member recruited every other year. This level would not be sufficient to have a significant impact on ECU.

We propose the strategy of revamping the FRG program, either working through NCBC, or using other sources of funding (e.g., Golden LEAF or North Carolina's Eastern Region). Faculty recruitment has a great track record, but the impact on ECU has been limited. We propose to focus recruitment on faculty to strengthen specific areas at ECU. Successful recruitment of three to four faculty per year will cost (at \$150,000 per recruit) \$450-600,000 each year, or about \$2.5 million over five years. We propose that NCBC spearhead a request to the legislature to provide additional funding and alter the existing FRG program. The expanded and modified FRG program would focus on the non-Triangle universities, especially ECU and UNC-Charlotte. With additional funding, the program could be used to fund multiple grants at each university for an increased impact. If State funds are not made available, some of the funds could come from NC Eastern Region, perhaps at a smaller level. Although Golden LEAF has not historically funded faculty recruitment, faculty recruitment that is tied to the development of an institute or center might be a component of a fundable grant. We would expect that the program to gather funds for this enhanced FRG program will be spearheaded by NCBC, NC Eastern Region, and ECU.

This program will require support from ECU as well, since appointments, salary, and space at the university will need to be guaranteed. The management of the recruiting program will also require support from ECU. Dr. Deirdre Mageean, vice chancellor for ECU's Division of Research and Graduate Studies, has expressed strong support for this idea and will help to guide the recruitment program.

Desired OUTCOME:

BioAbility would expect over the first five years to build strong research faculty by a total of 15-20 researchers. Strong faculty will attract (or bring!) NIH grants and other funding with them. In addition, the faculty research programs will employ related researchers, postdocs, graduate students and others, creating 70-100 more research personnel over the five years. We would

expect to find patent disclosures to double, NIH funding to more than double, patent applications to triple, and new companies formed to double over the five years.

Measuring SUCCESS:

Success will be measured first by the creation of this program and the availability of funds to recruit faculty. Following this, the success of recruiting can be measured in number of recruits, quality of recruits, associated personnel, and funding. Third, following recruitment, additional funding, disclosures, and possibly even direct commercialization can be assessed.

Examples: Faculty Recruitment Programs

North Carolina's FRG Program

Since 1986, a total of 52 researchers were attracted to North Carolina's Universities, both public and private, through the FRG program managed by NCBC. Up until 2001, the majority of these grants went to the three major Triangle universities. In fact, of the first 39 grants, all but one went to one of the three major Triangle universities. The one exception went to ECU in 1989 (\$55,646) to Dr. Edmund Stellwag. In addition to Dr. Stellwag, ECU received two recent grants, to Mary Thomassen in 2005 and Rickey Hicks in 2006, each for \$150,000. In addition, one FRG was awarded to UNCC, three to UNCG, two to Wake Forest, and one is in progress to NC A&T. Note that there were a few years (1995-6 and 2002-3) when the FRG program was on hiatus and grants were not awarded.

The average FRG grant was about \$250,000, but some of these grants were for multiple researchers or departmental programs (such as Professor Ron Sederoff's Forestry Biotechnology program at NCSU). When the four larger programs are removed, the average cost is just under \$200,000. The most recent grants, for 2005 through 2007, recruited seven faculty members and were for a flat \$150,000 each. These grants are targeted at non-research universities within the State, which includes ECU.

As of July 2007, the total amount spent on the FRG program was \$9,872,403.20. When ‘follow-on spending’ was calculated, however, that amount was \$362,799,695.07 or \$36.74 dollars returned per dollar spent. The follow-on amounts include direct and indirect grant funding and any company funding for companies founded by recruited faculty members.

NCBC records indicate that six companies originated with the research from those 52 recruits. Additional information on those companies is provided in Appendix III. A comprehensive study of commercialization has not been conducted on the recipients of FRGs. A study has been proposed to NCBC to determine what other commercialization has occurred from the recruitments, such as spin-offs of the technology, licensing, companies started by students and postdocs, etc.

Kentucky — Bucks for Brains

In 1997, the Commonwealth of Kentucky passed commonwealth bill HB1 *The Kentucky Postsecondary Education Improvement Act of 1997*. One portion of this bill is the Research Challenge Trust Fund or “Bucks for Brains.” This program calls for the creation of a trust fund whose interest revenues will be used for state universities to create endowed faculty positions. The money is combined with matching funds provided by the given university to create these endowed positions.

Through this Act, the Commonwealth of Kentucky has provided over \$350 million in funding to help improve postsecondary education through the eight state-backed universities. In 1998, the commonwealth allocated \$110 million as the first installment of the Research Challenge Trust Fund. Since this time, the commonwealth has two additional allocations to the research challenge fund, \$120 million in 2000 and another \$120 million in 2002. This program has helped universities in Kentucky drum up over \$280 million in private donations so far.

In fiscal year 2006, the Commonwealth of Kentucky received a 12 percent return on this fund, providing almost \$48 million in interest revenue. Of this money, the institutions are required to spend 70 percent on department chair and faculty positions.²³

To date, the Bucks for Brains program has provided 159 endowed chairs and 227 endowed professorships at Kentucky's public universities. In addition, approximately 30 percent of all new U.S. patent applications in Kentucky are generated by Bucks for Brains faculty. Of the Kentucky start-up companies that are dependent on technology created at a state university, 36 percent of the technologies were created by Bucks for Brains faculty.²⁴ During 2005 and 2006, the Commonwealth had five companies created using technology based on research conducted by Bucks for Brains researchers.²³

Georgia

The Georgia Research Alliance (GRA) recruits scientists to Georgia through the Eminent Scholars program. Researchers targeted are primarily in advanced communications and computing and the biosciences. The potential economic development impact of the research programs is expected to be high. To date, 55 faculty members have been recruited to Clark Atlanta University, Emory University, Georgia Institute of Technology, Georgia State University, Medical College of Georgia, or the University of Georgia. GRA has invested \$400 million in people, laboratories, and equipment for university research and development, with a return of nearly \$2 billion in federal and private funds.²⁵

Strategy 5. Build research institutes at ECU.

The NEED:

To help bring in additional researchers and attract larger funding levels, it is desirable to develop one or two institutes or research centers at ECU. These institutes will be good homes for FRG-recruited faculty, attract additional top researchers, and attract the larger program funding (both from government and private foundation sources) that comes with a focused research area.

Examples of this include the Institute for Regenerative Medicine at Wake Forest University, which continues to build its research staff and is currently spinning out multiple companies, and the Forest Biotechnology Research Group at NCSU, both detailed below. Creating two new institutes at ECU will help level the playing field and be good for the State in general.

The STRATEGY:

Identify two to three areas of research strength and gain administrative support for development of a major institute with dozens of faculty and researchers. ECU currently has cardiovascular and metabolic institutes, as well as a reputation in the cardiovascular/robotic surgery area.

Members of the ECU administration have provided information on the following two areas they would like to focus on and have already received support for this concept from the Chancellor.

The ECU Metabolic Institute

The existing Metabolic Institute is an interdisciplinary network of scientists, physicians, nurses, and allied health professionals that conduct research related to metabolic disease, primarily the complex challenges of obesity and diabetes. The proposed Metabolic Institute will have an organizational structure and be designed to facilitate enhanced cooperation, sharing of resources, and increased productivity. The mission of the ECU Metabolic Institute will be to develop, promote, facilitate, and support:

- 1) interdisciplinary and multidisciplinary metabolic research
- 2) education and training of undergraduate, graduate and post-graduate students for careers in research, medicine, nursing and health care professions related to metabolic disease
- 3) outreach education and prevention/treatment programs for the population of Eastern North Carolina

The Metabolic Institute currently has a core group of about 12 faculty members and an additional 30 affiliated faculty, but it needs a formal organizational structure, administrative support staff, dedicated research and clinical space, and seed funding for initiating new projects. Specific needs in each category include:

- Organizational structure – Recurring funds are needed for a permanent director, three additional faculty positions, an institute chief operating officer and three support staff
- Administrative support staff – chief operating officer, administrative secretary, RN program coordinator, and data clerk
- Dedicated research and clinical space – approximately \$10 million needed to up-fit unfinished shell space in the fourth floor of the ECU Cardiovascular Center
 - Four laboratories, each at least 1,500 sq. ft., adjacent to each other, to accommodate the needs of the new Director (year 1) and the three additional scientists (year 2) recruited
 - Offices for the Director and administrative staff (8 offices)
 - Conference room (for 30 occupants)
 - Clinical facilities for outpatient care and human research
- Seed funding

The Institute for Biomolecular Design, Analysis and Processing

ECU currently has a network of about 35 to 40 interdisciplinary research scientists with experience in the area of biomolecular design, analysis, and processing. The faculty members are spread across several colleges and departments, including the Departments of Chemistry, Biology, Physics, Allied Health, Engineering, and Biochemistry. The creation of this Institute would provide mentoring, leadership, and adequate resources (research space and start-up funds), for these faculty to collaborate in a synergistic way.

Specific needs for the ECU Institute for Biomolecular Design, Analysis and Processing include the following:

- Research space – research space is limited and much of it is old.
 - Faculty in the Brody School of Medicine occupy a building that is 25 years old. Cost estimates to renovate the research and clinical laboratory space (floors 3 to 8, 74,000 sq ft) are in the range of \$30 million.
 - No research space is available for new faculty in the science departments on the East Campus. Approximately 8,000 sq ft of unfinished space in the new Science and Technology building could be quickly up-fitted for approximately \$2.0 million, while plans for building a new facility are developed

- The College of Technology and Computer Science, which encompasses the engineering department, lacks research space. Both long and short term solutions are needed.
- Start-up funds – start-up packages in the \$400,000 to \$500,000 range per faculty member will help attract top people in a competitive recruiting environment.
- Access to PhD programs and students – Graduate enrollments are low because of a limited number of tuition waivers and low graduate assistantship stipends. An increase in permanent allocations to support training of an additional 80 students in these programs is needed in the form of graduate assistantships (80 at \$23,000 each), tuition waivers and health insurance (80 at \$17,000 each) for a total of \$3.2 million annually.

This strategy will take financial support, a focused grant writing program, and heavy recruitment. Recruitment can tie in with the FRG programs recommended above. Extended sabbaticals from foreign faculty (e.g., two-year visits) could help populate the researcher base of the new institutes. This effort will need to be spearheaded by ECU's research management, but should be supported by NCBC. Logical sources of initial funding for the Institutes would be the Golden LEAF Foundation, or the State. In June 2007, the Metabolic Institute received a \$1 million grant from Golden LEAF that will provide equipment and upgrades of laboratory space.

Desired OUTCOME:

BioAbility anticipates that this strategy would result in the development or expansion of two research institutes at ECU with at least 20 faculty each and at least \$10 million each in annual funding. These research institutes would employ at least 50 people in high-paying jobs, plus students. A longer term outcome will be the creation of new technologies, patents and commercialization. Within 10 years, BioAbility would expect to see two to three companies spun out of research from each institute.

Measuring SUCCESS:

Measures of success would include the initial development and seed funding of each institute, annual faculty and staff levels, and annual funding. Additional metrics would include the development of intellectual property, patents applied for, licensing fees and commercialization. All of these factors can be measured annually, and we would expect to see annual growth in each category over the first 10 years.

Examples: Research institutes

Case study: NCSU Forest Biotechnology Research Group – Ron Sederoff

The Forest Biotechnology Research group is a part of the Department of Forestry and Environmental Resources in the College of Natural Resources at NCSU and was established in 1985-1986. The purpose of the research group is to promote innovation in basic science to advance the application of molecular genetics to forest trees. This purpose is implemented through research, scientist training, and technology transfer. Interactions with other research groups, both at the university and worldwide, contribute to meeting these goals.

In 1986, research in forest biotechnology began with the addition of Dr. Anne-Marie Stomp to the NCSU faculty. In May 1987, the NCBC awarded \$680,000 over two years to the School of Forest Resources at NCSU for development of a forest biotechnology program. The grant was intended for equipment, facility renovations, and faculty recruitment of Dr. Ron Sederoff, a leading tree molecular biologist. The intent of the grant was also to establish a National Center of Excellence in Forest Biotechnology, which would explore the genetic improvement of Southern pines. Dr. Sederoff, a world leader in forest biotechnology, was appointed to lead the new Center effective July 1, 1987. Dr. Stomp and Dr. Hou-min Chang worked closely with Dr. Sederoff putting together laboratory facilities for the program and writing research proposals to support the program's work. Dr. Sederoff continues today as the co-director of the Forest Biotechnology Group. In 2002 Dr. Vincent Chiang, was recruited as the other co-director of the program.

Currently, the Forest Biotechnology staff has grown to 15 employees. The group consists of the two co-directors, two associate professors, one assistant professor, one research assistant, and four research associates, one statistician, and four additional laboratory employees.

NCBC states that as of July 2007 follow-on funding generated from the initial \$680,000 grant totals \$11,183,642. This figure is compiled from Dr. Sederoff's CV, and any survey responses NCBC received from him in the past.

Other faculty members have also been awarded grants that have brought in additional funding for the Forest Biotechnology program. Dr. Leonel M. van Zyl has brought in over \$390,000 from 1997 through 2007. Dr. Chiang has been awarded over \$3 million since 2005. Several of these grants are shared by multiple institutions.

Other accomplishments credited to the initial NCBC grant are the awarding of five patents to Dr. Sederoff, which are assigned to NCSU. Dr. Chiang is the holder of 15 patents. Two of Dr. Chiang's patents are assigned to NCSU, two are held personally, eight are assigned to the University of Michigan, and three are assigned to International Paper Company.

Additional technology transfer successes credited to the Forest Biotechnology Group include the establishment of a start-up company, ArrayXpress Inc., founded in 2003. Using proprietary technology, ArrayXpress designs, produces, and statistically analyzes microarrays for clients at a lower cost than the industry standard. Dr. van Zyl currently serves as the company's Chief Scientific Officer, while retaining his position in the Forestry Biotechnology Group.

Further, in 2004, the NCSU Forest Biotechnology Industrial Research Consortium (FORBIRC) was established with 11 participating companies worldwide. The Consortium is directed by Dr. Chiang and coordinated by Dr. Sederoff and Dr. Chang. FORBIRC promotes innovation and advances in forest, wood, and paper science using the most advanced forest biotechnology by creating a collaborative platform involving leading global forest products industry participants and NCSU. Members of the Consortium pay dues that fund research projects and bring in additional funding to the program.

An additional commercialization success achieved by Forest Biotechnology faculty is Dr. Stomp's formation of the biotechnology company, Biolex Inc. Biolex genetically engineers duckweed to produce therapeutic proteins, such as insulin. Biolex of Pittsboro, NC has registered with the Securities and Exchange Commission and plans to raise as much as \$70 million during its initial IPO. After starting the company, Dr. Stomp returned to NCSU as an Associate Professor of Forestry.²⁶

Case study: Wake Forest Institute of Regenerative Medicine – Anthony Atala

Until 2003, Dr. Anthony Atala was a well-established, internationally known surgeon and researcher in the field of pediatric urology and urologic tissue engineering at Children’s Hospital at Harvard. In 2003, Dr. Atala was recruited to Wake Forest University and Bowman Gray Medical School to head the newly formed Wake Forest Institute of Regenerative Medicine.

In the field of surgical urology, ten techniques or technologies developed by Dr. Atala and his team have been used clinically. He is the editor of seven books and has published more than 200 journal articles or book chapters, more than 250 abstracts, and has applied for or received over 200 national and international patents. He has numerous honors and awards including the Christopher Columbus Foundation Award (2000), funded by the U.S. Congress, which is bestowed on a living American who is currently working on a discovery that will significantly affect society, the Gold Cytoscope award (2000) for outstanding contributions to the field of urology, the 2002 Morehouse Space/Medicine Life Sciences Research Center award for contributions to medical science, the 2002 Scientific American Research Leader in Medical Treatments award, has been named one of the “Best Doctors in America” since 2002, the Grand Award from Popular Science for What is Best from 2006, and one of the “Fast 50” of 2006 from Fast Company magazine.

When Dr. Atala arrived in Wake Forest, he brought with him a 20 person team of researchers and the promise of bringing one of his companies that he had formed in Boston. Today, the Institute of Regenerative Medicine has over 100 scientists and researchers, has filed over 20 patent applications, has its own building in the Piedmont Triad Research Park in downtown Winston-Salem, and two of Dr. Atala’s companies, Tengion and Plureon, have operations in Winston-Salem. Recently, Plureon has generated considerable news and press for Dr. Atala, Wake Forest University, and Plureon, with the announcement of finding amniotic fluid-derived stem cells with physical characteristics of both embryonic and adult stem cells. Tengion has also generated news recently with the announcement that the company will be initiating its third Phase II clinical trial of regenerated human bladders derived from the patient’s own cells. This trial will be based in the United States at five hospitals to treat 10 patients with non-neurogenic over-active bladder. Tengion employs approximately 30 people in North Carolina.²⁷

According to sources familiar with the recruitment effort, the negotiations required between Wake Forest University, Dr. Atala, and Children's Hospital were some of the most complex and detailed because of the number of patents Dr. Atala had filed and had approved while at Children's. Most of Dr. Atala's patents for his companies were licensed from Children's and Harvard and which patents would be allowed to be brought with him to Wake Forest were the subject of intense negotiations. Wake Forest will not reveal how much the University and Medical Center paid to recruit Dr. Atala, saying only that they were investing in the "growth and development" of the University and School. Dr. Atala currently has over \$13 million in grant funding.²⁸ Additionally, in 2005, a \$150,000 grant from the NCBC was approved for the recruitment of another researcher to the Wake Forest Institute of Regenerative Medicine, although it was not awarded.²⁹

VI. BEYOND OUR STRATEGIES: THE IDEAL WORLD

This report is intended to catalog strengths and weaknesses of the Region relevant to the bioscience industry and to provide recommended strategies that build on those strengths to reinforce and expand the life sciences industry in the Region. But what would the ‘ideal’ picture look like? It should be noted that, while the strengths of the NC BioEast Alliance Region are numerous, in our studies it is clear that many attributes of the Region are not ideal. Many of the issues that need greatest attention are far beyond the scope of this study or possible recommended strategies. In addition, their impacts are on many business sectors, not just the biosciences. For example, the greatest weakness in the area, cited by business managers and economic developers alike, is the K-12 public education system. Ideally, this system would be strengthened to the point of providing an excellent education and serve as an attractant instead of a deterrent to companies considering moving facilities to North Carolina.

Other types of trained personnel, now sought from the RTP area or beyond, would ideally be available within the Region. The development of a stronger engineering department at ECU with additional programs, faculty, and graduates would help provide for growth of existing companies and attraction of outside companies, which in the bioscience field frequently hire engineers. Trained managers in the bioscience field also generally come from outside areas at this time. As the critical mass of bioscience companies grows in the NC BioEast Alliance Region, however, so will the cache of available seasoned management for these companies. Currently 45.6 percent of adults in neighboring Wake County and 40.7 percent in Durham County have an education level that includes a bachelor’s degree or higher, while in Nash, Wilson or Wayne Counties that percentage is between 15.1 and 18.3 percent, and in Pitt County, the home of ECU, that number is 30.8 percent (see Appendix IV). These lower percentages, along with much smaller populations, give the Region a smaller population of highly educated individuals to serve as managers and higher level employees. Ideally there would be more, and over time, with local company growth, a greater percentage could be realized. BioAbility recommends that a detailed study on employee availability and projected industry requirements and demand for bioscience employees in the Region be commissioned to help guide future educational programs and understand shortfalls in specific subgroups of employees.

Ideally, ECU would represent the eastern part of North Carolina with a strong research faculty, grant levels more in line with those at the other medical schools and research universities in the state, and its own research and teaching hospital. Ideally this would lead to the generation of technologies that would lead to disclosures and subsequent patents. Some of these would be licensed out to companies, generating income and further research support. Still other technologies would be the basis of new company start-ups in the Region.

Also desirable would be improved connectivity of the Region with other locations. Airports in the Region would ideally add flights to other destinations. For example, Pitt Greenville Airport is reportedly trying to negotiate flights to Atlanta, GA and Washington Dulles International Airport in addition to the existing flights to Charlotte. It would also be advantageous if RDU added another daily flight to Europe. Within the Region, to create a smoother traffic flow for employees, a better road connecting Greenville and Goldsboro would be desirable.

As the RTP area and later the Triad area have discovered, it takes a critical mass of companies, deals and investments before outside funding sources are willing to travel to the area or even build local equity investment group offices. To build new bioscience facilities and companies requires local money. Ideally, local angel investors will be comfortable investing in the historically risky biotech industry.

Finally, the NC BioEast Alliance was created to attract enough companies to provide a critical mass in the Region, specifically in the bioscience sector. While these five counties have a history of friendly relations, there has also been a history of competition, such as for creating a regional airport (which therefore did not happen). Strategies allowing the five counties to work together to attract a number of sites of existing companies, while growing their own new companies largely through technology developed at ECU, will provide employment for citizens of all five counties.

The purpose of the strategies contained herein is to build strengths in the NC BioEast Alliance Region vis-à-vis the attraction and growth of bioscience businesses. They are intended to make

the area more attractive to outside groups and to increase the likelihood that the Region will be stronger as a source for new companies. While we have no ability to affect changes in the public education system or provide a strong regional airport, we have created strategies that can be expected to make a positive impact on the building of the bioscience community in the Region.

Appendix I. Participants in this Project

Participants

Table 1 includes the people interviewed by BioAbility, either in person during the regional tour or via telephone. Tables 2 and 3 list the people who participated in each SWOT meeting.

Table 1: Interviews conducted (includes ones from regional tour)

| Name | Title | Affiliation | County |
|------------------|--|---|------------------|
| John Chaffee | Director, Eastern Office | NC Biotechnology Center | |
| Charlie Harrell | Chairman | Edgecombe County Commissioners | Edgecombe |
| Frank Harrison | President | Carolinas Gateway Partnership | Edgecombe / Nash |
| John Gessaman | President and CEO | Carolinas Gateway Partnership | Edgecombe / Nash |
| Oppie Jordan | Vice President | Carolinas Gateway Partnership | Edgecombe / Nash |
| Mark Sorrells | Senior Vice President | Golden LEAF Inc. | Edgecombe / Nash |
| Marilynn Anselmi | Director | ECU/NCSU Rocky Mount Region Academic Programs | Nash |
| Bill Cooper, Jr. | Manager | NCCS BioNetwork | Pitt |
| Christy Weeks | Department Chair, Biotechnology program | Pitt Community College | Pitt |
| Deirdre Mageean | Vice Chancellor for Research, Graduate Studies, Economic and Community Development | East Carolina University | Pitt |
| Greg Smith | Curriculum Coordinator | NCCS BioNetwork | Pitt |
| Hans Engels | Site Manager | DSM Pharmaceuticals | Pitt |
| Kelly Andrews | Associate Director | Pitt County Development Commission | Pitt |
| Marilyn Thompson | Director, Finance & Administration | Pioneer Surgical / Encelle | Pitt |
| Marti Van Scott | Director, Office of Technology Transfer | East Carolina University | Pitt |
| Marty Hackney | Director, ECU Entrepreneurial Initiative | East Carolina University | Pitt |
| Paul Kauffmann | Chair, Professor of Engineering | East Carolina University | Pitt |
| Phil Hodges | Entrepreneur/owner | Metrics Inc. | Pitt |

| Name | Title | Affiliation | County |
|-----------------|---|--|---------------|
| Ron Hill | Vice President, R&D | Pioneer Surgical Orthobiologics | Pitt |
| Ted Morris | Associate Vice Chancellor for Economic and Community Development | East Carolina University | Pitt |
| Wanda Yuhas | Executive Director | Pitt County Development Commission | Pitt |
| Walter Pories | Professor of Surgery Chief, Metabolic Institute | East Carolina University | Pitt |
| Paul Gemperline | Professor Department of Chemistry | East Carolina University | Pitt |
| Eric Gonder | Senior Veterinarian | Goldsboro Milling | Wayne |
| Gene Smith | Department Head, Math & Science | Wayne Community College | Wayne |
| Jim Partridge | Facility Manager | AAR Cargo Systems | Wayne |
| Joanna Thompson | President | Wayne County Development Alliance Inc. | Wayne |
| Bill Conover | Director, Engineering, Maintenance & HSE | Sandoz | Wilson |
| Jennifer Lantz | Executive Director | Wilson Economic Development Council | Wilson |
| Joanna Ross | Research Manager | Wilson Economic Development Council | Wilson |
| Norris Tolson | President and CEO | NC Biotechnology Center | Outside |

Table 2. Participants at the September 18, 2007 SWOT meeting

| Name | Title | Affiliation | County |
|---------------------------|---|--|---------------|
| Billy Wooten | Vice President, Operations | Kanban Logistics Inc. | Edgecombe |
| Mark Heilman | Operations Manager | SePro Research & Technology Center | Nash |
| Ralph Rogers | Dean, Technology, Engineering, and Computer Science | East Carolina University | Pitt |
| Marti Van Scott | Director of ECU Office of Technology Transfer | East Carolina University | Pitt |
| Marty Hackney | Director, Entrepreneurial Initiative | East Carolina University | Pitt |
| Wanda Yuhas | Executive Director | Pitt County Development Commission | Pitt |
| Kelly Andrews | Associate Director | Pitt County Development Commission | Pitt |
| Ed Wilson | Retired / President | Wayne Community College | Wayne |
| Bill Byrd | President | Mount Olive College | Wayne |
| Joe Huffman | City Manager | City of Goldsboro | Wayne |
| Jimmie Edmundson | City Executive and Regional Vice President | BB&T | Wayne |
| Lt. Col. Phillip Brown | BioEnvironmental Flight Chief | Military/SJAFB | Wayne |
| Joanna Thompson | President | Wayne County Development Alliance Inc. | Wayne |
| David Lundie | Vice President and Plant Manager | Purdue Pharmaceuticals, L.P. | Wilson |
| Cindy Ingram | Assistant Director | Wilson Economic Development Council | Wilson |
| Bill Bullock | Vice President, Bioscience Industrial Development | NC Biotechnology Center | Outside |

Table 3. Participants at the October 22, 2007 SWOT meeting

| Name | Position | Institution | County |
|-----------------------|---|-------------------------------------|---------------|
| Al Delia | President and CEO | North Carolina's Eastern Region | |
| John Chaffee | Director, Eastern Office | NC Biotechnology Center | |
| Oppie Jordan | Vice President | Carolinas Gateway Partnership | Edgecombe |
| Frank Harrison | President | Carolinas Gateway Partnership | Edgecombe |
| Rep. Joe P. Tolson | Representative | NC General Assembly | Edgecombe |
| Ralph Rogers | Dean, Technology, Engineering, and Computer Science | East Carolina University | Pitt |
| Marti Van Scott | Director of ECU Office of Technology Transfer | East Carolina University | Pitt |
| Marty Hackney | Director, ECU Entrepreneurial Initiative | East Carolina University | Pitt |
| Wanda Yuhas | Executive Director | Pitt County Development Commission | Pitt |
| Kelly Andrews | Associate Director | Pitt County Development Commission | Pitt |
| Hans Engels | Site Manager | DSM Pharmaceuticals | Pitt |
| Ron Hill | Vice President, R&D | Pioneer Surgical Orthobiologics | Pitt |
| Bill Byrd | President | Mount Olive College | Wayne |
| Capt. Kylie Maclellan | Captain | Military/SJAFB | Wayne |
| David Lundie | Vice President and Plant Manager | Purdue Pharmaceuticals, L.P. | Wilson |
| Jennifer Lantz | Executive Director | Wilson Economic Development Council | Wilson |
| Jeffery Odum | Principal | NCBioSource | Outside |
| Cynthia Sollod | Science and Technology Development Program Manager | NC Biotechnology Center | Outside |

Appendix II. BioScience Companies in the NC BioEast Alliance Region

| County | Company Name | Primary Activities Performed |
|---------------|---------------------------------|-------------------------------------|
| Nash | Hospira Inc. – Rocky Mount | Production and Manufacturing |
| Nash | Spring Hope Biofuels LLC | Production and Manufacturing |
| Pitt | CardioVascular Resonances | Research and Development |
| Pitt | Carolina Medical Products | Production and Manufacturing |
| Pitt | Chirazyme Labs | Production and Manufacturing |
| Pitt | CTMG Inc. | Contract Research and Testing |
| Pitt | DSM Pharmaceuticals | Production and Manufacturing |
| Pitt | Ectocelle Inc. | Research and Development |
| Pitt | Fuji Silysia Chemical USA LTD. | Production and Manufacturing |
| Pitt | Metrics Inc. | Contract Research and Testing |
| Pitt | Microbe Management Inc. | Contract Research and Testing |
| Pitt | PhytoMyco Research Corp. | Research and Development |
| Pitt | Pioneer Surgical Orthobiologics | Research and Development |
| Wayne | Monsanto – Mt. Olive | Research and Development |
| Wilson | Leiner Health Products | Production and Manufacturing |
| Wilson | Merck & Company Inc. Wilson | Production and Manufacturing |
| Wilson | Microbac Laboratories Inc. | Contract Research and Testing |
| Wilson | Purdue Pharmaceuticals LP | Production and Manufacturing |
| Wilson | Sandoz Inc. | Production and Manufacturing |

Source: NCBC Research Library February 6, 2008

Appendix III. NCBC Faculty Recruitment Grant Spin-out Companies

This is only a partial list. A comprehensive study of commercialization has not been conducted.

Company Name: **Liposcience Inc.**

Address: 2500 Sumner Boulevard, Raleigh, NC 27616

Web site: www.liposcience.com

Number of Employees: 110

Funds raised: Series E Financing closed in 2003 \$15 million

Investors include Three Arch Partners, U.S. Bancorp Piper Jaffray Ventures, GE Capital Equity Investments, A. M. Pappas & Associates and INVESCO Private Capital.

Series F Financing closed in 2006 \$13 million

Investors include Camden Partners, LLC; GE Capital Equity Investments; INVESCO Private Capital; Pappas Ventures; Sightline Partners; Three Arch Partners; and Varian, Inc.

Other info: Registered for IPO in March 2002 but withdrew registration in October 2002.

Company Name: **Asklêpios BioPharmaceutical, Inc.**

Address: 510 Meadowmount Village Circle Number 112, Chapel Hill, NC 27517

Web site: www.askbio.com

Number of Employees: Unclear

Funds raised: Preclinical Trials \$1.6 million (Muscular Dystrophy Association) 2004

Human studies 2nd phase \$2.5 million (Muscular Dystrophy Association) 2006

Other info: Recipient of highest grant ever from Muscular Dystrophy Association for a for-profit organization.

Company Name: **NanoCor Therapeutics Inc.**

Address: 870 Martin Luther King Jr. Boulevard, Chapel Hill, NC 27514

Web site: www.nancorthx.com

Number of Employees: 30-40

Funds raised: Preclinical Research, Business Development \$500,000 (NIH)

Exclusive Licensing \$3.75 million (Medtronic)

Other info: Spun off from Asklêpios BioPharmaceutical, Inc. (AskBio) in November 2005.

Company Name: **Vesta Therapeutics Inc.**

Address: Suite 8 801 Capitola Drive, Durham, NC 27713

Web site: www.vestatherapeutics.com

Number of Employees: Unclear

Funds raised: Phase I Small Business Innovation Research Grant \$100,000 (NIH) 2005

Other info: Funded by Toucan Capital. Technology initially developed by Incara Pharmaceuticals Corporation and later sold to Vesta Therapeutics.

Company Name: **SoyMeds Inc.**

Address: None found

Web site: None found

Number of Employees: Unclear

Funds raised: Unclear

Other info: Spun out of UNC Charlotte Biology Department
Winner of Five Ventures award 2006

Company Name: **Biolex Therapeutics Inc.**

Address: 158 Credle Street, Pittsboro, NC 27312

Web site: www.biolex.com

Number of Employees: 105

Funds raised: 2nd Round \$36 million 2005

Investors: Polaris Venture Partners, Intersouth Partners

3rd Round \$30 million closed May 2007

Investors include: Intersouth Partners, Quaker BioVentures, Polaris Venture Partners, Mitsui & Co. Venture Partners, Johnson & Johnson Development Corporation and Dow Venture Capital.

Appendix IV. Education Level and Median Earnings of Selected Counties

Note: Data on Edgecombe County were not available.

Education level in 2006 by county (population 25 years or older)

| | Pitt | Wilson | Wayne | Nash | Wake | Durham | Orange |
|------------------------------------|-------|--------|-------|-------|-------|--------|--------|
| High school graduate or higher | 85.3% | 77.4% | 80.6% | 82.6% | 89.9% | 84.7% | 89.3% |
| Bachelor's degree or higher | 30.8% | 17.3% | 15.1% | 18.3% | 45.6% | 40.7% | 52.9% |
| Less than 9th grade | 5.6% | 9.8% | 7.7% | 8.0% | 4.2% | 6.3% | 4.1% |
| 9th to 12th grade, no diploma | 9.1% | 12.8% | 11.7% | 9.4% | 5.9% | 9.0% | 6.6% |
| High school graduate or equivalent | 26.4% | 35.2% | 34.0% | 35.9% | 19.1% | 21.8% | 20.5% |
| Some college, no degree | 20.3% | 17.0% | 21.4% | 18.6% | 16.8% | 15.7% | 10.5% |
| Associate's degree | 7.9% | 7.9% | 10.1% | 9.7% | 8.4% | 6.5% | 5.4% |
| Bachelor's degree | 20.3% | 13.2% | 10.1% | 13.3% | 29.9% | 23.0% | 25.7% |
| Graduate or professional degree | 10.5% | 4.0% | 4.9% | 5.1% | 15.6% | 17.7% | 27.2% |

Source: U.S. Census Bureau, 2006 American Community Survey

Median earnings in the past 12 months in 2006 inflation-adjusted dollars (population 25 years or older)

| | Pitt | Wilson | Wayne | Nash | Wake | Durham | Orange |
|------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Less than high school graduate | \$19,272 | \$22,626 | \$16,668 | \$14,012 | \$16,287 | \$19,093 | \$18,869 |
| High school graduate or equivalent | \$23,918 | \$25,422 | \$23,130 | \$25,859 | \$25,056 | \$23,139 | \$24,621 |
| Some college or associate's degree | \$26,356 | \$26,900 | \$27,251 | \$32,409 | \$34,234 | \$29,859 | \$31,853 |
| Bachelor's degree | \$40,481 | \$43,620 | \$34,901 | \$41,138 | \$48,640 | \$39,236 | \$36,469 |
| Graduate or professional degree | \$49,842 | \$41,724 | \$51,985 | \$49,271 | \$66,155 | \$52,198 | \$65,602 |

Source: U.S. Census Bureau, 2006 American Community Survey

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