



By Regan Stewart

Creating innovative products to improve health and quality of life has been a major global economic driver in the past year. Biotechnology is one of the fastest growing sectors of the U.S. economy. Technology has significantly altered the healthcare scene, which has spurred developments in medical devices and created alliances among the many subdivisions within the field.

There aren't yet discrete roles for those who discover, develop, and sell the fruit of biotechnology research; all the players are involved along the entire cycle of product development. Today there is new money flowing into the life science industry again from the public and private equity markets. State governments continue to allocate resources to support biotech efforts. Governments across the nation have seen the economic value in biotech and are identifying their own opportunities to grow the life sciences industry. States' resources for business including location, infrastructure, talent, and education are important factors keeping the major biotech companies rooted while attracting a new generation of innovators. Finding the right match of opportunities, skills, and resources is becoming the determining factor for success in the industry. At this still-early stage, the U.S. states offer varied strengths in biotechnology. Each is working to reinforce academic and industry collaboration, introduce incentives, and foster research and development (R&D) with the anticipation of a growing biotechnology workforce.

U.S. BIOTECHNOLOGY'S LEADING LOCATIONS

Looking for the top places in the country to locate a biotechnology business? We don't claim to have the definitive answers, but we have devised an interesting way to compare the success and importance of different states when it comes to biotech. Our rankings below use information contained in the study released in June by the Battelle Memorial Institute and the State Science and Technology Institute (SSTI) for the Biotechnology Industry Organization (BIO). That study divided the biotechnology industry into four major subsectors: Agricultural Feedstock & Chemicals, Drugs & Pharmaceuticals; Medical Devices & Equipment, and Research & Testing. The study provides numerous data on a

state-by-state basis for each subsector. The data we focused on is a measure called the location factor, which is available for each of the four subsectors mentioned above. If you can handle a little math, the location factor (a standard measure in economic geography) is the percentage of the state's workforce that is employed by the subsector divided by the percentage of the national workforce employed in the subsector. A location factor greater than one means (theoretically) that the state produces more economic activity in that subsector than it consumes—i.e. it's an economic leader and net exporter of biotechnology. If a state has a high location factor for biotechnology, it is outpacing the national average for employment in the industry, making it a clear leader and model for other locations. Which states lead the pack? Take a look. (The location factor is listed in parentheses.)



DELAWARE OFFERS DIVERSITY IN ALL BIOTECH SECTORS

The Battelle industry study (see opposite page) that lists all 50 states' growth, employment, and economic impact from their respected life science industries found that Delaware was the only state in the nation to have a specialization in all four bioscience subsectors, including agriculture feedstock and chemicals, drugs and pharmaceuticals, medical devices and equipment, and research and testing.

Biotechnology in Delaware planted its roots in the R&D standards set by the DuPont Company 200 years ago. The life science industries have diversified in the 21st century, creating companies that offer diagnostic and analytical equipment; medical devices; biological products, information technology products and services; pharmaceutical research, development, and manufacturing; as well as chemical products and ingredients for food and cosmetics.

"Life sciences and biotechnology is an innovative, diversified, and rapidly expanding field in the state of Delaware," says Judy McKinney-Cherry, Director, Delaware Economic Development Office (DEDO). "Results of the Battelle study clearly illustrate that Delaware is the only state in the nation that has specializations in [all] four key bioscience sectors."

The life sciences cluster in Delaware seems poised for sizeable further growth, and state officials aim to have Delaware become a global leader in R&D and scientific breakthroughs. The National Institutes of Health (NIH) have awarded a five-year, \$16.7 million grant to the Delaware IDeA Network of Biomedical Research Excellence (INBRE), a group of the state's academic and medical institutions that is led by the University of Delaware and the Delaware Biotechnology Institute (DBI). The program, which will be managed by the institute, represents a collective effort involving the University of Delaware, Delaware State University, Delaware Technical and Community College, Wesley College, and the Christiana Care Health System.

An extensive pool of scientists and engineers make up a healthy workforce to support this cluster. The life science and biotechnology cluster has a rapidly increasing workforce of approximately 15,000 employees representing 398 companies. The state possesses a strong foundation of industry leaders such as DuPont, Hercules, Intervet, Agilent Technologies, Syngenta, and the U.S. headquarters of AstraZeneca, one of the largest pharmaceutical companies in the world. Delaware's life science and biotechnology cluster is also supportive of start-up companies, and the state has received a \$250,000 grant this year that will be used to promote biotech careers in Delaware.

The state and DEDO have recognized the transformational potential of this cluster by making significant investments. Governor Ruth Ann Minner's New Economy Initiative has also bolstered this cluster by increasing the state's capacity to provide seed-stage venture capital funding, entrepreneurial support across several technology sectors, and by adding significant funds to the state's Experimental Program to Stimulate Competitive Research (EPSCoR). (The program is a joint program of the National Science Foundation and several U.S. states and territories.) Proactive efforts in the field of biotechnology such as the New Economy Initiative were one of the reasons Gov. Minner received the Biotechnology Industry Organization (BIO) Governor of the Year award in 2004.

In 2004, two new life science companies relocated to Delaware. ANP Technologies is a nanobiotechnology company that develops products used in bio-defense, homeland security, biopharmaceutical drug discovery/development and pharmacoproteomics. The start-up relocated from Aberdeen, MD to Newark, DE.

ParagonRx also relocated from Pennsylvania to Greenville, DE this year. The company provides a unique service to the pharmaceutical industry by offering risk management programs that help companies increase sales of drugs that potentially have significant side effects by making them safer to use for patients.

The Delaware Technology Park, a 40-acre research park adjacent to the Newark campus of the University of Delaware is home to both the Fraunhofer Center and DBI, which play major roles in Delaware's Life Science cluster. DBI, a \$22.5 million, 72,000-square-foot research facility, is focused on research, education, and economic development and is leading scientific discovery in human health, agriculture, and advanced materials. The life science cluster promises innovations and breakthrough research in the areas of agriculture including biofuels, genetically engineered crops, and vaccines.

"Our economy is evergreen, and Delaware's legislative and executive branches have demonstrated the support of these new economy bioscience businesses," says McKinney-Cherry. "Between our businesses climate and workforce, we have an economy that responds to

various different stimulus efforts and packages. We have made concentrated efforts in the area of bioscience, and it is beginning to show through studies and data that these efforts are bearing fruit."

AGRICULTURAL BIOSCIENCE

Iowa's continued investment in its research capabilities has greatly benefited the state. Iowa is home to a diverse range of bioscience companies, including companies involved in biomass conversion, traditional biotechnology, pharmaceuticals, and medical devices. But its national leadership role is primarily in the agricultural industry—specifically bioenergy and biofuels—which is demonstrated by its biosciences research universities, the University of Iowa and Iowa State University, with supplemental expertise by the University of Northern Iowa.

"Iowa has a long and proud tradition of world-class research coming from its colleges and universities," says Mike Blouin, director of the Iowa Department of Economic Development. "Perhaps one of the greatest benefits that comes from our investment is the way Iowa's educational institutions partner with companies both small and large, new and established, to conduct mutually beneficial research. The connection between company health, job creation, and cutting-edge research and technology is undeniable in Iowa."

Recent investments in bioscience R&D facilities include the Iowa Values Fund, which has dedicated \$27 million to university and independent college research and development infrastructure over the next seven years. The three public research universities will receive funding focused on multiuse goods manufacturing processes approved by the FDA; protein purification facilities for plant, animal, and chemical manufactured proteins; upgrading FDA drug approval laboratories in Iowa City to a larger, multiclient, goods manufacturing processes facility; and crop and animal livestock facilities for growing transgenic crops and livestock.

Currently, Iowa's employment in the biosciences industry is 24% higher than the national average, with jobs paying \$12,000 more than the state's median income. This large employment base is concentrated in organic and agricultural chemicals, with a focus on industrial applications geared toward energy, industrial commodities, and specialty health products. It also suggests that additional investment in growing the biosciences industry will create new opportunities for Iowa.

Iowa has established strengths in plant and animal sciences. Encouraging the state's using of plant and animal biomass and waste streams to generate chemicals, energy, fuels, and materials for industrial and commercial applications will enhance even more growth. Deploying the production in agriculture, food science, nutrition, and processing technology to develop and produce functional foods and nutraceuticals will continue the sustainability of bioscience firms in Iowa.

BIOTECH IN THE SOUTH

The state of Tennessee also has an advantageous agricultural biotechnology infrastructure. "Ag bio is one of those disciplines that other states overlook," says Eric Cromwell, Director of Technology Development Division for the Tennessee Department of Economic and Community Development. "I don't think Ag research is as appreciated elsewhere as [it is] here. There is opportunity for us to capitalize on that."

Tennessee officials realize that a valuable business environment for life sciences, coupled with the state's long-standing logistical strengths, make it a great place to distribute biotechnology-related goods—especially when short shelf life is involved. "It really provides a competitive advantage," says Cromwell.

Home to the FedEx Superhub, Memphis, TN offers a prime distribution advantage for biotech businesses since this area can move goods faster than any other part of the country. With major trucking firms and an extensive network of trucks and rail, Memphis and Tennessee are a national crossroads. Cromwell describes the state as benefitting from an "old industry meets new industry" approach.

Memphis is also home to the University of Tennessee Health Science Center and several medical research centers, including St. Jude Children's Research Hospital.

Nashville, TN is regarded by state officials as the "healthcare services industry capital," and is well known for nurturing entrepreneurial, innovative healthcare companies. Biotechnology represents a strong growth segment in Nashville with support from academic and research institutions such as Vanderbilt University and Medical Center. Strong infrastructure support, a planned life sciences center for growing companies, and access to capital are all means by which Nashville hopes to grow its biotechnology sector.

The Knoxville/Oak Ridge, TN communities represent established and substantial research centers. The Oak Ridge National Laboratory, managed by Battelle and the University of Tennessee, along with the UT Medical Center and the UT Environmental Biotechnology Center, are encouraging biotechnology development and commercialization.

Technology 2020, a project aimed at making full use of the technology resources in East Tennessee, has partnered with the Tennessee Technology Development Corporation to create the TennesSeed Fund. The fund is designed to encourage growth of technology venture capital and start-up technology companies by making equity investments of \$500,000 to \$3 million for companies in early growth stages.

Finally, the Tri-Cities area of Upper East Tennessee (made up of Johnson City, Bristol, and Kingsport) has impressive and established biopharmaceutical and chemical research-based industries. Eastman Chemical Co., King Pharmaceuticals, and East Tennessee State University's College of Medicine are all valuable contributors to the state's biotechnology focus.

PRIME LOCATION FOR GLOBAL PHARMA

New Jersey is arguably the center of the world's pharmaceutical industry as well as a center for growing interdependence between the pharmaceutical and biotech sectors. The state already accounts for nearly one-quarter of the dollars spent on research and development in the nation by pharmaceutical companies.

New Jersey is the home to one of the world's top five biotechnology clusters in the nation, generating \$1 billion in 2002, with more than 120 businesses and 8,000 employees. The pharmaceutical sector here includes names that have defined the industry throughout the twentieth century, such as Bristol-Myers Squibb, Johnson & Johnson, Novartis, Pfizer, Wyeth, Novo Nordisk, Merck, and Schering-Plough.

Industry-specific education is helping to grow the bioscience workforce in New Jersey. Rutgers—the state's university system—now offers an MBA in pharmaceutical management, and the Robert Wood Johnson Medical School offers a joint M.D./M.S. degree in biomedical informatics.

"New Jersey has created an environment that welcomes companies on the cutting edge. We still are the location for ideas; we have more scientists, engineers, and technicians per capita than any other state," says Virginia Bauer, CEO and Secretary Designate of the New Jersey Commerce & Economic Growth Commission.

New Jersey bioscience research parks encourage academic and industrial interaction. The New Jersey Economic Development Authority redeveloped the New Jersey Technology Centre in North Brunswick on a 50-acre former Johnson & Johnson facility between Rutgers and Princeton universities. Along with an expanding wet-lab incubator, the facility has 330,000 square feet within several new and renovated buildings with three major life sciences tenants.

Academia and industry have increased collaboration on research in New Jersey. The state's 2005 budget included \$8.8 million in new funding for the New Jersey Commission on Science and Technology. Since the creation of a new and improved Business Employment Incentive Program (BEIP), New Jersey has seen the creation of the Garden State Life Sciences Fund. Under the BEIP guidelines, biotechnology companies can win grants by creating as few as 10 jobs.

A COMMUNITY OF COMMUNITIES

Most of the new investment in North Carolina's biotech sector has occurred in the Raleigh-Durham-Chapel Hill area that surrounds Research Triangle Park (RTP)—the largest research park in the country. RTP has 140 companies employing over 38,000 employees across 7,000 acres. RTP is located near three major research universities: Duke University, North Carolina State University, and the University of North Carolina-Chapel Hill. In the adjacent North Carolina pine forest there exists an additional 1,100 acres for development.

"One of the main attractors for biotech and pharmaceutical companies is the research facilities, which provide incredible resources," says Jamie Nunnally, Director of Communications, Research Triangle Park. "There is an endless resource of new great minds coming out of the universities."

The Research Triangle does not have a dominant central city. Rather, it is made up of four mid-sized cities, several smaller towns, and numerous rural communities. The schools form the core of what makes RTP successful.

The University of North Carolina-Chapel Hill and Duke University have outstanding medical schools, says Nunnally. "Many companies like to form relationships with our graduate schools and students to conduct clinical trials with the universities."

Pharmaceutical and biotech companies in the RTP area include Bayer CropScience, BASF, Biogen, BioTraces, Diosynth Biotechnology Services, Eisai, McMahan Research Laboratories, Syngenta, Aeolus Pharmaceuticals, and Eli Lilly.

HOSPITALS, SCHOOLS, AND INDUSTRY COLLABORATE IN MASSACHUSETTS

Some of the reasons Massachusetts is famous for its biotechnology cluster: Harvard Medical School, Children's Hospital, Brigham & Women's, Beth Israel, UMass, Joslin Diabetes Center, and Mass General Hospital. All provide opportunities for collaboration with research and development units of biopharmaceutical businesses.

Massachusetts also has the largest concentration of colleges and universities in the world. Harvard, MIT, Northeastern, Tufts, Boston College, Boston University, the University of Massachusetts, Worcester Polytechnic Institute, and the Massachusetts College of Pharmacy and Health Sciences and many others provide opportunities for collaborative research, technology transfer, and a large pool of talented potential employees.

"Massachusetts has all of the right ingredients," says Deborah Shufrin, Chief of Staff for the state's Department of Business and Technology, "[including] a highly educated workforce; world-

renowned research institutions, particularly in the areas of science and technology; strong public organizations; and access to venture capital funding."

The medical device industry in Massachusetts is both an ongoing vital contributor and a stabilizing factor to the state's economy, providing high paying manufacturing jobs, contributing to total state exports, attracting significant amounts of venture capital investment, and utilizing local suppliers.

MassMEDIC, the Massachusetts Medical Device Industry Council, has data that indicates from 1997-2002 annual shipments of medical devices increased by 25% from \$4 billion in 1997 to \$5 billion in 2002. The total payroll of the medical device sector grew from \$989 million in 1997 to \$1.24 billion in 2002.

In 2002, the total economic impact of the medical devices sector in the state equaled \$7.3 billion. In 2003, 10% of all exports from Massachusetts were from the medical devices cluster. Joseph Leghorn, Board Member of MassMEDIC, says that Massachusetts has moved away from being viewed as a high-cost area. The state and local governments are willing to work with companies, he says.

"It is possible to locate in areas where there are reasonably priced [homes] and good schools," says Leghorn. "This is a situation where it is a good sized state and people know each other." At any cost, it's likely that Massachusetts will continue to be attractive to biotech companies. "With the highest number of science and technology graduate students in the country and the greatest number of science and engineering PhDs awarded on a per capita basis," says Shufrin, "it is no wonder that Massachusetts ranks among the top three states in the nation in the number of patents awarded per capita."