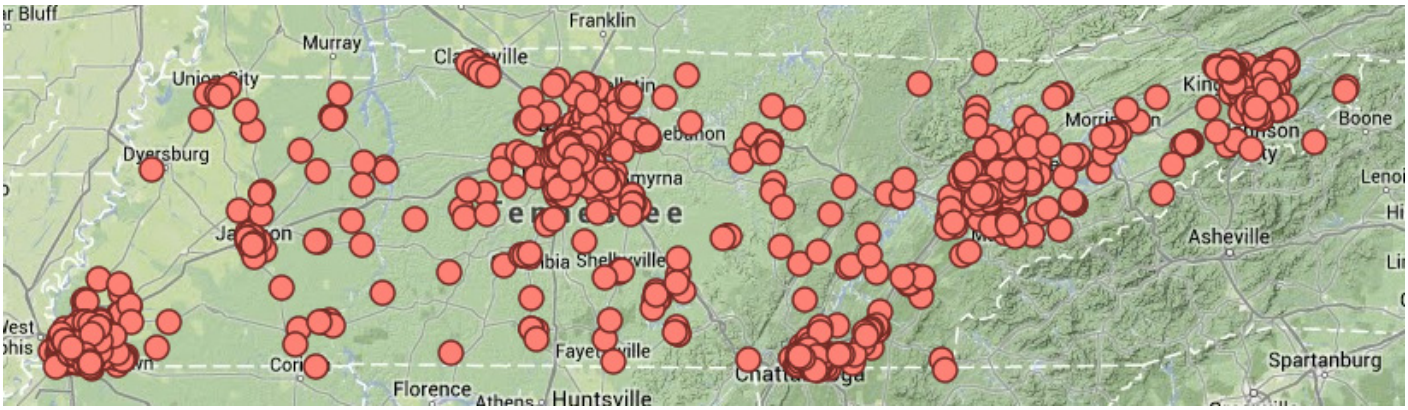
LIFE SCIENCE
tennessee

Tennessee's Life Sciences Industry

Targeted for Growth

Tennessee's Life Science Industry: Targeted for Growth

Worldwide, the life science industry has experienced dynamic growth over the past decade and is expected to continue its upward trajectory into the future. Tennessee has successfully positioned itself to be a substantial participant in that growth with plans to expand its footprint in the sector over the next five to 10 years.



Tennessee's 1,200 plus life science companies are situated all across the state.
Google Fusion Table, Data from the Tennessee Department of Economic and Community Development

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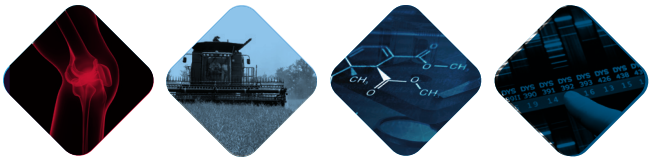


EXECUTIVE SUMMARY

The life science industry heals, fuels and feeds the world. It is one of the fastest growing industry segments in the United States, employing more than **1.6 million** people in the research and development of pioneering therapies, medical devices, improved agricultural products and practices, as well as alternative energy production processes and industrial products.

This diverse and rapidly growing industry already has contributed significantly to Tennessee's economy. Tennessee now has an immense opportunity to target the life sciences for future investment, and create a catalyst for the state's economic growth.

Tennessee's life science industry improves the health and quality of life here in Tennessee and across the globe.

More than 1,200 life science establishments exist in Tennessee, employing more than 38,000 Tennesseans. Those employees earn an average salary of $75,673 annually, 81 percent higher than the average private-sector wage of about $41,759. Nationally, every new life science job creates 5.8 additional jobs. Despite the recent recession, during the 10-year period from 2001 to 2010, the U.S. bioscience industry gained jobs, despite overall job losses in U.S. private sector industry employment.

Research and private investment in life sciences has been substantial in Tennessee, and it is expected to grow in the coming years. More than $1.1 billion was privately invested in the industry in Tennessee from 2004 to 2009 alone. From the government side, the National Institutes of Health (NIH) infused $450 million in life science research in 2012.

Bioscience Industry Employment in Tennessee; source BIO/Battelle 2012 Jobs Report for Tennessee.

TENNESSEE BY THE NUMBERS		
	> 1,200	Life science businesses and organizations
	> 38,000	Employees in the life science industry
	$76,000	Average annual wage of a life science employee
	$1.1 billion	Private investment in life science from 2004-2009
	$450 million	NIH funded research in Tennessee in 2013

Total Tennessee Bioscience Jobs by Sector

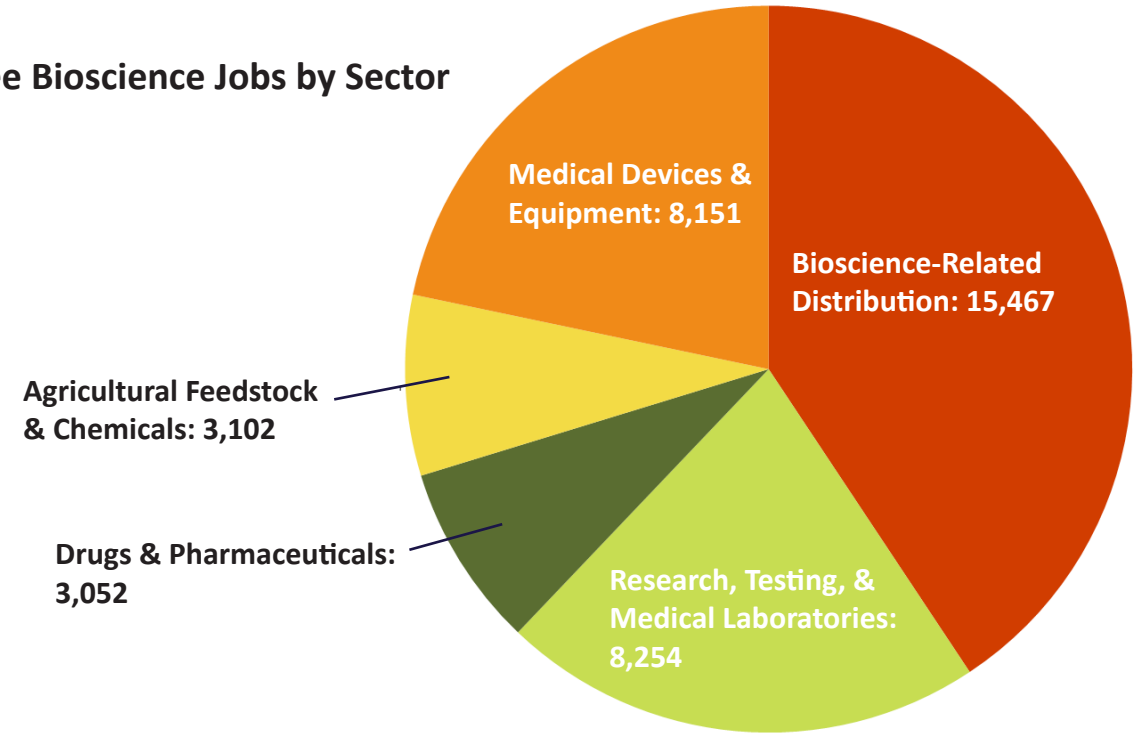


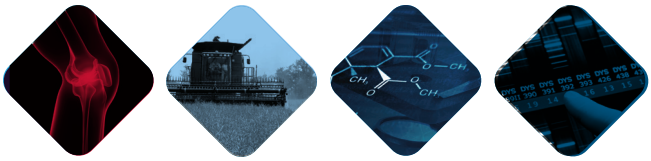
Figure: BIO/Batelle 2012 Jobs Report Update for Tennessee

The industry includes five sectors:

Medical Device – West Tennessee ranks seventh among all states for the size of its medical device manufacturing industry. The Memphis area is the second-largest center for orthopedic devices in the U.S. In 2009, medical device companies paid approximately $275 million in wages to Tennessee residents.

Pharmaceuticals – Led by the state's strong presence of clinical research organizations and academic research institutions, Tennessee ranks among the top states in the nation for the number of active clinical trails. Major pharmaceutical companies not only have distribution centers in Tennessee, but also manufacture and package some of the best-known pharmaceutical brands including Augmentin®, Allergra®, Dr. Scholl's®, and Claritin® to name a few.

Research, Testing and Medical Laboratories – Tennessee is home to several world-class research institutions and numerous development and biotechnology companies. With more than $2.2 billion in combined annual research among its academic and federal research institutions, these organizations are working with investors and entrepreneurs to move innovations to market.



TARGETED FOR GROWTH

Agricultural Feedstock and Chemicals – Tennessee is known for its specialized employment base in agriculture feedstock and chemicals. In Tennessee, that subsector is two times more concentrated than that of the nation. Organizations and companies such as University of Tennessee Institute of Agriculture, the Tennessee Department of Agriculture, Memphis Bioworks Foundation, Ag Innovation Group, the NextFarm Accelerator and Genera Energy are already helping to develop more successful agricultural technology businesses across the state.

Bioscience-Related Distribution – Tennessee has a specialized employment base in this subsector with businesses in Tennessee growing 12.9 percent from 2001-2010, totaling over 780 establishments.

All three major regions across the state have businesses and major institutions involved in the life sciences:	
West TN	Memphis is home to St. Jude Children's Research Hospital, and is the second-largest center for orthopedic devices in the U.S., as well as a leading distribution and logistics hub for the entire industry.
Middle TN	Nashville is home to Vanderbilt University, one of the nation's top federally funded research universities and medical centers. The area is home to some of the state's largest biotechnology companies, medical laboratories and numerous other life science companies, and serves as a hub for many of the nation's largest health care services companies.
East TN	East TN is one of the state's premier locations for biofuels, pharmaceutical and chemical research and commercialization. The area is home to Oak Ridge National Laboratory, one of the largest federal laboratories in the country, a major chemical company and the University of Tennessee as well as other colleges and universities.

Leading life science companies in Tennessee including Smith & Nephew, Medtronic, Wright Medical (Biomimetic Therapeutics), MicroPort Scientific, Cumberland Pharmaceuticals, GTx, Aegis Sciences, Provectus, ICON, and several leading pharmaceutical companies have a significant impact on Tennessee's economy.

INDUSTRY CHALLENGES AND OPPORTUNITIES

Life Science Tennessee is a statewide, non-profit, member organization whose mission is to advance and grow the life science industry in Tennessee through advocacy, partnerships and alignment with economic and workforce development.

Members include companies, universities, research institutions, government and economic development groups, and other industry associations involved in the discovery and application of life science products and related services that improve the health and well-being of people throughout the world.

Life Science Tennessee conducts business and economic development activities; advocates on behalf of the industry; educates the public about the benefits of life science research and product development; and provides a network for the exchange of ideas, information and opportunities.

Life Science Tennessee has identified three key ingredients critical for the expansion of the industry: 1) the facilitation of technology transfer and commercialization; 2) the development of the life science workforce; and 3) ensuring access to capital for emerging companies.

In 2011, Life Science Tennessee developed a report on tech transfer and commercialization identifying critical barriers to new technology development, including improving commercialization practices at the state's universities. Life Science Tennessee has since launched a Venture Forum designed to showcase emerging companies and technologies, and to increase their exposure to investors and industry experts.

In 2012, the association conducted a survey of the state's life science companies' workforce needs and identified a gap in available talent with adequate industry experience. Life Science Tennessee works with various partners across the state to increase feedback to academia on necessary skill sets, and to expand the number of internships available to students.

In 2014, Life Science Tennessee will focus on the third key ingredient for a strong life science industry, access to capital, analyzing tools and policies that foster capital formation.

Life Science Tennessee's Workforce Development, Entrepreneurship and Economic Development, Policy and Advocacy and Programming committees bring together industry executives, academia, policy makers and world-renowned experts to identify challenges and to develop common solutions to ensure that life science companies and organizations continue to thrive in Tennessee.

THE LIFE SCIENCES: A HIGH GROWTH AND HIGH WAGES INDUSTRY

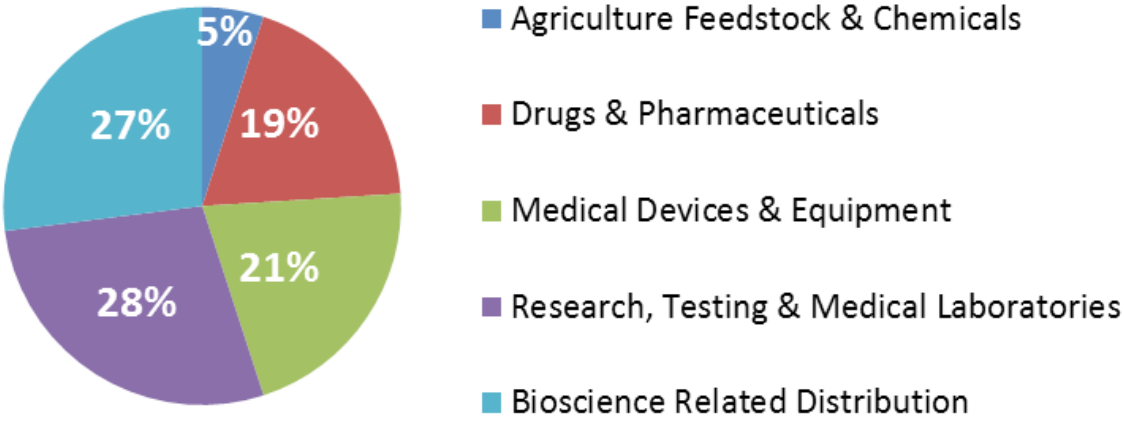
The life sciences are a diverse group of sectors and activities with a common link: they apply knowledge of the way in which plants, animals and humans function. The industry spans different markets and includes manufacturing, services and research activities. It includes companies in the fields of biotechnology, pharmaceuticals, biomedical technologies, life systems technologies, nutraceuticals, cosmeceuticals, food processing, environmental biology and biomedical devices. The industry also includes organizations and institutions that devote the majority of their efforts in the various stages of research, development, technology transfer and commercialization. By definition, the life sciences are a unique industry cluster that are constantly changing to incorporate the latest research and scientific discoveries.

Broadly defined, the industry includes the following five sectors:

- agricultural feedstock, chemicals and biofuels,
- drugs and pharmaceuticals,
- medical devices and equipment,
- research, testing and medical laboratories, and
- bioscience related distribution.

Bioscience related distribution is a newly recognized sector dealing with logistics, warehousing and distribution of biomedical products across the marketplace. West Tennessee is home to many bioscience related distribution companies given the influence of FedEx.

Employment Composition of the U.S. Bioscience Sector, 2010



Source: Battelle/BIO State Bioscience Initiatives, May 2012

High Wages, High Growth

In the U.S., the overall bioscience sector paid average annual wages of $82,697 in 2010, $36,380 more than the average annual wage of the total U.S. private sector. Real earnings for bioscience industry workers have increased by 13.1 percent since 2001, compared with 4.4 percent for the U.S. private sector. Nationally, every one new life science job creates 3.2 additional jobs, generating a ripple effect that Tennessee experiences as well.

In Tennessee, there are more than 1,200 life science establishments, employing more than 38,000 Tennesseans. Those employees earn an average wage of $75,673 annually, 81 percent more than the average private-sector wage of about $41,759.

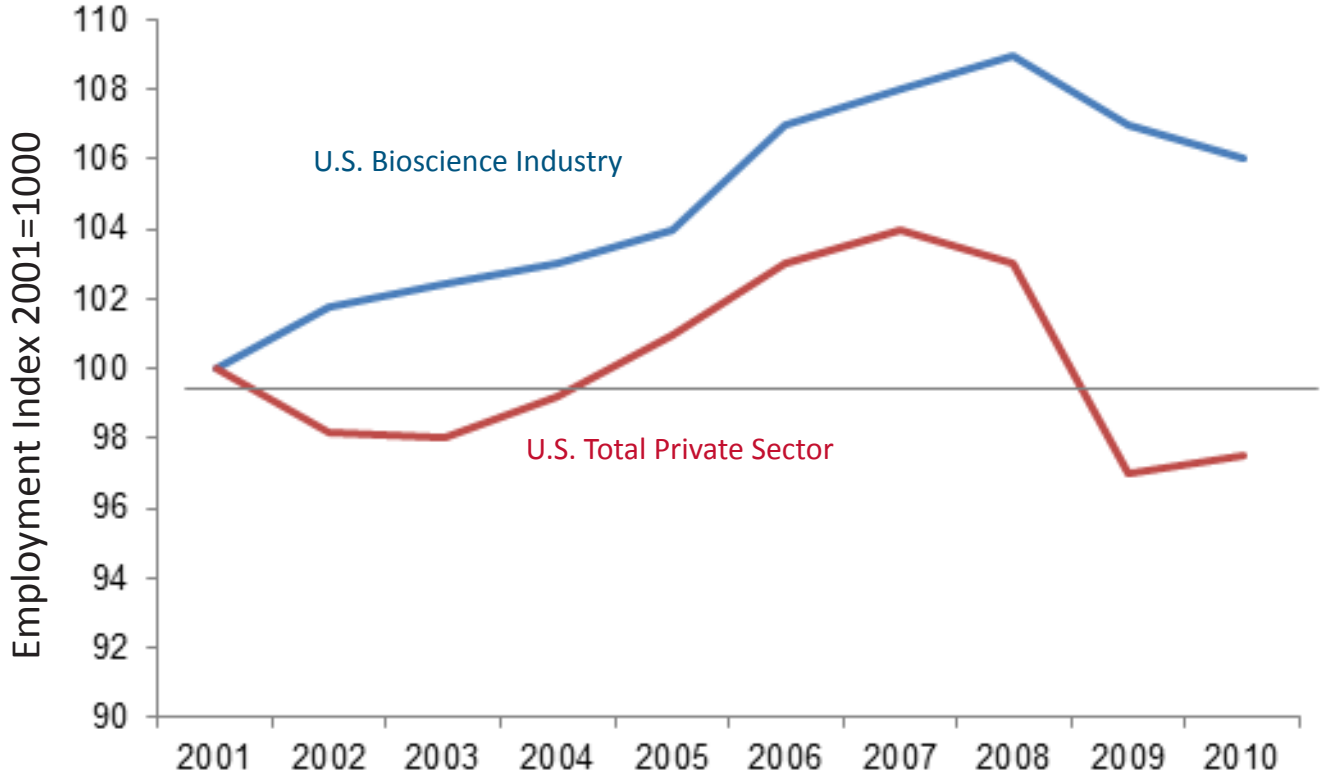
U.S. Average Annual Wages per Employee, 2010

Drugs & Pharmaceuticals	**$99,486**
Finance & Insurance	$84,516
Research, Testing, & Medical Laboratories	$84,065
Total Biosciences	**$82,697**
Bioscience-related Distribution	**$80,049**
Professional, Scientific, & Technical Services	$77,313
Information	$74,382
Medical Devices & Equipment	**$72,301**
Agricultural Feedstock & Chemicals	**$90,869**
Manufacturing	$57,511
Construction	$49,588
U.S. Total Private Sector	**$46,317**
Transportation & Warehousing	$44,198
Real Estate, Rental & Leasing	$43,779
Health Care & Social Assistance	$43,732
Retail Trade	$26,655

Source: Battelle/BIO State Bioscience Initiatives, May 2012

Nationally, bioscience employment growth – led by research, testing and medical labs – greatly outpaced overall national employment growth in 2001–2010. There are an estimated eight million bioscience jobs.

U.S. Bioscience and Total Private Sector Employment, 2001-2010



Source: Battelle/BIO State Bioscience Initiatives, May 2012 Insert Figure: U.S. Bioscience and Total Private Sector Employment, 2001-2012

Looking to the future, the biosciences remain positioned for strong economic growth. The U.S. Department of Labor projects that the biosciences will see industry growth of 21.2 percent over 10 years for the life sciences, making it one of the fastest-growing industry sector.

THE LIFE SCIENCES BY SECTOR

West Tennessee's medical device industry is the seventh largest in the country. The state has one of the biggest and most specialized shares of employment in the agriculture, feedstock, chemical and biofuels industry. Employment is growing rapidly in the medical device and research fields, as well, putting Tennessee at the cusp of a specialization in the medical device industry sector.

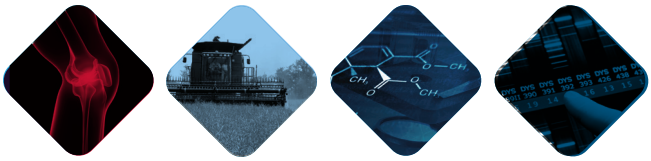
Agriculture, Feedstock and Chemicals, Biofuels

Agriculture technology includes new innovations in seeds, modern agricultural equipment and techniques, and a host of other technologies related to food safety, diagnostics and novel health. The sector includes new crops, new varieties of existing crops, new traits, inputs, diagnostic tools, livestock improvement, food safety, precision agricultural tools, new markets in biofuels and bio-based products, local logistics systems and improved farming techniques. The opportunity for new agricultural technology businesses runs across the spectrum of agriculture and there are many areas in which new businesses can thrive.

Bales of switchgrass, seen here on display at the 2012 University of Tennessee Biomass Field Day, are a non-food source crop used for making biofuels. Photo by P. McDaniels, UT Institute of Agriculture. (ag.tennessee.edu)

Organizations and companies such as University of Tennessee Institute of Agriculture, Tennessee Department of Agriculture, Memphis Bioworks Foundation, Ag Innovation Group, NextFarm Innovation Accelerator and Genera Energy are already helping develop successful agricultural technology businesses across the state. There are many examples of companies throughout Tennessee already thriving in this sector such as Dupont Tate & Lyle in Loudon, BASF in Chattanooga, Cargill in Knoxville and Memphis, and PMC Biogenix in Memphis.

In addition, startup agricultural-technology businesses are being developed across Tennessee, providing a great foundation for future innovation. Examples include Southern Natural Foods (Knoxville), FBSciences (Collierville), Delta BioRenewables (Whiteville), and EcoSurgTM (Memphis). These businesses have successfully commercialized agricultural technologies.



Commercialization is key to creating new jobs and increasing agricultural productivity and income. Governor Bill Haslam supports this innovation and workforce development through the Governor's Rural Challenge, a 10-year strategic plan to promote agricultural development in Tennessee.

Drugs and Pharmaceuticals

Tennessee is currently home to 33 drug and pharmaceutical companies. Leading pharmaceutical companies such as Abbott, Accredo, Cumberland Pharmaceuticals, Merck, Pfizer and Sanofi/Chattem have headquarters or operations in Tennessee. The drug and pharmaceutical subsector produces commercially available medicinal and diagnostic substances. The subsector is generally characterized by large multinational firms heavily engaged in research, development and manufacturing activities to bring drugs to market.

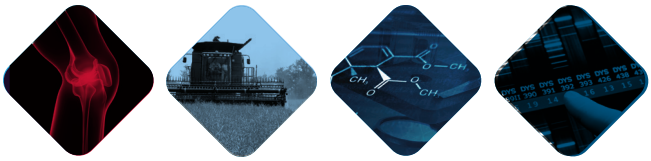
In 2011, biopharmaceutical companies in Tennessee supported $6.9 billion in economic output, which represented the value of goods and services produced by the companies and its ripple effects. Major pharmaceutical companies not only have distribution centers in Tennessee, but also manufacture some of the best known pharmaceutical brands. Acquisitions of companies such as Memphis-based Schering-Plough Corp., manufacturer of Claritin® and Dr. Scholl's® products, by Merck brought a significant Tennessee investment by a top pharmaceutical company.

In 2011, Dr. Reddy's Laboratories acquired the Bristol, Tennessee, oral penicillin facility through an agreement with GlaxoSmithKline. Dr. Reddy's now hold, the rights for Augmentin® and Amoxil® brands in the U.S. Established in 1984, Dr. Reddy's is a global pharmaceutical company, which conducts research on cancer, diabetes, cardiovascular, inflammation and bacterial infection.

Medical Device

West Tennessee ranks seventh in the country for the size of its medical device industry and puts Tennessee at the cusp of a specialization in medical device as related to other states. In 2010, medical device companies paid approximately $586 million in wages to Tennessee residents. Between 2001 and 2010, the state showed a 34 percent increase in employment, despite the recession. Firms in the medical device and equipment subsector produce a variety of biomedical instruments and other health care products and supplies for diagnostics, surgery, patient care and laboratories. This sector of the life science industry produces goods, including bio-imaging equipment, surgical supplies and instruments, orthopedic/prosthetic implants and devices, and dental instruments and orthodontics.

Memphis is the second-largest center for orthopedic devices in the U.S. and has a reputation as a center of excellence in the sector. The region is home to Wright Medical Technology, a company that develops, manufactures and distributes medical devices worldwide and MicroPort Scientific, which recently purchased OrthoRecon a division of Wright Medical. The OrthoRecon division generated nearly $296 million in revenues in 2012 and has more than 600 employees in the Memphis region.



TARGETED FOR GROWTH

Smith & Nephew and Medtronic, both global medical device companies, have a strong presence in West Tennessee. Smith & Nephew maintains its advanced surgical devices division in Tennessee, employing more than 2,000. Medtronic's spine and biologics businesses, which employs over 1,500 Tennesseans, is also headquartered in Memphis and accounted for $3.5 billion, or 22 percent, of Medtronic's $15.8 billion in revenue in 2010.

Numerous medical device and supply companies exist across Tennessee, one of the largest being East Tennessee-based DeRoyal Industries, a leading global manufacturer of orthopedic, surgical and wound care supplies with more than 2,000 employees. Founded by Pete Debusk in 1973, the company markets more than 20,000 products and has more than 70 U.S. patents. Mr. Debusk remains the owner and chairman of the company today.

Based in Chattanooga, Glenveigh Medical is a bioscience and medical technology company with a focus on obstetrics. Started in 2004 by a maternal-fetal medicinal specialist, Glenveigh moved its headquarters from Durham, N.C. to Tennessee in 2009. Advanced Catheter Therapies (ACT), also based in Chattanooga, is an early-stage research and development medical device company that focuses on innovative catheter technologies targeting vascular disease.

Middle Tennessee is home to several companies in the medical device industry, including musculoskeletal device company BioMimetic Therapeutics and Pathfinder Therapeutics, a company specializing in bio-imaging devices used in surgical treatments.

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Research, Testing and Medical Laboratories

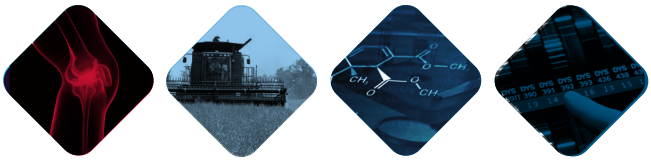
Tennessee continues to see an increase in biotechnology companies and medical laboratory research facilities. Several publicly traded biotechnology businesses are located in Tennessee including GTx, Inc. in Memphis, Cumberland Pharmaceuticals in Nashville and Provectus Biopharmaceuticals in Knoxville. Numerous emerging mid-sized biotechnology companies also call Tennessee home, many of which began with technology from our state's research institutions.

Contract research organizations, often called CROs, provide both clinical and pre-clinical research for the life science and health care industries. CROs bring specialized laboratory expertise in diagnostics therapeutics and product development. In Tennessee, CROs are a leading driver of the state's life science economy. Our state is home to many CROs, both large and small, including Sarah Cannon Research Institute and ICON, which both work with pharmaceutical companies around the world to complete hundreds of clinical trials each year.

Recent numbers from Battelle cite more than 300 medical laboratory and testing facilities across Tennessee. These companies are at the forefront of bringing new, highly innovative and very specialized technologies to better diagnose and treat patients in Tennessee and beyond. Many of these companies are engaged in highly specialized diagnostics and research to find the best treatments for some of the most challenging medical diagnosis, including rare diseases and specific cancers. Tennessee is also home to the emerging industry of highly specialized laboratories utilizing sophisticated diagnostic technology. These laboratories and CROs are involved in both clinical and pre-clinical research bringing the very latest technologies to market in the fields of bioinformatics, genomics and other promising diagnostic technologies.

Pharmaceutical companies and our state's research and medical centers are involved clinical trials in collaboration with hospitals and providers across Tennessee. These trials are bringing new medicines and therapies to the patients across the globe. Since 1999, there have been more than 3,700 clinical trials of new medicines in collaboration with the state's clinical research centers, university medical schools and hospitals in Tennessee. Many of the state's clinical tests involve collaborations with such respected local institutions as Vanderbilt University, University of Tennessee Health Science Center and East Tennessee State University's Quillen School of Medicine.

The Vanderbilt University Institute for Clinical and Translational Research (VICTR) is part of a growing NIH initiative that is designed to push experimental findings into clinically meaningful practices and advance translational medicine through the creation of Clinical and Translational Science Awards (CTSAs). More than 60 CTSAs are now linked together to create a consortium with coordinated efforts to improve societal health creating a roadmap for medical research and bringing patients new treatments in a more efficient manner. Vanderbilt University holds the largest single government research grant for its CTSA program with a five year, $46 million NIH grant.



TARGETED FOR GROWTH

Tennessee is home to several world-class research institutions and receives a sizable amount of government research funding.

In Tennessee, the NIH infused $450 million in 2013 for life science research. Tennessee ranks 12th in the country in NIH funding. Each NIH dollar invested in Tennessee generates $2.32 in new business activity, putting the state in the top 10 for economic activity created by NIH funding.

Bioscience-related Distribution (Biologistics)

A new component of the life science industry is bioscience-related distribution. This includes distribution of biologicals that involve specialized approaches, such as cold storage, high product regulations and new technologies for distribution. Three industries fall within this category: (1) distribution of drugs; (2) distribution of medical equipment and devices; and (3) agricultural-related chemicals and seed distribution.

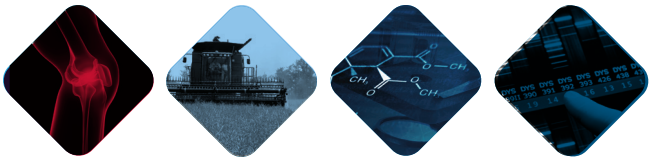
In Tennessee, there are 784 bioscience-related distribution establishments. The number of jobs in this sector is nearly two and a half times more concentrated in Tennessee than the national average. Employment in this field increased marginally from 2001 to 2010, despite the 2008-2009 recession.

Biologistics involves shipping medical equipment or biological materials on a tight schedule. This business sector is set to grow with continued expansion of Tennessee's life science industry, particularly as its research focuses more and more on personalized cures as the life science industry grows worldwide. Numerous life science companies already have chosen Tennessee for product manufacturing and distribution because of the state's central location and superior transportation system.

Tennessee has natural strengths that position the state well for success in biologistics. The state is centrally located and has a strong transportation infrastructure. Tennessee's location places it within a day's drive from 75 percent of the major markets that represent 50 percent of the entire United States population. The state provides immediate access to eight interstate highways: 24, 26, 40, 55, 65, 75 and 81, with 59 just southeast of the Tennessee border.

Air freight is also successful with the busiest freight airport in the world located in Memphis, with connections to any location in the world. The state six commercial airports and 74 regional and community service airports. There are numerous options for rail transportation, with three major carriers that traverse all parts of the state. Tennessee boasts 1,062 miles of navigable waterways and is centrally located on the nation's inland waterway system, connecting with river port in 21 state and three ocean ports.

With its headquarters in Memphis and vast operations in West Tennessee, FedEx gives the state's bioscience businesses a prime distribution advantage.



NATIONALLY RANKED RESEARCH INSTITUTIONS

East Tennessee State University

ETSU's Quillen College of Medicine received $7.7 million in NIH research funding in 2013 for innovations in many bioscience areas including cardiology, pharmacology, primary care, bone loss and cancer.

East Tennessee State University Research Foundation (ETSURF) was established in 2002 to support research, scholarly and artistic activities at the university. ETSURF is the administrative and fiduciary entity for the ETSU Innovation Laboratory, manages ETSU intellectual property and accepts and administers selected contracts and grants from private industry, foundations and other non-governmental agencies.

The **ETSU Innovation Laboratory** is an economic development initiative that partnered with the Tennessee Small Business Development Center and the ETSU Entrepreneurial Leadership Program. The Innovation Lab offers a full-service small business incubator designed to support entrepreneurs and investors to affect the successful establishment of technology-based start-up and spin-off businesses in order to achieve technology transfer, create jobs, and enhance economic development within the region.

Meharry Medical College

Meharry Medical College was founded in 1876 to improve the health and health care of minority and underserved communities by offering education and training programs in the health sciences; placing special emphasis on providing opportunities to people of color and individuals from disadvantaged backgrounds, regardless of race or ethnicity; delivering high quality health services; and conducting research that foster the elimination of health disparities.

Meharry has more than 200 full-time faculty members who examine biological, behavioral and other factors that contribute to the disproportionate burden of poor health outcomes borne by minority and underserved populations. All of the areas of research explore health disparities for people of color, in general, and African Americans, in particular. Research centers include The Center for Women's Health Research, The Center for AIDS Health Disparities Research, The Center for Molecular and Behavioral Research and the Sickle Cell Center.

University of Memphis FedEx Institute of Technology

The University of Memphis FedEx Institute of Technology is a research catalyst, engaging collaborative interdisciplinary research teams to drive innovation, commercial technology realization and corporate partnerships. The institute's engagement efforts put the university in touch with a wide contingent of the corporate, government and non-profit leaders, decision makers and innovators of Memphis and Shelby County.

The institute promotes the development of new, interdisciplinary research centers within the institute and across the University of Memphis. Research supporting the life science industry includes research in bioinformatics, health care and technology and musculoskeletal disciplines.

The institute also supports the growth of existing research labs with seed funding technology tools, in-kind contributions, professional services and marketing and public relations support. New research funds are cultivated for the researchers through their corporate and government partners, and supports economic development via technology transfer.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL), a division of the U.S. Department of Energy conducts biotechnology research with a focus on bioenergy and industrial biology to bring additional renewable energy sources and innovative conversion technologies from biomass.

Managed by UT Battelle, a partnership of the University of Tennessee and Battelle Memorial Institute, ORNL's research supports the Department of Energy's mission in scientific discovery and innovation, clean energy and nuclear security. ORNL has a staff of about 4,600 and an annual budget of more than $1.65 billion. Major research initiatives include accelerating biomass production and conversion for energy and materials; delivering sustainable transportation solutions; advancing the understanding of climate change impacts; and providing science and technology for global security.

ORNL's bioenergy program focuses on achieving the national goal of reducing oil imports through abundant biomass resources, reliable biofeedstock supply systems and innovative bioconversion technologies for producing bioenergy and bio-based products.

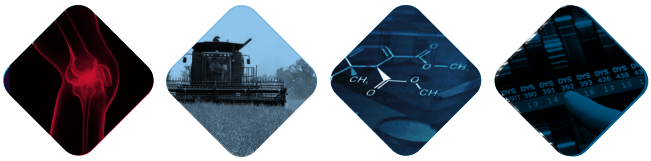
St. Jude Children's Research Hospital

For more than 50 years, St. Jude's mission has been to advance cures and means of prevention for pediatric catastrophic diseases through research and treatment.

Their research ranges from discovery-focused and hypothesis-driven laboratory studies to clinical trials of specific medications, treatment regimens and other therapeutic interventions. St. Jude seeks to translate knowledge acquired through basic research into novel approaches for clinical diagnosis and treatment. At the same time, clinical and laboratory-based investigators use the challenges encountered in the clinic to focus the efforts of their research.

In January 2010, St. Jude Children's Research Hospital and Washington University School of Medicine in St. Louis, announced an unprecedented effort to identify the genetic changes that give rise to some of the world's deadliest childhood cancers. The team joined forces to decode the genomes of more than 600 childhood cancer patients. **The St. Jude Children's Research Hospital – Washington University Pediatric Cancer Genome Project** is the largest investment to date aimed at understanding the genetic origins of childhood cancers. Scientists involved in the project are sequencing the entire genomes of both normal and cancer cells from each patient, comparing differences in the DNA to identify genetic mistakes that lead to cancer.

The availability of sophisticated centralized resources offers St. Jude investigators an exceptional research advantage. This includes a Good Manufacturing Practices (GMP) facility capable of manufacturing clinical grade biologics, a chemical biology group capable of synthesizing and testing small molecules for therapeutic activity, and the Hartwell Center for Bioinformatics. These and other well-equipped facilities staffed with highly trained specialists are widely available to clinical and basic science investigators to support the design, implementation, analysis, interpretation and reporting of research.



The University of Tennessee

University of Tennessee researchers at its flagship campus in Knoxville, at the UT Health Science Center (UTHSC) in Memphis, and at the other campuses and institutes in the statewide system are pioneering breakthrough research in the life science industry, including pharmaceuticals, environmental biotechnology and bioenergy. UT researchers also have numerous collaborations with the other major research entities in the state of Tennessee, including the Oak Ridge National Laboratory, Vanderbilt University and St. Jude Children's Research Hospital.

New research facilities at the UTHSC include a cancer research building, a **NIH-funded Regional Biocontainment Laboratory** for the investigation of infectious diseases and a new College of Pharmacy building that includes an **FDA-certified GMP manufacturing facility**. Both the Biocontainment Lab and the GMP facility have been designed to handle academic projects as well as industry contracts.

The UTHSC campus includes colleges of Allied Health Sciences, Dentistry, Graduate Health Sciences, Medicine, Nursing and Pharmacy. UTHSC also has state-funded centers of excellence in neuroscience, molecular resources, and pediatric pharmacokinetics.

Patient care, professional education and research are carried out at hospitals and other clinical sites across Tennessee. Endowed professorships, research centers of excellence, and continuing relationships with research and health care facilities across Tennessee ensure that both basic science and applied research stay focused on contemporary health topics.

UT's **Cherokee Farm** in East Tennessee is a joint project between the university and Oak Ridge National Lab. It is an innovation campus designed to provide an infrastructure for positioning the university and the state as a world leader in collaborative research. Drawing from Tennessee's established leadership in neutron research, materials science, computational science and energy independence and sustainability, UT's Cherokee Farm will bring both public and private research partners together to work on solving globally important challenges. Parcels are available for immediate development, and plans are under way for research suite leasing.

The **UT Center for Renewable Carbon** at the university's Institute of Agriculture focuses on research, teaching and outreach related to bioenergy production and biomaterials processing. This center is involved with the Tennessee Biofuels Initiative, a program funded with $70 million to construct a pilot biorefinery for research and demonstration of biomass-to-ethanol conversion technology. The center also is involved with the SunGrant Initiative, a national network of land-grant universities and federally-funded labs collaborating on establishing a bio-based economy. The initiative aims to create university-based research, extension and educations programs for bio-based energy technologies to not only help solve America's energy needs but also to revitalize rural communities. It is one of five regional centers for the initiative.

Vanderbilt University

Vanderbilt University and Medical Center researchers are at the forefront of posing innovative solutions to some of the most challenging questions facing us today. Vanderbilt is one of only 10 universities in the United States ranked within the top 20 on each of two key indicators: U.S. News & World Report's "Best Universities and Colleges" (ranked 17) and federal obligations for science and engineering research and development (ranked 20).

Research is one of the core missions of Vanderbilt University, and it is supported by more than 40 research centers in Vanderbilt University's College of Medicine alone. The university's total research expenditures are more than $571 million with $339 million in NIH funding, ranking the university in the top 10 for NIH funding. Vanderbilt is pioneering leading studies in the life sciences, including human genetics, cancer and stem cell research.

The university's **Center for Technology Transfer and Commercialization** provides a variety of intellectual property-related services to Vanderbilt researchers, including innovation identification, protection, marketing and licensing. The office also works with investment professionals, angel investors and experienced management teams to identify technologies that are appropriate for a commercialization strategy involving a start-up company.

Vanderbilt University's Division of Sponsored Research coordinates, executes and promotes the science, technology and humanities programs of the university in conjunction with nonprofit and for-profit organizations.

TENNESSEE'S LIFE SCIENCE PARKS AND INCUBATORS

Cool Springs Life Sciences Center

The Cool Springs Life Sciences Center is a 15-acre, 260,000 square foot life-sciences focused research and development campus committed to providing a world class bioscience business environment that benefits tenant companies and the biotech community by providing a unique campus dedicated to life science research, development and manufacturing. Infrastructure is in place to provide state-of-the-art systems for redundant power, HVAC, IT systems and chemical waste handling.

The center, shown here, is home to Wright Medical's biologics company, Biomimetic Therapeutics, as well as the Vanderbilt University Center for Neurological Drug Discovery and several other small life science companies. The center provides dedicated space for well-equipped laboratory research, product development and manufacturing facilities for medical device, biotechnology, pharmaceutical and other life science-oriented companies and their support services. The range of potential research activities at the center is as diverse as biomedical research itself and includes pharmaceutical and medical device development activities utilizing organic chemistry, biochemistry, molecular and cellular biology, tissue culture work, histology, nanotechnology, biomedical engineering, tissue engineering, etc. The scope of manufacturing work could range from non-technical production to high-tech cGMP microbiological clean room operations.

Cumberland Emerging Technologies Life Sciences Center

Cumberland Emerging Technologies, Inc. (CET) is a joint initiative between Cumberland Pharmaceuticals and the region's innovation community. Located in Nashville, CET's Life Sciences Center offers flexible lab and office space, equipment and other resources to early-stage life science companies.

CET works to bridge the development gap and bring biomedical technologies from the research laboratory to the commercial marketplace.

CET provides universities, hospitals, research organizations and entrepreneurs with a commercial development infrastructure for their technologies, including technology transfer licensing skills, regulatory expertise and assistance in obtaining funding for development. The center's flexible approach allows researchers to utilize one or all of its services, customizing a plan for each project. In addition to all of CET services, tenants have access to an employee benefits program, custom build-outs and the opportunity to interface with other young biotechnology companies.

Memphis Bioworks/UT-Baptist Research Park

The UT-Baptist Research Park is a growing major bioscience research complex located in the heart of a world-class research and clinical treatment cluster in Memphis. Within the research park campus and close by is an array of biomedical, bioscience, research, teaching, business and logistics resources, including University of Tennessee Health Science Center, Cadaveric Training Facility, St. Jude Children's Research Hospital, Methodist Hospital, LeBonheur Children's Hospital, The Regional Medical Center of Memphis, Regional Biocontainment Lab, a completed $20 million animal testing vivarium, FedEx World Hub and Southwest Tennessee Community College.

Key assets within the UT Baptist Research Park are TriMetis, a pre-clinical research facility and the Memphis Bioworks Business Incubator. The incubator provides critical resources and services created to meet the needs of start-up, early stage and growth bioscience companies and creating an ideal ecosystem for successful entrepreneurship. TriMetis operates a 26,000-square-foot Good Laboratory Practice (GLP) facility focused on both in vitro and in vivo research, helping medical device, pharmaceutical biotech companies and academic institutions advance their research through specialty laboratory and consultation services.

With more than 52,000 square feet of office and wet lab space presently available, and 230,000 square feet in development, the UT-Baptist Research Park offers ideal sites for bioscience growth – from incubator stage to thriving bioscience business.

Cherokee Farm

UT's Cherokee Farm in East Tennessee is a joint project between the university and Oak Ridge National Lab. It is an innovation campus designed to provide an infrastructure for positioning the university and the state as a world leader in collaborative research.

Drawing from Tennessee's established leadership in neutron research, materials science, computational science and energy independence and sustainability, UT's Cherokee Farm will bring both public and private research partners together to work on solving globally important challenges. Parcels are available for immediate development and plans are under way for research suite leasing.

ETSU Innovation Lab

The ETSU Innovation Laboratory is an economic development initiative partnered with the Tennessee Small Business Development Center and the ETSU Entrepreneurial Leadership Program. The Innovation Lab offers a full-service small business incubator designed to support entrepreneurs and investors to affect the successful establishment of technology-based start-up and spin-off businesses in order to achieve technology transfer, create jobs and enhance economic development within the region.

Biomass Innovation Park

Home of Genera Energy, Inc. and based in Vonore, Tennessee, the Biomass Innovation Park is the country's largest and most comprehensive industrial biomass management and processing facility. Genera designed and built the Biomass Innovation Park to be the country's leading research and development facility for demonstrating and optimizing the feedstock supply chain. In operation since 2011, the Biomass Innovation Park is the only commercial facility operating today that can perform all the processes and steps necessary to bridge the farm gate and the biorefinery gate, ranging from biomass receiving and inventory management to size reduction and characterization.

SUPPORTING AND ADVOCATING FOR THE LIFE SCIENCE INDUSTRY

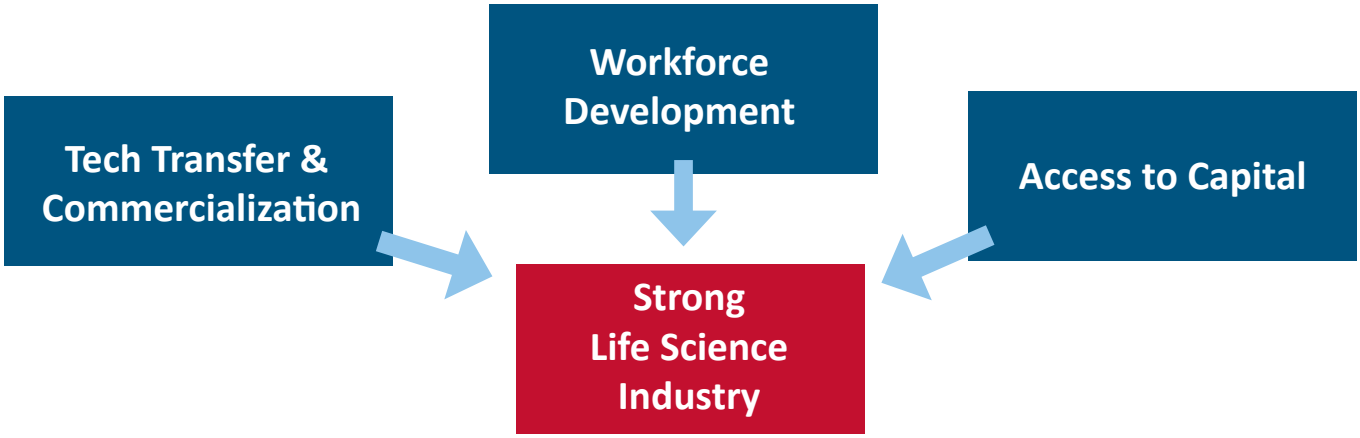
Tennessee is a state that is rapidly being recognized as a major player in the life science arena. State policy leaders have recognized life sciences as an integral part of the state's economy. Tennessee has built centers of excellence around medical devices, biopharmaceuticals, biofuels and clinical research. Capitalizing on these emerging trends is vital to the continued growth and expansion of the life science industry in Tennessee, and to the resulting high-wage jobs, economic opportunities and advancements and discoveries in health care, alternative fuels and beyond.

Support of industry growth in Tennessee requires backing from the state's leading industry organizations. Life Science Tennessee is the leading advocacy organization for the industry in the state. Working closely with state policy makers and our congressional delegation, Life Science Tennessee ensure they have necessary feedback from the industry for continued growth.

Life Science Tennessee has identified three key ingredients critical for the expansion of the industry: 1) the facilitation of technology transfer and commercialization; 2) the development of the life science workforce; and 3) ensuring access to capital for emerging companies.

In 2011, Life Science Tennessee developed a report on tech transfer and commercialization identifying critical barriers to new technology development. In 2012, the association conducted a survey of the state's life science companies to assess workforce needs. In 2014, Life Science Tennessee will focus on the third key ingredient for a strong life science industry: access to capital.

Three Key Ingredients for a Thriving Life Science Industry in Tennessee



Technology Transfer and Commercialization

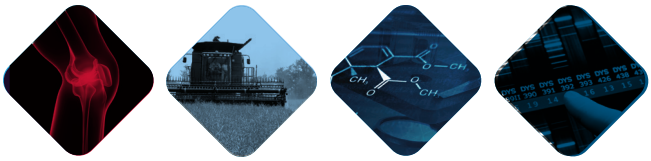
A region's prosperity is determined by its ability to identify, create and commercialize innovation. Life Science Tennessee advocates for increased commercialization and technology transfer in Tennessee, advancing a culture of activities that encourage and support entrepreneurship, as well as increasing access to capital for the state's life science start-ups. In the fall of 2011, Life Science Tennessee identified some of the leading barriers to commercialization in Tennessee and issued a report identifying those barriers as well as best practices in other states. Life Science Tennessee has also collaborated with State of Tennessee leadership, including the Governor's office, Department of Economic and Community Development (ECD) and legislative leadership, in a vigorous effort to determine statewide strategies that will boost innovation and commercialization in Tennessee.

Life Science Tennessee has made a number of additional recommendations that help to expedite technology transfer and commercialization which include:

- Increase access to capital for early-stage innovation activities.
- Improve commercialization practices at Tennessee's research institutions.
- Strengthen the collaboration between Tennessee's researchers and entrepreneurs.
- Continue and expand the current paths that encourage entrepreneurship.
- Strengthen partnerships and collaborations between industry and academia.
- Encourage incentive programs and expand incubators to support existing small business activity.

LIFE SCIENCE TN
Conference & Venture Forum

To support technology transfer and commercialization, Life Science Tennessee launched its first Venture Forum showcasing emerging life science companies from across the state in 2012. The forum includes a mentorship program where entrepreneurs gain invaluable feedback from leading life science industry executives. The experience culminates in pitch presentations during Life Science Tennessee's annual meeting in front of a panel of investors.



Workforce Development

A 2012 report produced by the Life Science Tennessee Workforce Development Committee including a survey of life science companies in the state revealed that a significant gap existed in the life science workforce.

The survey collected data from 47 life science companies, employing over 9,000 people in Tennessee. Results indicated that access to skilled labor was the second most highly cited barrier to growth, behind federal regulatory practices, and ahead of access to capital. While more than 50 percent of companies surveyed for the report cited intentions to expand in the following year, 62 percent noted that the lack of availability of technically trained talent was significant problem.

The report found that while companies need candidates with masters or doctorate degrees in fields such as chemistry and biology, the degree alone was not sufficient. Industry experience, specifically, familiarity with regulatory practices, is critical.
Much of the problem can be attributed to the emerging nature of Tennessee's life science industry which hasn't yet reached the critical mass similar to other life science clusters. One survey respondent noted, "It can be difficult convincing strong candidates to relocate to an area that does not yet have a solid base of life science companies."

To overcome this challenge Life Science Tennessee is working to create stronger connections between industry and academia. Life Science Tennessee's Workforce Development committee regularly convenes leaders of industry and academia, including administrators, deans and professors, to increase feedback and to develop common solutions.

PASSAGE OF THE LAB LICENSE BILL: A Victory for Industry Growth

The LifeSciTN WFD report also revealed a critical shortage in lab technicians. Fortunately, in 2013, with the support of LifeSciTN members, the Tennessee General Assembly passed a bill that updated the state's outdated medical laboratory licensing requirements.

The previous policy essentially required all Tennessee medical laboratories to employ either medical laboratory technicians (MLTs) or medical technologists (MTs) to meet regulatory requirements set by the state's medical laboratory review board. The skill set of MTs and MLTs, however, does not always match up with the skills needed in certain specialized laboratories.

The new policy is a win for workforce development as it will allow highly specialized medical laboratories the flexibility they need to hire properly trained personnel to run advanced laboratory tests.

Direct connections to academia can make sourcing talent easier for industry, and academia benefits from a clearer understanding of what skills and degrees are in demand in the life science market and can adjust programs accordingly.

Life Science Tennessee is working with numerous partners including BioTN and Memphis Bioworks (see partnering section for more on these organizations) to develop an internship handbook and a program for helping companies establish new internship programs.

While much of Life Science Tennessee's workforce development efforts focus on post-secondary education and training, promoting STEM education at all levels is critical. The Tennessee Department of Education and the Department of Labor and Workforce Development has placed a focus on STEM education and workforce development programs. Vital to the industry, improvement of K-12 math and science educational opportunities must continue to be a priority.

The association supports various programs across the state including BioTN's GK-12 program, which provides funding for graduate students in STEM disciplines to teach K-12 students throughout Tennessee.

Access to Capital

Small-to-medium sized enterprises (SMEs) are the primary drivers of employment, however access to capital can be a significant barrier to creating and growing new life science companies. In 2014, Life Science Tennessee will conduct a study of the opportunities and challenges associated with securing funds for start-ups and SMEs in Tennessee. The report will analyze the impact and effectiveness of state policies for capital formation. The report will also review tools used by other state governments and communities of life science companies to increase access to capital.

Life Science Tennessee Legislative Days

Each year, Life Science Tennessee members gather for a full day of meetings in both our state and nation's capitols. The state legislative event, called Day on the Hill, takes place in February and is an opportunity for life science industry executives to meet with policy makers to discuss the impact the industry has on the state. The Day on the Hill includes presentations to committees on pressing policy issues.

Members meet with Tennessee's congressional delegation during the Day in D.C., which takes place every March. Over two days, members discuss a variety of issues including regulation, health care reform and research funding.

Life Science Tennessee Board Members meet with U.S. Senators Bob Corker and Lamar Alexander and U.S. Representative Steve Fincher during the 2013 Day in D.C. Pictured from left: Tom Ballard, Jud Schneider, Steve Bares, Paul Seltman, Rep. Fincher, Sen. Corker, Sen. Alexander, Bruce Doeg, Brandy Bivens and Sam Lynch.

Life Science Tennessee works closely with AdvaMed, a leading national medical device association and BIO, the Biotechnology Industry Organization on federal issues during the D ay in D.C., and on an on-going basis.

Life Science Tennessee's advocacy efforts extend well beyond the legislative events. The Policy and Advocacy Committee regularly meets to discuss policy issues as they arise, and meet with local, state and federal policy makers and policy experts as needed to ensure that the industry's collective interests are accounted for.

PARTNERING FOR THE GROWTH OF THE LIFE SCIENCE INDUSTRY

Growth of the life science sector will require additional resources and support from organizations that are already actively engaged with our industry. Life Science Tennessee's focus on economic development, entrepreneur development, workforce development, access to capital and policy is aligned with numerous strategic partners in the state. Continued emphasis on programs that encourage commercialization, growth, retention and recruitment of the companies are keys to overall industry growth.

Tennessee's life science industry is supported by leading innovation and industry organizations and programs including:

The State of Tennessee, including the Department of Economic and Community Development (ECD), the Department of Education and the Department Labor and Workforce Development are all instrumental in supporting our high tech, high wage and highly specialized industry. The Tennessee Department of Economic and Community Development, which has identified the life sciences as a major industry target for growth in Tennessee. ECD is leading projects that promote innovation, expansion and retention of the life science industry here.

Launch Tennessee (formerly the Tennessee Technology Development Council) is the state's leading organization fostering economic development for innovative and high growth industries. Launch Tennessee is committed to building the state's life science industry as evidence of the state's commitment to growing innovation-based jobs here. The organization's support of the nine regional accelerators, along with their keen focus on the life science industry as a key growth sector strengthens the life science industry's growth potential in the state.

The Memphis Bioworks Foundation brings together public, private, academic and government entities in a collaborative effort to change the Memphis bioscience landscape. Established in 2001 as a nonprofit, the Foundation's leading initiatives are to expand upon the community's current bioscience niches and demonstrated areas of leadership to create an internationally recognized center for the development and the commercialization of bioscience technology is recognized worldwide for their efforts in industry expansion in Tennessee.

BioTN, a nonprofit organization that provides unique educational training and workforce development in science and technology, seeks to enhance regional assets in healthcare service and technology by supporting the expansion of technologies focused on the life science industry. BioTN is helping to provide the needed workforce for the industry in Tennessee.

MEMBERS

2nd Generation Capital LLC
AccelNow
AdvaMed
Advanced Catheter Therapies
Advanced Plasma Products
Aegis Sciences Corporation
Ag Innovation Group
Anderson Benson
Baker, Donelson, Bearman, Caldwell & Berkowitz
Bartlett Area Chamber of Commerce
Bass, Berry & Sims PLC
Berg Pharma
BIO
BioMimetic Therapeutics
Bioquant
BioTN
Bioventures
Bioventus LLC
Bradley Arant Boult Cummings
Butler, Snow, O'Mara, Stevens & Cannada
CirQuest Labs, LLC
Compass Innovation
Cool Springs Life Sciences Center
CSL Behring
CSL Plasma
Cumberland Emerging Technologies
DDN
Diagnovus
Diatech Oncology
DuPont Cellulosic Ethanol
East Tennessee State University
Ernst & Young
eSpin Technologies
Frazier, Barnes & Associates
Genentech, Inc.
Genera Energy, Inc.
Genetics Associates
Genome Explorations
Glenveigh Medical
Greater Memphis Chamber
Harbert Fund Advisors, Inc.
Hogan Lovells US LLP
Hubble Telemedical
Industrial Microbiological Laboratories
Innova Memphis
Insight Genetics, Inc.
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iScreen Vision Inc.
Key Biologics
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LaunchTN
Leadership Health Care
Memphis Bioworks
Middle Tennessee State University
Molecular Sensing
Mountain Group Capital
Nashville Health Care Council
NellOne Therapeutics
NextGxDx
Novartis Pharmaceuticals Corporation
Ntelligent Growth Consulting
NuSirt
Oak Ridge National Laboratory
OneC1ty
Pershing Yoakley & Associates
Pfizer
Precision Nuclear
Rare Disease Therapeutics Inc.
Renewable Algal Energy, LLC
RxBio
Ryan Search & Consulting
Sanofi/Chattem
Smith & Nephew
Stability Biologics
Tennessee Board of Regents
Tennessee Department of ECD
TriMetis Life Sciences
TriStar Technology Ventures
University of Tennessee
University of Tennessee Research Foundation
Vanderbilt University
Vanderbilt University Office of Technology Transfer
VWR International
Waddey & Patterson
Waller Lansden
Williamson Co. Chamber of Commerce
Wright Medical Technology

About Life Science Tennessee

Life Science Tennessee is a statewide, non-profit, member organization whose mission is to advance and grow the life science industry in Tennessee through advocacy, partnerships and alignment with economic and workforce development.

Members include companies, universities, research institutions, government and economic development groups, and other industry associations involved in discovery and application of life science products and related services that improve the health and well-being of people throughout the world.

Life Science Tennessee conducts business and economic development activities; advocates on behalf of the industry; educates the public about the benefits of life science research and product development; and provides a network for the exchange of ideas, information and opportunities.

LIFE SCIENCE tennessee

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