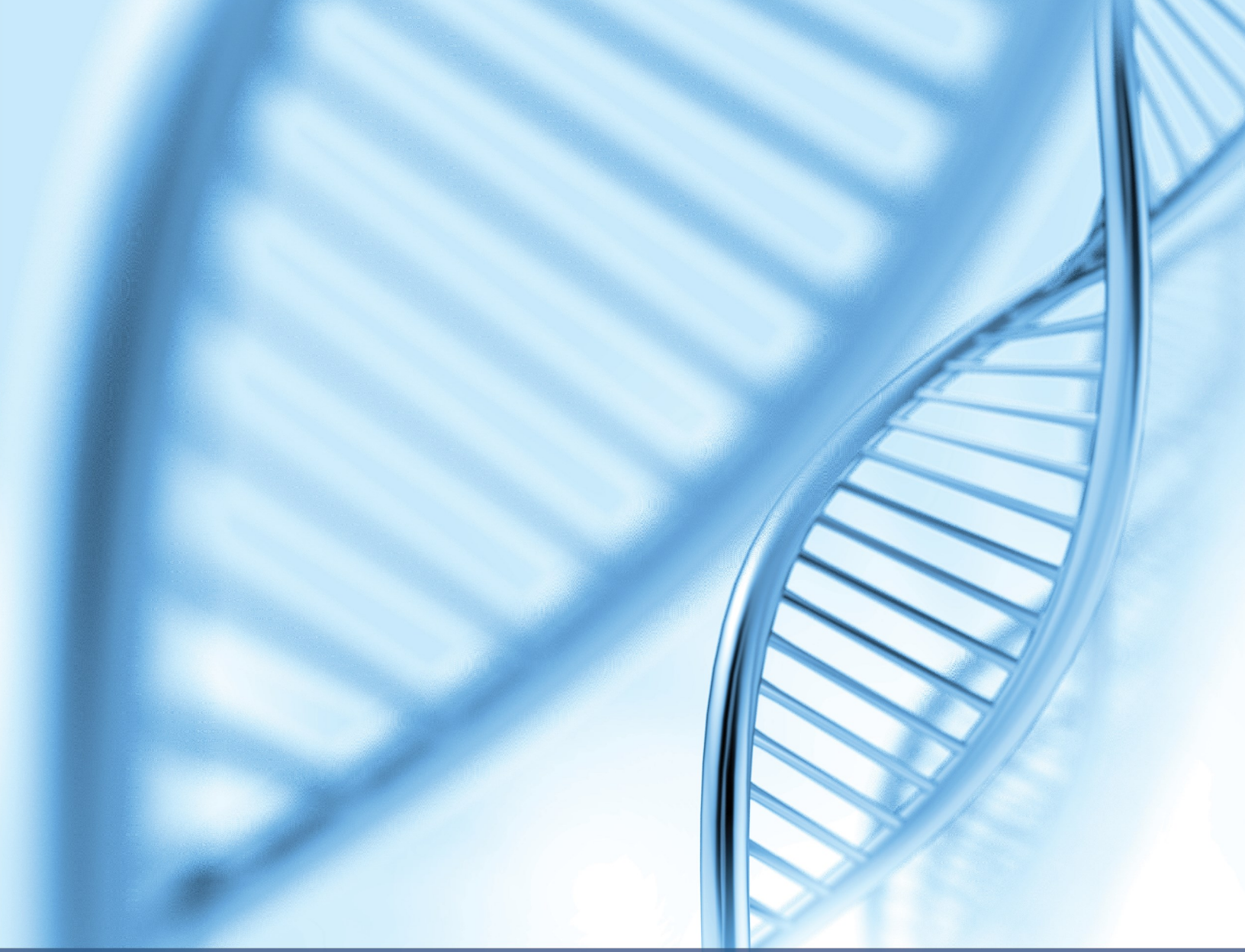

2015 Texas Biotechnology Industry

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THE STATE OF TEXAS GOVERNOR

TEXAS WIDE OPEN FOR BUSINESS

Contents

Completed April 2015

Texas Biotech Headlines

Austin-based pharmaceuticals firm **XBiotech Inc.** raises $76 million in IPO and begins building $200 million Austin campus

See Page 15

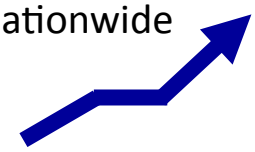
Austin Community College wins $4.9 million state grant to build critically needed wet lab space in Central Texas

See Page 24

Houston-based **Texas Medical Center**, world's largest medical center, opens the nation's largest innovation center, the **TMC accelerator (TMCx)**

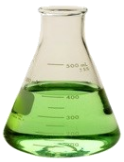
See Page 19

Texas ranks **#2 for employment of life and physical scientists** nationwide



See Page 4

Texas is home to the **nation's largest biodiesel plant** and ranks **#1 for U.S. biodiesel production**



See Page 28

Texas public institutions award over 65,000 **biotech-related degrees** from 2010 to 2014

See Page 17

North Texas-based medical devices firm **Greatbatch** plans to add 130 jobs by 2017

See Page 10

Shell plans to build a cellulosic ethanol pilot plant at its largest Technology Center in Houston

See Page 29

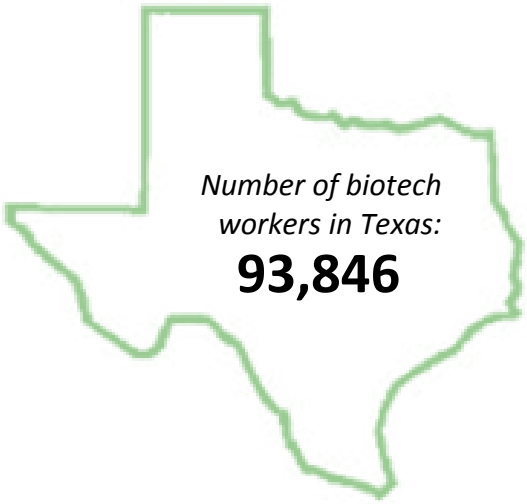
Biotechnology in Texas

The Biotechnology Industry

As home to over 3,700 biotechnology manufacturing and R&D firms, Texas is one of the leading biotech states in the country. More than 93,800 workers are employed in biotech-related sectors in Texas, and dozens of global biotech companies, such as Novartis, Abbott, and Medtronic, have major operations in the state. A concentration of highly trained biotech workers, multiple top-tier research institutions, and a top-ranked business climate all strengthen the state's status as a biotechnology leader.

Biotechnology is technology based on biology which harnesses cellular and molecular processes to develop products that help improve the health of humans and the planet. People have used the biological processes of microorganisms for more than 10,000 years to make and preserve food products. Modern biotech provides breakthrough tools to combat diseases, increase crop yields, and develop cleaner energy sources.

Because of the breadth of biotechnology activities, the field actually encompasses many related industries, from medical, to chemical, to agricultural. Within the North American Industry Classification System (NAICS), the federal standard for classifying businesses, biotechnology spreads across the ten subsectors listed below.



Irving-based Kimberly Clark and Dallas-based Celanese, both on the 2014 Fortune 1000 list, are among the largest biotech-related companies headquartered in the state.

Biotechnology Subsectors

- Research and Development in Biotechnology
- Research and Development in Physical, Engineering, and Life Sciences
- Pharmaceutical and Medicine Manufacturing
- Medical Equipment and Supplies Manufacturing
- Electromedical Apparatus Manufacturing
- Analytical Laboratory Instruments Manufacturing
- Medical and Diagnostic Labs
- Testing Laboratories
- Pesticides, Fertilizer & Other Agricultural Chemical Manufacturing
- Other Basic Organic Chemical Manufacturing

Top Texas-Based Biotechnology Firms
(by Global Revenues)

Kimberly-Clark
Respiratory healthcare products
HQ: Irving
Sales: $19.7 billion

Celanese
EVA polymer-based medical care products
HQ: Irving
Sales: $6.8 billion

KCI The Clinical Advantage
Wound care medical devices
HQ: San Antonio
Sales: $2 billion

Greatbatch
Medical device technologies
HQ: Frisco
Sales: $687.7 million

Cyberonics
Neuromodulation medical device
HQ: Houston
Sales: $282 million

Key Texas Biotechnology Rankings

No. 1 for U.S. biodiesel production

No. 1 for U.S. agricultural sciences doctorates

No. 2 in life and physical scientists employment nationwide

No. 3 for U.S. biological/biomedical sciences and life science doctorates

No. 3 in U.S. science, engineering, and health doctorate holders

No. 3 for U.S. life sciences doctorates

Texas Attracts Biotechnology Investment from around the World

Selected foreign services companies with biotechnology-related operations in Texas:

Denmark
ALK-Abelló: Round Rock

France
Essilor: Dallas
Virbac: Fort Worth

Germany
Ottobock: Austin

Japan
FUJIFILM: College Station
Fujirebio: Seguin
Hitachi: Dallas
HOYA: Dallas, Lewisville
Rigaku: Austin

The Netherlands
Philips: Arlington, Houston
Royal Dutch Shell: Houston

Singapore
Flextronics: Irving

Spain
Grifols: San Marcos, Statewide locations

Switzerland
Galderma: Fort Worth
Lonza: Houston
Novartis: Fort Worth, Houston
Orthofix: Lewisville

United Kingdom
Medtronic: San Antonio
Mylan: Sugar Land
Smith & Nephew: Austin, Fort Worth

Top Life Sciences Companies in Texas

Selected firms with corporate management, research, or manufacturing facilities in the state

Sources: D&B, US FDA, company websites

Texas Biotech Workforce

Texas is home to over 3,700 firms involved in biotechnology-related manufacturing, scientific research, and laboratory analysis. These firms employ more than 93,800 workers at an average annual salary of over $84,000. The table on page 5 provides a snapshot of the Texas biotechnology industry as of third quarter (Q3) 2014. The state has seen overall increases in the number of biotechnology firms, employment, and average annual wages since a year prior, in Q3 2013.

Texas is top ranked for the employment of biotech-related scientists and doctorate holders

In 2012, the most current data available, Texas ranked No. 2 nationally for the number of life and physical scientists employed, with 47,770, according to the National Science Foundation (NSF). Additionally, in 2013, Texas ranked No. 3 nationally for employed science, engineering, and health doctorate holders, with 43,700, according to the NSF.

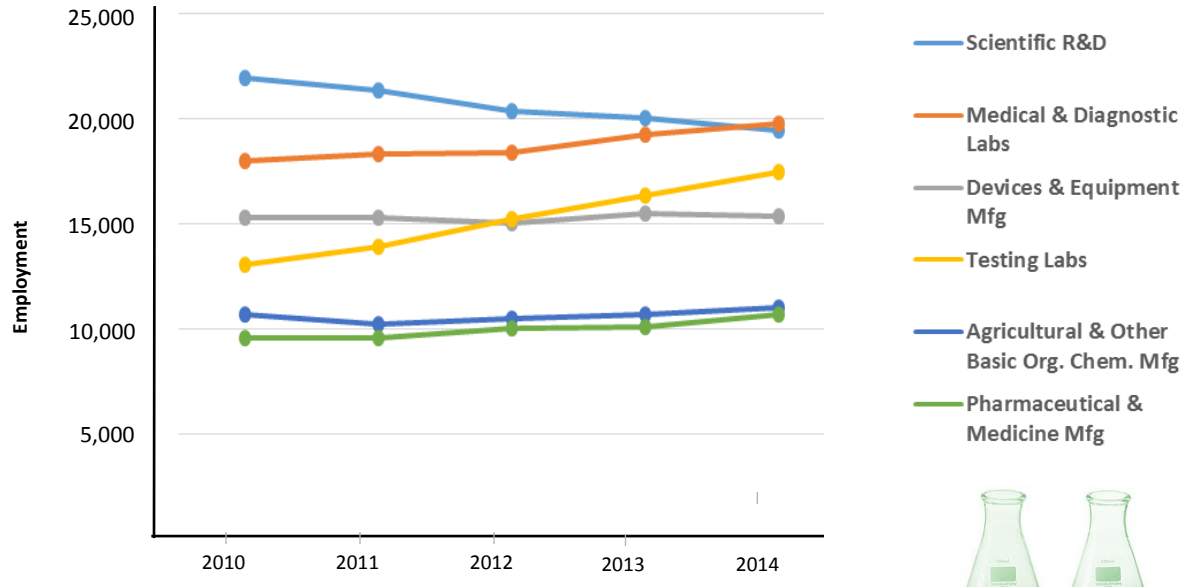
Texas' Top Rankings for Biotechnology Workers in the U.S.

Texas is home to one of the largest clusters of biotechnology professionals in the U.S. Texas' top national rankings for the number of workers in key biotech-related occupations are shown below.

Occupation	*Texas Rank*
Medical & Clinical Lab Technologists	**1**
Ophthalmic Medical Technicians	**1**
Veterinary Technologists & Technicians	**1**
Pharmacy Technicians	**2**
Animal Scientists	**2**
Environmental Scientists	**2**
Plant & Soil Scientists	**3**
Biological Scientists, All Other	**4**

Source: U.S. Bureau of Labor Statistics

Texas Biotech-Related Employment 5-Year Trends



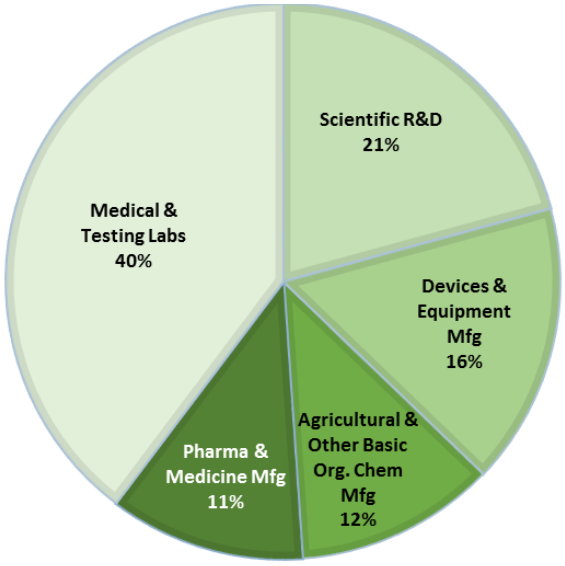
Source: Texas Workforce Commission
Private sector employment only. Data from third quarter of each year.

As shown in the chart to the right, in Q3 2014, 40% of Texas' biotech-related workers were engaged in medical and testing labs (NAICS 6215 and 54138), 21% in scientific R&D (NAICS 541711 and 541712), 16% in devices and equipment manufacturing (NAICS 334510, 334516, and 3391), 12% in agricultural and other basic organic chemical manufacturing (NAICS 32519 and 3253), and 11% in pharmaceutical and medicine manufacturing (NAICS 3254).

From Q3 2010 to Q3 2014, the most recent five years of available data, overall biotechnology-related employment in Texas increased 5.6% (see graph on previous page). The medical and diagnostic labs, testing labs, and pharmaceuticals manufacturing segments saw continuous employment increases each year during that period, with the testing labs segment experiencing the greatest overall employment increase, growing 33.5% between Q3 2010 and Q3 2014.

Over 61% of Texas biotechnology employment is R&D and testing-related

Texas Biotech Employment
by Sector



Source: Texas Workforce Commission

Biotechnology Employment in Texas
Third Quarter 2014

Sector (Industry Code)	Employees	Firms	Average Annual Wage
Medical and Diagnostic Labs (6215)	19,812	918	$54,652
Testing Laboratories (54138)	17,464	768	$70,252
R&D in Physical, Engineering, and Life Sciences (541712)	14,769	702	$93,756
Medical Equipment and Supplies Manufacturing (3391)	11,921	672	$51,324
Pharmaceutical and Medicine Manufacturing (3254)	10,668	126	$90,688
Other Basic Organic Chemical Manufacturing (32519)	7,910	90	$120,224
R&D in Biotechnology (541711)	4,718	333	$87,516
Pesticides, Fertilizer, and Other Agricultural Chemical Mfg. (3253)	3,097	81	$83,044
Electromedical Apparatus Manufacturing (334510)	1,911	43	$75,088
Analytical Laboratory Instruments Manufacturing (334516)	1,576	29	$78,104
TOTALS	**93,846**	**3,762**	**$80,444**

Source: Texas Workforce Commission

State Government Initiatives

Business Incentives Programs

In 2003, the Texas Legislature created the $295 million **Texas Enterprise Fund** (TEF), a "deal closing" fund created to attract businesses and new jobs to Texas. The Legislature reauthorized the TEF most recently in 2015. As of January 2015, the TEF has awarded over $98.1 million to biotechnology-related projects. The table on page 7 details these projects and the 11,451 jobs they have committed to create.

In 2005, the Texas Legislature founded the $200 million **Texas Emerging Technology Fund** (TETF) to promote the commercialization of technological innovations across multiple industries, including biotechnology. The fund invested approximately $289.7 million into biotechnology-related deals, with about $134.6 million going to commercialize start-up companies and $155.1 million awarded to universities and related consortiums. The TETF was abolished in 2015.

The Texas Emerging Technology Fund has invested almost $290 million in over 100 biotech deals

Education & Research

In January 2015, Gov. Greg Abbott proposed a new **Governor's University Research Initiative** to attract and recruit top researchers to Texas' higher educational institutions. The 84th Texas Legislature passed legislation to create the Initiative and allocated $40 million of the TETF's unexpended balance to fund it.

In 2005, the Texas Legislature established the Texas **Science, Technology, Engineering and Mathematics (T-STEM) Initiative**. Modeled on national STEM programs, T-STEM focuses on educating and graduating more Texas students in STEM fields critical for maintaining a skilled, competitive state workforce. In part, T-STEM aims to more closely align high school curricula with admissions requirements for competitive colleges. Under the initiative, 91 T-STEM Academies have been created, serving 56,000 Texas students across the state. For more details on biotech-related education, see pages 16-25.

Stem Cell Regulation

In April 2012, the Texas Medical Board approved new guidelines for the use of experimental stem cell therapies. The guidelines stipulate that the stem cell procedures are done for research only, that they receive approval from a public or private institutional research board, and that patients sign consent forms. Texas joins other states such as California, New York, and Illinois in the enactment of rules governing stem cell research.

Texas Leads the Nation on the War on Cancer

In 2007, Texas voters overwhelmingly approved a constitutional amendment establishing the **Cancer Prevention and Research Institute of Texas (CPRIT)** and authorizing $3 billion in state bond money to fund state cancer research, prevention programs, and services over ten years. Since beginning operations in 2009 through February 2015, CPRIT has awarded over $1 billion in grants to Texas researchers, institutions, non-profits, and private enterprises.

The research and prevention efforts funded by CPRIT advance the health of Texans, research superiority of the state, life science infrastructure, and the Texas economy. These projects are operating in virtually all regions of the state with Texas-based employees.

CANCER PREVENTION & RESEARCH INSTITUTE OF TEXAS

Texas Enterprise Fund
Biotechnology-Related Awards

Company	City	Description	Jobs	Award (Millions)
Baylor College of Medicine	Houston	Bovine gene-mapping project	N/A	$2.0
Becton, Dickinson & Co.	San Antonio	Global professional services for medical devices	296	$1.56
Cardiovascular Systems	Pearland	Arterial disease medical devices manufacturing facility	100	$0.6
Ferris Manufacturing	Fort Worth	Medical products manufacturing	100	$.45
G-Con, LLC	Bryan	Pharmaceutical manufacturing	408	$3.0
Grifols, Inc.	San Marcos	Plasma testing laboratory & fractionation plant	190	$0.5
Hanger Orthopedic Group	Austin	Headquarters relocation of orthotic and prosthetic patient care services firm	236	$1.5
Medtronic, Inc.	San Antonio	Diabetes division expansion	1,384	$6.0
Scott & White Memorial Hospital	Temple	Cancer Research Institute and other research initiatives	1,485	$7.5
Texas Institute for Genomic Medicine & Lexicon Pharma.	College Station & Houston	Genome mapping and "knockout" mouse cell line library	5,000	$50.0
The University of Texas Health Science Center at Houston, M.D. Anderson, & G.E. Healthcare	Houston	The Center for Advanced Diagnostic Imaging	2,252	$25.0
		TOTAL	**11,451**	**$98.11**

R&D Credit Regulation

In June 2013, Texas signed House Bill (HB) 800 into law, reinstating the **research and development (R&D) tax credit** for Texas companies. Although not permanent, both the sales tax exemption and research credit are extended through 2026 and are expected to be a boost to Texas manufacturing and high-technology industries, including biotechnology. The law went into effect in January 2014.

HB 800 reinstates franchise tax credits for companies conducting qualified research activities (QRAs) within the state. The new law provides Texas companies the option of selecting either a sales tax exemption on property purchased by persons engaged in QRAs or the franchise tax credit, but not both.

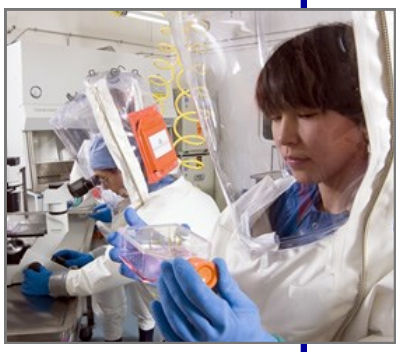
Texas Uniform Trade Secret Act

Effective September 1, 2013, Texas became the latest state to enact a version of the Uniform Trade Secrets Act (UTSA). The UTSA provides a legal framework for improved trade secret protection across industries within the United States.

The **Texas Uniform Trade Secret Act (TUTSA)** expands the definition of a trade secret under state law to include financial data and customer lists. TUTSA also reduces the cost of Texas businesses bringing lawsuits to protect their trade secrets, allowing them to recover the cost of attorney fees. Many Texas high tech industries, including biotechnology, will benefit from the TUTSA.

Advanced Biotech Clusters in Texas

Biodefense & Pandemic Preparedness



Biodefense technologies are designed to inoculate citizens against infectious agents that may be used in an attack and to detect biological, chemical, or nuclear attacks. In addition, technologies can make urgently needed treatments easier to administer on the battlefield or during a civilian crisis.

Key Texas Research Centers: Texas A&M's **Center for Innovation in Advanced Development & Manufacturing (CIADM)** in College Station serves as one of three federally designated biodefense centers. Texas houses two of the nation's Biosafety Level-4 (BSL-4) labs, which study some of the world's most dangerous microbes. The BSL-4 labs are at The University of Texas Medical Branch (UTMB) **Galveston National Laboratory** and the privately run **Texas Biomedical Research Institute** in San Antonio. UTMB's **Center for Biodefense and Emerging Infectious Diseases** serves as a Regional Center of Excellence for Biodefense and Emerging Infectious Diseases Research.

Key Companies: In Austin, **1st Detect** designs products to detect chemical warfare agents and explosives, while **Inview Technology**'s cameras operate the short wave infrared spectra beyond human visibility for applications ranging from military to life sciences. Houston-based **Pulmotect** develops therapies to boost human immune systems against bioterror agents like anthrax. College Station-based **G-CON** makes self-contained clean room pods that can be used for drug development and biomanufacturing.

Vaccines

Vaccines improve the body's resistance to disease by introducing weakened forms of a disease-causing organism. Researchers are continuing to discover new applications for vaccines, as well as methods to improve production capabilities and delivery systems.

Key Texas Research Centers: Texas A&M's **National Center for Therapeutics Manufacturing (NCTM)** and **CIADM** are two new facilities soon to become national leaders in vaccine development and manufacturing. UT San Antonio's **South Texas Center for Emerging Infectious Diseases** is focused on vaccine development and infectious diseases. UTMB's **Sealy Center for Vaccine Development** is focused on developing and promoting the most effective and safest disease prevention strategies.

Key Companies: In Houston, TETF awardee **Bellicum Pharmaceuticals** is developing oncological therapies, including a vaccine for prostate cancer, while Austin-based **Astrogenetix** uses biomarkers developed in the microgravity of space to develop vaccines for salmonella. Globally headquartered in Denmark, pharmaceutical company **ALK-Abelló** has its U.S. headquarters in Round Rock, just north of Austin. ALK is a leader in the development of allergy vaccinations, which are designed to reduce and potentially eliminate the effects of an allergic reaction.

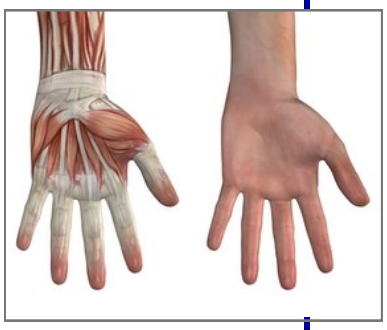
Personalized Medicine

Personalized medicine uses individual genetic information to prevent disease, choose medicines, and make other decisions about health. Researchers are interested in the use of gene-based tests to match patients with optimal drugs and dosages.

Key Texas Research Centers: **The University of Texas M.D. Anderson Cancer Center**'s **Sheikh Khalifa Bin Zayed Al Nahyan Institute for Personalized Cancer Therapy,** located in Houston, is a leader in the field. The **Texas A&M Institute for Genomic Medicine**, with the world's largest library of mouse knockout embryonic stem cells, is advancing personal medicine at the genomic level.

Key Companies: Austin houses a cluster of personalized medical companies including **Asuragen**, an Ambion spinoff and leader in personalized molecular diagnostics; **Luminex**, which offers a range of diagnostics and research assays throughout the areas of infectious diseases, human genetics, and personalized medicine; and **NanoMedical Systems**, which is developing its implantable Personalized Molecular Drug-delivery System to improve the long-term release of therapeutic agents. A Dallas-area cluster includes Irving-based **Caris Life Sciences,** a leading provider of pathology technologies and offers customized molecular profiles of patient tumors to facilitate effective treatments; Irving-based **Miraca Life Sciences,** specializing in the development and commercialization of the highest quality anatomic pathology services; and Dallas-based **Gradalis**, focused on the development and commercialization of novel personalized therapeutics to treat cancer.

Regenerative Medicine



Research institutions are gaining the capability to create personalized organs in the laboratory that match a patient's specific genetic makeup, relieving the pressure of finding a donor.

Key Texas Research Centers: Texas A&M's Health Science Center College of Medicine **Institute for Regenerative Medicine (IRM)** is an A&M joint venture with Scott & White Hospital and the Temple Bioscience District that received $5 million in TETF funding. Baylor College of Medicine's **Stem Cells and Regenerative Medicine (STaR) Center** focuses on stem-cell stimulation to regenerate tissues and the use of stem cells to repair damaged tissue. The **Armed Forces Institute of Regenerative Medicine (AFIRM)** at Fort Sam Houston in San Antonio advances therapies for injured service members and veterans.

Key Companies: Austin-based **SpineSmith** designs, develops, and markets implants and biologics for surgical fixation, correction, and tissue regeneration of the spine. San Antonio area -based **Targazyme (FKA America Stem Cell)** and **StemBioSys** as well as College Station-based **BLAST Therapeutics** are all working on developing technologies to expand the therapeutic potential of bone marrow-derived stem cells.

Medical Devices

Many of the biggest players in the medical device industry have corporate facilities in Texas. More than a dozen Fortune 1000 medical device giants alone have manufacturing or management operations in the state, including **Abbott Laboratories**, **Agilent Technologies**, **Baxter International, Becton Dickinson, CareFusion, GE**, **Johnson & Johnson**, **Medtronic**, **St. Jude Medical**, **Stryker**, **Thermo Fisher Scientific, and Zimmer**.

These companies and many others have developed a large medical device workforce in the state. Over 740 firms employ more than 15,400 workers in this sector, making Texas one of the top states in the nation for the number of medical device workers.

More than a dozen Fortune 1000 medical device giants have major operations in Texas

A wide range of medical products are developed and produced in Texas, from surgical sutures and bandages to molecular biology kits and medication delivery systems. While a broad spectrum of medical specializations are served by Texas device companies, the state has developed several unique clusters, including ophthalmology, orthopedics, cardiology, diagnostics, and wound care (see page 12 for details).

$1.4 billion

Amount invested by venture capital firms 2002 to 2014 in 78 biotech and 82 medical device deals in Texas.
(PricewaterhouseCoopers/National Venture Capital Assn. MoneyTree Report, Data: Thomson Reuters)

Emerging Technology & Venture Capital

Since 2005, the state's Texas Emerging Technology Fund (TETF) has invested over $88 million in medical device-related deals. From 2009 to 2014, venture capital firms invested over $526.7 million in 82 Texas medical device deals, according to The MoneyTree Report from PricewaterhouseCoopers and the National Venture Capital Association based on data provided by Thomson Reuters.

Greatbatch Expands in North Texas

In May 2015, Texas-based **Greatbatch** announced plans to move its North Texas headquarters from Frisco to Plano and add another 130 jobs by 2017. Two years ago, the medical device manufacturer relocated its corporate headquarters from Buffalo, New York to Frisco, Texas. At that time, it was a move of top executives and some administrative support. Since then, the company has grown to just over 30 people and outgrown its current space in Frisco.

"We wanted to establish a presence in North Texas to help with our growth strategy in a strong medical device community with a vibrant business climate," said Christopher Knospe, Greatbatch's Director of Global Communications and Government Affairs.

Greatbatch designs and manufactures critical medical device technologies for the cardiac, neurostimulation, vascular, and orthopaedic markets and batteries for high-end niche applications in the portable medical, energy, military, and environmental markets.

Major Companies

Top 10 Medical Device & Equipment Companies with Texas Operations

By Parent Company Global Revenues

Company Name	Primary Locations	Specialization	Sales (Millions)
GE Medical Systems (General Electric)	El Paso	Cardiology products	$148,589
Hitachi High Technologies America (Hitachi)	Dallas	Lab instruments	$93,325
Ethicon (Johnson & Johnson)	San Angelo	Surgical supplies	$74,331
Alcon Research (Novartis)	Houston	Ophthalmic products	$53,634
Flextronics	Irving, Plano	Contract design & manufacturing	$26,108
Dunlee (Philips)	Arlington	Radiology & imaging products	$26,000
Abbott Laboratories	Irving	Diagnostics	$20,247
Kimberly-Clark	Irving	Respiratory (disposables)	$19,724
Medtronic	Fort Worth, San Antonio	Surgical devices & diabetes mgmt.	$17,005
Thermo Fisher Scientific	Austin	Diagnostics	$16,889

Representative sample only. Sources: Dun & Bradstreet, company websites

Texas Medical Devices Companies Go Global

In May 2014, UK-based **Smith & Nephew** (S&N) completed the purchase of Austin, Texas-based **Arthocare**, an innovative medical device company operating in the sports medicine segment, for $1.7 billion. Now operating as a Texas-based subsidiary branded as **ArthroCare Sports Medicine**, the firm strengthens global medical technology leader S&N's sports medicine portfolio.

In March 2015, Houston, Texas-based **Cyberonics**, Inc., a neuromodulation-specializing medical devices company, announced $2.7 billion plans to merge with Italian medical device company and cardiovascular treatment leader **Sorin SpA**. The deal will create a new global company headquartered in the UK with its epilepsy device operations based in Houston.

In July 2014, UK-based medical devices giant **Medtronic** completed its approximately $105 million purchase of Houston-based **Visualase**, which received $750,000 in TETF funding for the development and marketing of a range of innovative minimally invasive neurosurgery products. Visualase has become a branded part of Medtronic's surgical technologies unit, which accounts for about 10 percent of the company's revenue.

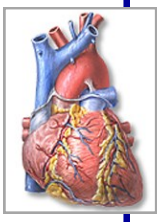
Texas Medical Device Clusters

Orthopedics

Key Products: Spinal, extremity, bone/tissue implants

Key Companies: The Austin region is home to more than 15 spinal and extremity orthopedic firms, originally anchored by the spine division of Fortune 1000 device maker **Zimmer**. Other orthopedic leaders in the region include **LDR Spine**, **DJO Surgical**, **DePuy Orthopaedics, Hanger Inc.,** and **Integra LifeSciences**. Additonally, multiple bone and tissue grafting firms, including **Zimmer Orthobiologics** and **BioMedical Enterprises (BME),** are located in the Austin-San Antonio corridor. Further north, the Dallas/Fort Worth region is home to the U.S. HQ of Dutch orthopedic firm **OrthoFix**.

Cardiology



Key Products: Catheters, surgical instruments, prosthetic heart valves

Key Companies: The Houston metro area is a hub of cardiology R&D and startups and is the location of established cardiovascular device firms like **Merit Medical Systems, Cardionics, Millar,** and **Cardiovascular Systems**. In the Dallas/Fort Worth region, Allen-based **Atrion Corp.** and Plano-based **Argon Medical Devices** manufacture instruments for cardiovascular surgery. In Austin, prosthetic heart-valve manufacturer **On-X Life Technologies** is part of that metro area's growing cardiology sector.

Diagnostics

Key Products: Cell cultures, laboratory equipment, clinical chemicals

Key Companies: Austin is home to a cluster of cutting edge diagnostics equipment firms, including **Luminex**, **Agilent Technologies**, **Asuragen**, and **Thermo Fisher Scientific**, while the nearby San Antonio's diagnostics cluster is anchored by **Becton Dickinson**'s corporate service center and **Fujirebio Diagnostics**' facility in Seguin. The Dallas/Fort Worth region is home to a major diagnostic product manufacturer, Fortune 500 giant **Abbott Laboratories** in Irving.

Wound Care

Key Products: Electromedical wound equipment, mattress systems, skin dressings, bandages

Key Companies: San Antonio is home to an established wound care cluster, which includes **KCI** and **Innovative Trauma Care (ITC), Rochal Industries**, and wound and burn R&D organization the **National Trauma Institute (NTI)**. Dallas/Fort Worth's concentration of wound care firms is led by **Smith & Nephew Biotherapeutics**, a maker of treatments for acute, chronic, and burn-related wounds. Medical supply firms in the region include wound-dressing makers **Strukmyer Medical**, **Winfield Laboratories**, and **Ferris Manufacturing**. Houston is home to wound care products maker **Mylan Institutional**.

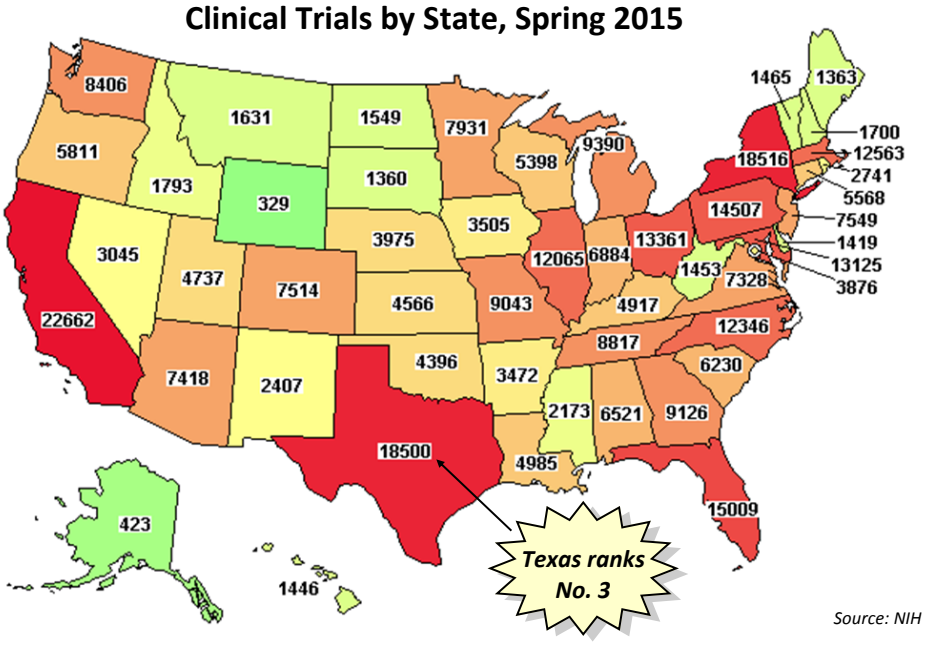
Pharmaceuticals

A growing list of global pharma companies have established research and production facilities in Texas, including UK-based, **Activis (**formerly Allergan), UK-based **Mylan,** and Switzerland's **Lonza**. Additionally, Texas has also fostered the headquarters of homegrown pharmaceutical successes like Fort Worth's ophthalmic leader **Alcon Laboratories** (now part of Swiss global pharma giant Novartis) and wound care innovator **Smith & Nephew Biotherapeutics** (formerly Healthpoint Biotherapeutics). These companies and many others have developed a substantial pharmaceutical manufacturing workforce in the Lone Star state. Approximately 125 firms now employ more than 10,600 workers in the sector, making Texas one of the top states in the nation for number of pharmaceutical manufacturing workers.

Texas is also a leading pharmaceutical research state. In Spring 2015, Texas ranked No. 3 nationally for number of clinical trials, with approximately 18,500 studies underway, according to the National Institutes of Health (see map below). In addition, many of the world's leading clinical trial and contract research firms have operations across Texas, including **PPD**, **Covance**, **Quintiles**, **INC Research**, and **Radiant Research**.

Texas pharmaceutical companies employ more than 10,600 skilled workers

Since 2005, the state's Texas Emerging Technology Fund (TETF) has invested over $146 million in pharmaceuticals-related deals.



Source: NIH ClinicalTrials.gov

Major Companies

Top 10 Pharmaceutical Companies with Operations in Texas

by Parent Company Global Revenues

Company Name	Primary Location	Specialization	Sales (Millions)
Galderma Laboratories (Nestlé)	Fort Worth	Dermatology	$92,829
Alcon (Novartis)	Fort Worth	Ophthalmics	$53,634
FUJIFILM Diosynth Biotechnologies Texas (FUJIFILM)	College Station	Molecular biologics	$23,697
Activis (formerly Allergan)	Waco	Ophthalmics	$13,060
Mylan	Sugar Land	Generic pharmaceuticals	$7,719
Smith & Nephew Biotherapeutics (Formerly Healthpoint Bioth.)	Fort Worth	Dermatology	$4,617
Lonza Houston (Lonza)	Houston	Viral vectors	$4,024
NBTY	San Antonio	Vitamins	$3,205
Virbac Corp. (Virbac SA)	Fort Worth	Veterinary care	$1,013
Omega Protein	Houston	Nutritional products	$308

Representative sample only. Sources: Dun & Bradstreet, company websites

Texas A&M Biocorridor in the News

In December 2014, UK-based biopharmaceuticals firm **FUJIFILM Diosynth Biotechnologies Inc**., a biologics contract development and manufacturing subsidiary of Japanese photography and imaging giant FUJIFILM, completed its purchase of College Station, Texas-based vaccines company **Kalon Biotherapeutics** for an undisclosed amount. Kalon, now a subsidiary known as **FUJIFILM Diosynth Biotechnologies Texas LLC,** was a TETF-supported Texas A&M University (TAMU) spin-off that manufactures vaccines for companies, notably **GlaxoSmithKline**, which is partnering in **TAMU's Center for Innovation in Advanced Development and Manufacturing (CIADM)** and the CIADM's $91 million **Pandemic Influenza Vaccine Facility (PIVF).**

TAMU received $40 million in TETF funding to create the CIADM, which will serve as one of the nation's three national biodefense centers and an anchor for the **TAMU Biocorridor** when completed in 2017.

In September 2014, the **Pandemic Influenza Vaccine Facility** site was dedicated in Bryan, Texas. When completed in 2017, the $91 million, 100,000 sq. ft., state-of-the-art flu vaccine manufacturing facility will develop vaccines targeting pandemic influenza strains, as well as help protect the nation against infectious disease and the threat of bioterrorism.

PIVF artistic rendering, courtesy of the Beck Group

Austin Pharmaceuticals Firm Goes Public, Plans Major Expansion

In April 2015, Austin-based **XBiotech Inc.** held an IPO, raising $76 million. The company is a leading developer of next-generation therapeutical antibodies to treat a variety of diseases, including cancer, vascular disease, type 2 diabetes, acne, and psoriasis.

In September 2014, XBiotech broke ground on its first manufacturing and research facility of its planned $200 million campus of buildings. The 48,000 sq. ft. building is expected to open in 2015 and to begin production and shipping the company's colorectal cancer-fighting drug Xilonix by 2016.

Founded in Canada in the mid-2000s, XBiotech has raised over $50 million to fund its product development and expansion plans. The company also has subsidiaries in Switzerland, Germany, and Japan.

XBiotech
Next Generation Antibody Therapy

Texas-Made Pharmaceutical Products

A wide variety of consumable pharmaceuticals and pharmaceutical products are manufactured in Texas. Below are a few examples of leading products, ranging from Alcon's eye care products to Omega Protein's nutritional products.

Biomedical Research

Research and development (R&D) is the lifeblood of the biotechnology industry. In Texas, the R&D pipeline is supplied in part by the state's vast network of public universities and health-related institutions, which invest heavily in R&D and intellectual property generation. In fiscal year (FY) 2013 alone, the latest data available, Texas public institutions of higher education expended almost $2.9 billion on medical and life sciences research, accounting for over 65% of all higher education R&D expenditures in the state.

Public investment in biotechnology research is complemented by the state's substantial cluster of private sector R&D activity. Texas is home to over 1,000 private scientific R&D firms that employ more than 19,400 workers. Many of the largest private biotechnology R&D firms in the world have operations in Texas, including **PPD**, **Covance**, **Quintiles**, **INC Research**, and Shin Nippon Biomedical Laboratories' **SNBL USA** subsidiary. These firms have helped make the state a hub of clinical trials and other breakthrough research.

In 2013, Texas higher education institutions expended almost $2.9 billion on life science R&D

In addition to R&D facilities, Texas has more than 1,600 medical and testing laboratories, which include blood, pathology, imaging, diagnostics, and device testing facilities. These laboratories employ more than 37,200 in Texas. Major laboratory firms in the state include LabCorp's **Esoterix** subsidiary, Spanish biological product firm **Grifols**, and Sonic Healthcare's **Clinical Pathology Laboratories** subsidiary.

Since 2005, the state's Texas Emerging Technology Fund (TETF) has invested over $142 million in some of the state's major higher education institutes for biomedical research-related deals in sectors ranging from agricultural genomics to therapeutics manufacturing.

Texas is also a leader in cancer research. Major institutions in this field include **MD Anderson Cancer Center** in Houston, **Scott & White Cancer Institute** in Temple, and Dallas-based **Texas Oncology** and **Mary Crowley Cancer Research Centers**. Additionally, the **Cancer Prevention and Research Institute of Texas (CPRIT)**, a $3 billion state-funded initiative based in Austin, has been instrumental in expanding Texas cancer research.

Texas in Top Ten for Biotech-Related Doctorates

In 2013, the National Science Foundation ranked Texas among the top ten of U.S. states for number of doctorates awarded in biotech-related fields:

- #3 for **all Doctorates** Awarded
- #1 for **Agricultural Sciences** Doctorates
- #7 for **Health Sciences** Doctorates
- #3 for **Life Sciences** Doctorates
- #3 for **Biological/Biomedical Sciences** Doctorates

Biotech Education in Texas

Number of Biotechnology-Related Degrees Awarded, 2010-2014

All Texas Public Universities, All Degree Levels

Healthcare Professionals Technicians		29,568
Biological & Biomedical Sciences		24,906
Plant & Agricultural Sciences		5,514
Animal Sciences		5,137
	TOTAL	**65,125**

Source: Texas Higher Education Coordinating Board

Top Ten Texas Institutions for Biomedical R&D

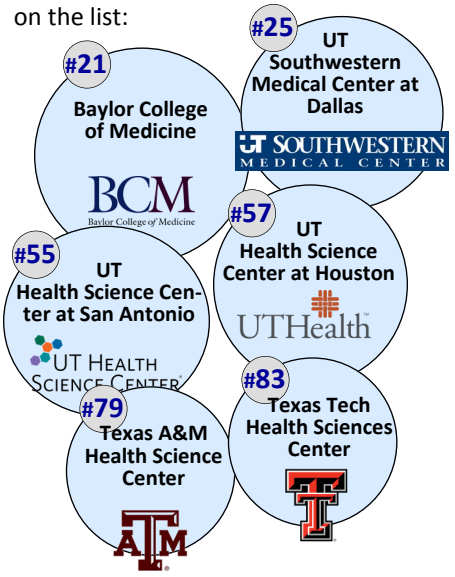
by FY 2013 Expenditures

Institution	Total R&D (Millions)
Univ. of Texas (UT) M.D. Anderson Cancer	$670.5
Baylor College of Medicine-Houston	$481.8
UT Southwestern Medical Ctr. at Dallas	$404.3
UT Health Science Center (HSC) at Houston	$220.1
Texas A&M University	$201.6
UT Health Science Center at San Antonio	$156.4
UT Medical Branch (UTMB) at Galveston	$144.7
The University of Texas at Austin	$80.9
Texas A&M Health Science Center	$75.4
Texas Tech University Health Science Ctr.	$61.0
TOTAL	**$2,496.7**

Source: Texas Higher Education Coordinating Board

Texas Places Six Research Medical Schools in Top 100

In 2015, *U.S. News & World Report* ranked the nation's top 100 research medical schools. Texas landed six schools on the list:

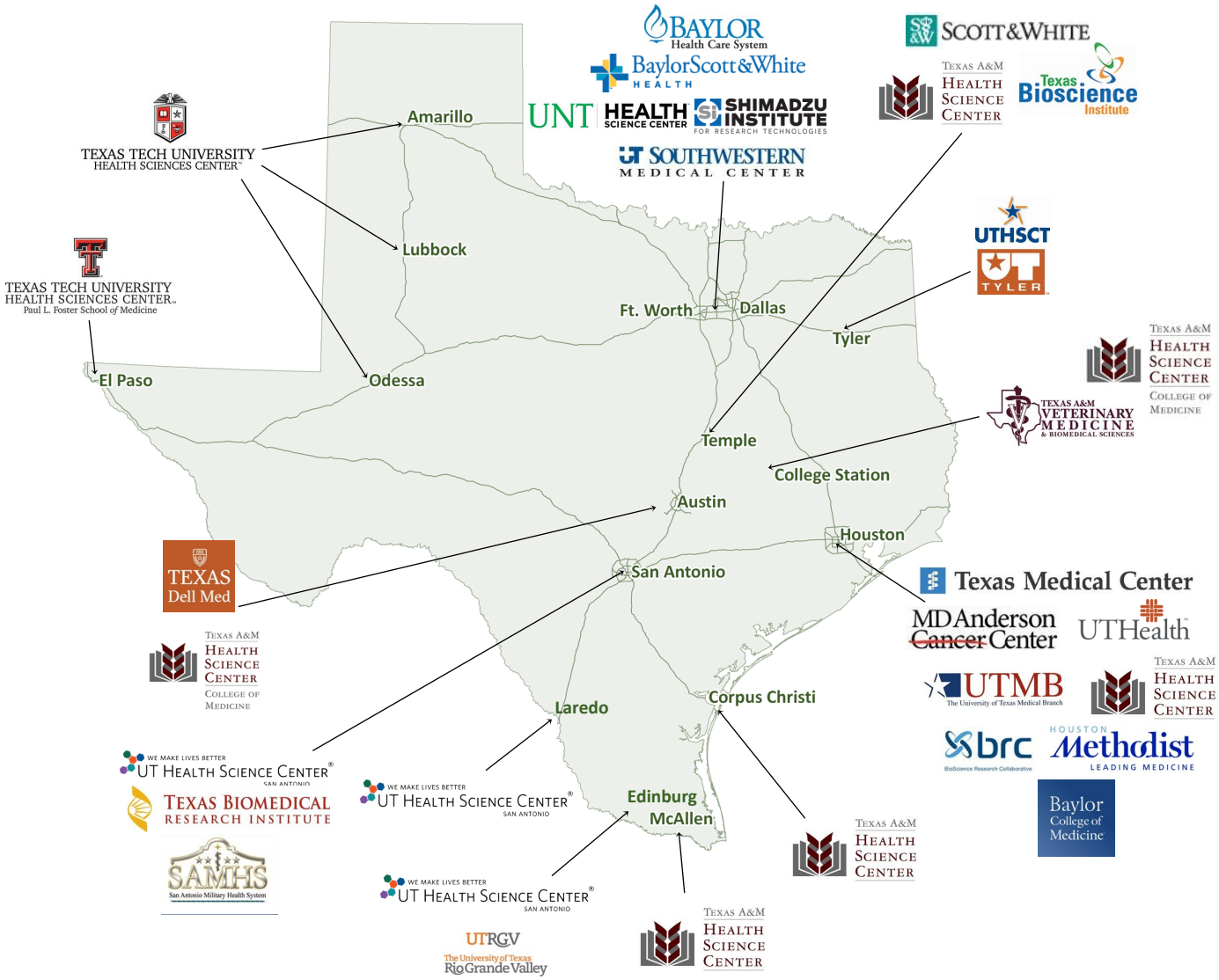


In 2014, the **University of Texas** (UT) ranked No. 2 nationally for the number of pharmaceutical-related patents earned by a university (Class 424—Drug, Bio-Affecting and Body Treating Compositions), while the **State of Texas** ranked No. 7 nationally, according to the U.S. Patent and Trademark Office.

Research Centers

Texas is home to top-ranked biotechnology and medical research institutions, federally designated centers, innovative research collaborations, and some of the world's largest medical complexes. A number of the most ambitious Texas medical center expansions are a result of the U.S. Department of Defense's (DoD) 2005 military base realignments across the nation, which consolidated military medical facilities in San Antonio. A sampling of military, university, and private medical research facilities are profiled regionally on the following pages. The map below provides a broad snapshot of some of the state's major medical-related research centers and nine medical schools.

Texas Medical Schools & Selected Medical Research Centers



Due to space limitations, not all institutions are included.

HOUSTON/GULF COAST

World's Largest Medical Center Opens Nation's Largest Innovation Center

The **Texas Medical Center (TMC)** in Houston is the world's largest medical center with 106,000 employees housed on 1,345 acres comprised of 21 hospitals, 13 support organizations, eight academic and research institutions, six nursing programs, three public health organizations, three medical schools, two universities, two pharmacy schools, and a dental school. TMC members include **Baylor College of Medicine**, **UT M.D. Anderson Cancer Center (MDACC)**, **UT Health Science Center**, **The University of Houston (UH)**, **Rice University**, **Texas A&M University Health Science Center**, **The Methodist Hospital**, and **Texas Children's Hospital**.

In late 2014, the **TMC accelerater (TMCX)** began operations in 100,000 sq. ft. of a former Nabisco cookie factory, making it the country's largest business incubator. TMCX, the TMC's life sciences business incubator, provides life science startups access to TMC facilities and resources and works to transform scientific innovations into companies that can save lives, manage diseases, and improve quality of life.

The TMC opened the **TMCX+** next door to the TMCX in April 2015 in 24,000 sq. ft. space dedicated to further mentoring startup life sciences companies, as well as providing them office space.

Texas Medical Center


Texas Medical Center

UT RGV Medical School Opening Soon

UT Rio Grande Valley (RGV) began construction of its new medical school in August 2014, scheduled to open for classes in Fall 2016. Facilities will include a 15,000 sq. ft. Smart Hospital complex, a virtual anatomy and histology laboratory, and an interactive, personalized learning platform. With its unique location at the border of the U.S. and Mexico, the school is dedicated to increasing the number of minorities practicing medicine in Texas.

UTRGV
The University of Texas Rio Grande Valley


UTRGV Medical School, artistic rendering

Houston Methodist Expands

The **Houston Methodist hospital system** has recently announced the following expansions.

- A 470,000 sq. ft., 193-bed full-services hospital in The Woodlands, opening in 2017
- A 135,000 sq. ft. medical office building, also in The Woodlands, opening in late 2015
- A 390-bed inpatient tower on the Houston Methodist Hospital campus in the TMC

Houston Methodist is a leading health provider based in Houston that is top ranked by *FORTUNE* and *U.S. News & World Report.*

HOUSTON Methodist LEADING MEDICINE

UTMB at Galveston Is National Leader in Fighting Infectious Diseases

The University of Texas Medical Branch (UTMB) at Galveston was established in 1891, making it the oldest of UT Systems' four medical schools. UTMB has developed a strong program in infectious disease research with several facilities devoted to that field.

utmb Health
Working together to work wonders.™

- Has over 2,500 students and 1,000 faculty with total research expenditures of $144.7 million in FY 2013
- Became a member of Houston's Texas Medical Center in 2010
- Serves as one of the nation's 11 federal Regional Centers of Excellence for Biodefense and Emerging Infectious Diseases Research (CBEID), for the Western Region. The **CBEID at UTMB Galveston** was established by the National Institutes of Health (NIH) in 2002 and serves as the lead institution for participating academic institutions in the Western Region, a five-state area that includes Louisiana, Arkansas, New Mexico, and Oklahoma.
- One of the nation's two National Biocontainment Laboratories is located at UTMB. The **Galveston National Laboratory (GNL)** was established with grants awarded by the NIH's National Institute of Allergy and Infectious Diseases (NIAID). The GNL conducts research to develop therapies, vaccines, and diagnostic tests for naturally occurring emerging diseases such as SARS, West Nile encephalitis, and avian flu, as well as for microbes that might be employed by terrorists.
- In 2003, the UTMB CBEID was awarded a $110 million NIH grant to establish the GNL's **Robert E. Shope Laboratory**, a Biosafety Level 4 facility. The lab opened in 2004 and is the first full-sized facility of its kind in the nation to be located on a university campus.

BCM Top Ranked for R&D

The **Baylor College of Medicine (BCM) in Houston**, located in Houston's Texas Medical Center, is the state's only private medical school.

- Had research support of $481 million in FY 2013 and trains over 3,000 students, including residents and post-doctoral fellows
- Has received over $140 million to date in CPRIT cancer research funding
- Ranked as one the nation's top 25 medical schools for research by *U.S. News & World Report* in 2015
- Faculty includes members of the National Academy of Sciences, Institute of Medicine, Howard Hughes Investigators, and many leaders of professional organizations

Baylor College of Medicine

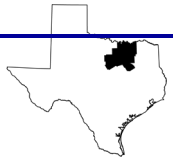
MD Anderson Raises Millions for Its Moon Shots Program

In April 2015, a **UT MD Anderson Cancer Center (MDACC)** fundraiser featuring President Bill Clinton and General Colin Powell raised $5.2 million for the institution's Moon Shots Program (MSP), an unprecedented effort to significantly reduce deaths from cancer, including a pilot initiative to advance innovative pancreatic cancer research.

MD Anderson Cancer Center

The MDACC is the nation's top-ranked hospitals for cancer care. Its $3 billion MSP was announced in 2012, inspired by America's space program to put a man on the moon.

NORTH TEXAS



Southwestern Medical District & UT SW Medical Center Expand

The **Southwestern Medical District (SMD)** in Dallas is a 390-acre medical complex that is home to world-class biomedical research organizations employing over 30,000. Member institutions include University Hospital-St. Paul, University Hospital-Zale Lipshy, Children's Medical Center Dallas, and Parkland Health & Hospital System.

- In April 2015, SMD received a $4 million CPRIT award to recruit **Dr. Xiaochun Yu**, a top cancer researcher, from Michigan
- In October 2014**,** a new $800 million, 460-bed state-of-the-art **William P. Clements Jr. University Hospital** opened
- Planned SMD expansions include a new $1.27 billion **Parkland hospital campus**, scheduled to open in 2015

One of the world's top academic medical centers, **the University of Texas Southwestern Medical Center (UTSWMC)**, is also located at SMD. UTSWMC alone employs 13,800 and trains over 4,700 students annually with an operating budget of nearly $2.3 billion.

- Ranked No. 25 for best U.S. research medical schools in 2015 by *U.S. News & World Report*
- Its Harold C. Simmons Cancer Center (HSCC) is a National Cancer Institute (NCI) designated cancer center, a distinction held by only 68 top-tier cancer centers nationwide
- UTSWMC's outstanding faculty has included six Nobel Prize recipients since 1985. In 2013, Dr. Thomas Sudhof won a Nobel award in Medicine for work he began at SWMC and continued at Stanford
- In May 2015, UTSWMC's HSCC opened its new satellite facility at the Moncrief Cancer Institute in Fort Worth, the 22,500 sq. ft. **HSCC Fort Worth**. It will bring comprehensive clinical cancer services to Tarrant and surrounding counties.

University of North Texas Leads in Training Primary Care Physicians

The **Texas College of Osteopathic Medicine (TCOM)** is located at the University of North Texas (UNT) HSC in Fort Worth. It is the state's only osteopathic medical school and a leader in training physicians in primary medical care and rural medicine.

- Has over 900 students and 259 full-time and 650 part-time faculty
- Approximately 65% of TCOM's graduates practice primary care medicine, helping reduce the statewide and nationwide shortage
- UNT HSC ranked No. 52 for best U.S. medical schools for primary care in 2015 by *U.S. News & World Report*
- TCOM's Osteopathic Research Center is a national research program that studies the clinical effectiveness of osteopathic manipulative medicine

SOUTH TEXAS

Nationally Ranked Cancer Center at UTHSC at San Antonio

The **University of Texas Health Science Center (UTHSC) at San Antonio** is one of the UT System's four medical schools.

- Over 3,000 students trained annually on UTHSC campuses in San Antonio, Harlingen, Edinburg, and Laredo
- Managed $156.4 million in annual research related activity in FY 2013
- In September 2014, the NCI reconfirmed the **UTHSC Cancer Therapy & Research Center's** as one of four cancer centers in Texas
- Also in 2014, UTHSC announced its new **Military Health Institute**, which leverages the area's military medicine expertise

Military Medical System Trains World-Class Health Care Providers

The U.S. Air Force and Army's **San Antonio Military Health System (SAMHS)** oversees all the military treatment facilities and the healthcare needs of approximately 240,000 DoD beneficiaries in the San Antonio area. With a $1.2 billion budget and 12,000 staff, SAMHS healthcare services are led by the **San Antonio Military Medical Center**, a Level 1 trauma center and the DoD's largest inpatient hospital and **Wilford Hall Ambulatory Surgical Center**, the DoD's largest outpatient ambulatory surgery center.

SAMHS' medical education program, **the San Antonio Uniformed Services Health Education Consortium**, has over 35 programs and 600 residents in training. Its goal is to train world-class physicians and allied health specialists.

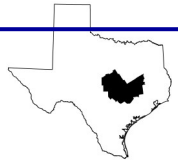
San Antonio Serves as Hub of Private Sector Scientific R&D

Since 1947, San Antonio's **Southwest Research Institute (SwRI)** has provided contract R&D services to industrial and government clients across industries, which today include biotechnology and medicine. SwRI's headquarters facility employs nearly 2,800 workers and occupies over two million square feet of office and laboratory space across 1,200 acres. SwRI's 2014 revenues were $549 million and, in 2014, the organization dedicated $6.9 million to fund 73 internal research programs, separate from contract client projects.

The **Texas Biomedical Research Institute (TBRI)**, SwRI's sister institution located on an adjacent 200 acre campus, is one of the world's leading independent biomedical research institutions. TBRI's annual budget is over $70 million and it employs approximately 360 people. The institute is home to the Southwest National Primate Research Center with the world's largest colony of baboons for biomedical research; the nation's only privately owned biosafety level 4 laboratory; and the AT&T Genomics Computing Center, the world's largest computer cluster devoted to human genetic and genomic research.

Photo source: TBRI

CENTRAL TEXAS



Dell Medical School Builds Partnerships in Central Texas

In 2014, the **UT Austin** broke ground on the 515,000 sq. ft., $334 million campus for the **Dell Medical School** (DMS). The medical school will be part of the Austin's new medical district and is scheduled to open in 2016. UT partner, **Seton Healthcare**, is building a new $295 million teaching hospital adjacent to the UT Austin's campus which is scheduled to open in 2017.

- In March 2015, UT announced the **Design Institute of Health** (DIH), a collaboration between the MDS and UT's College of Fine Arts. The DIH will bring a design-thinking approach to everything from new medical devices to a reimagined structure for the region's health care system.
- In February 2015, Austin-based **Huston-Tillotson University** (HTU), a historically black university, and the DMS announced a new partnership to jointly manage the $35 million **Sandra Joy Anderson Community Health & Wellness Center** at HTU. The Center will address mental health issues in East Austin, particularly in underserved populations.
- In August 2014, the **LIVESTRONG Foundation** donated $50 million to UT Health to establish the **LIVESTRONG Cancer Institutes** (LCI). The LCI will work in partnership with the DMS to advance cancer research and patient care.

Texas A&M Health Science Center Raises Millions for Research Efforts

Texas A&M Health Science Center College (TAMHSC), based in College Station, is a state agency and academic unit of TAMU that consolidates all health-related entities across the system. TAMHSC is dedicated to addressing health care needs and operates eight campuses across the state.

- Over 2,400 students and 3,000 faculty members
- Ranked No. 79 for best U.S. medical schools for primary care in 2015 by *U.S. News & World Report*
- Managed $75.4 million in annual research related activity in FY 2013
- In February 2015, TAMHS announced achieving over $100 million in research funding, a milestone at a time when overall sector funding is stagnant.

The **Texas A&M Health Science Center College of Medicine (TAMHSCCM)**, one of the state's nine (soon to be eleven) medical schools, is a community-based medical school providing third- and fourth-year clinical training at regional clinical campuses around the state through affiliations through local physicians, clinics and hospitals.

- Has five main campuses with over 870 students and 2,640 faculty members
- In 2014, TAMHSCCM in Round Rock announced it will expand from a two-year program to a three-year program

Austin Community College Building Critically Needed Wet Lab Space

Austin Community College (ACC) is a nationally recognized two-year college serving an 8-county area in Central Texas based in Austin. ACC's programs cover everything from accounting to welding, including life science-related areas such as biotechnology, nursing, radiology, Health Information Technology, and medical lab technology. ACC serves over 58,000 students on eleven campuses.

- In August 2014, the 200,000 sq. ft. **ACC Highland campus** opened in the newly renovated portion of a former shopping mall. The remainder of what will be the new Highland Campus is largely still under construction, designed as a private-public partnership which will also be home to a regional workforce innovation center, professional incubator, cloud computing company Rackspace, student housing, and more.
- In February 2015, ACC received a $4.9 million TETF award to develop a highly specialized biotechnology research lab known as a wet lab to address a critical shortage of this type of research space in the region. ACC is the first two-year institution to apply for and receive funding from the TETF Research Award Matching Program, as well as the first state community college to build a wet lab.

ACC will partner with the **Texas Life-Sciences Collaboration Center, the Austin Technology Incubator (ATI) at UT Austin,** and the **City of Georgetown**. The wet lab facility will provide a unique learning experience to ACC students and allow companies developing products, including pharmaceutical drugs, to lease space in the 8,400 sq. ft. lab, which will be built at the ACC Highland campus.

BioResearch Valley and BioCorridor Drive Central Texas Biotech Innovation

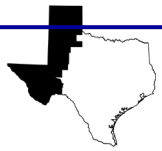
The **Research Valley Partnership,** in conjunction with the **Texas A&M University (TAMU) System**, coordinate the **BioResearch Valley** and **Biocorridor,** branding for the combined resources and facilities anchored by TAMU's main campus in the Bryan-College Station area to foster education, research, development, commercialization, and the production of biotechnology products and therapies, including pharmaceuticals and vaccines.

With its proximity to Houston's medical center, the Biocorridor intends to become the nation's premier destination for the discovery of new therapies, preclinical trials, and manufacturing—all in one location.

The Biocorridor's interdisciplinary collaborations and research will encompass humans, animals, and plants.

Participating Biocorridor research facilities include the **TAMU Health Science Center**, **TAMU College of Veterinary Medicine and Biomedical Sciences (CVM), TAMU Institute for Preclinical Studies (TIPS)**, **TAMU Institute for Genomic Medicine (TIGM)**, and **TAMU's National Center for Therapeutics Manufacturing (NCTM)**. Companies include **G-CON, Caliber Biotherapeutics**, and **FUJIFILM Diosynth Biotechnologies Texas LLC**. A further participant is the **TAMU Bioscience Business Accelerator**.

WEST TEXAS



Medical Center of the Americas Builds Innovation in El Paso

The **Medical Center of the Americas (MCA)**, managed by the **MCA Foundation**, is a fast growing 440 acre campus in El Paso anchored by **Texas Tech University Health Sciences Center (TTUHSC) El Paso, University Medical Center of El Paso,** and **El Paso's Children's Hospital.** The MCA is working to advance the region's biomedical innovation pipeline and assets, including **UT at El Paso, William Beaumont Army Medical Center at Fort Bliss,** and the **Universidad Autónoma de Ciudad Juarez**.

MEDICAL CENTER OF THE AMERICAS FOUNDATION

- In February 2015, the MCA broke ground on a $29 million, 60,000 sq. ft. biomedical research and technology building. It will house the **RedSky Biomedical Institute**, TTUHSC labs, and incubator space for startups.

TTUHSC Leads Medical Training and Research in West Texas

Texas Tech University Health Sciences Center (TTUHSC), is based in Lubbock with satellite campuses in Abilene, Amarillo, El Paso, Lubbock, Midland, Odessa, and Dallas/Fort Worth.

TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER™

- TTHUSC system includes two medical schools (**TTUHSC School of Medicine (SOM)** and **Paul L. Foster SOM**, two nursing schools, a pharmacy school, a graduate school of biomedical sciences, and a school of allied health sciences
- Managed over $61 million in annual research related activities in FY 2013
- Has trained over 10,000 health professionals
- Serves the health care needs of more than 2.5 million people who live throughout a vast 108-county area in West Texas

EAST TEXAS

UTHealth Northeast Drives Primary Care Physician Training in East Texas

The **University of Texas Health Science Center at Tyler,** which does business as **UTHealth Northeast,** is the only university medical center in North East Texas and a world-renowned center of pulmonary and infectious disease treatment and research.

- Employs over 800 with an annual budget of $150 million
- Managed $11.5 million in annual research related activities in FY 2013
- Has more than 20 outpatient clinics, a hospital, and an emergency care center
- Its graduate medical education programs – with residencies in family medicine and occupational medicine – provide doctors for the Northeast Texas region
- Offers residency programs in family medicine and occupational medicine, as well as master's degree programs in biotechnology and environmental science
- Partner to the **Heartland National TB Center**, which is located at the **Texas Center for Infectious Disease in San Antonio** and is one of the nation's four regional training and medical consultation centers for tuberculosis

UTHEALTH NORTHEAST

Animal & Agricultural Biotech

Animal biotechnology focuses on the genetic improvement of domesticated animal species, including cloning, selective breeding, artificial insemination, and genetic engineering. Crop biotechnology research is centered on increasing yields by making plants stronger and more resistant to pests and environmental stresses, as well as by developing genetically modified (GM) organisms, biopesticides, herbicides, and other crop protections.

Texas was the nation's No. 1 cotton producer and 93% of the state's cotton crop was genetically modified in 2014

-U.S. Dept. of Agriculture

Texas is a natural choice for agricultural biotechnology business as the nation's leading producer of cattle and cotton and the No. 3 overall producer of agricultural products, behind California and Iowa. The state is also home to established agricultural feedstock and chemicals manufacturing industries concentrated in the Texas Panhandle and Gulf Coast regions.

The Lone Star State is home to world-class agricultural education and research facilities, particularly through the Texas A&M and Texas Tech University Systems (see the box at right). Texas is ranked No. 1 nationally for Agricultural Sciences Doctorates by the National Science Foundation. Furthermore, Texas A&M has long led the nation in graduating more students in animal and agricultural-related fields than any other institution.

Since 2005, the state's Texas Emerging Technology Fund (TETF) has invested $1.25 million in animal-related deals.

Leading Texas Research Centers

Texas has been at the forefront of animal and agricultural research for over 100 years. Below are profiles of some of the state's leading public research centers for agricultural and animal sciences, located at two of the state's leading university systems: Texas A&M and Texas Tech.

Texas A&M AgriLife Research: Serves as the state's premiere R&D agency in agriculture, natural resources, and the life sciences with 13 statewide regional centers and over 500 doctoral-level researchers.

Texas Tech Univ., Animal & Food Sciences Dept., Burnett Center for Beef Cattle Research: The Center's scientists are leaders in the study of beef cattle feeding and management.

Texas A&M, College of Veterinary Medicine and Biomedical Sciences: The sole veterinary college in Texas focuses disciplines including infectious diseases, toxicology and environmental health science, cardiovascular sciences, neurosciences, and reproductive biology.

Texas A&M, Dept. of Soil & Crop Sciences: The department is one of the largest such facilities in the world with a global reputation. It develops technologies to sustain environmentally and economically sound production systems and promotes the wise use and management of soil, plant, and water resources.

Agribusiness Industry Leaders Continue to Invest in Texas Cotton R&D

Because Texas is the nation's largest producer of cotton, the state is a natural location for the R&D operations of Fortune 500 agribusiness firm **Monsanto**. In fact, the Missouri-based company has nine locations in Texas, including a research farm outside of Lubbock and testing centers in Haskell and near Corpus Christi.

In 2010, Monsanto opened its newest Texas facility, the $10.5 million **Texas Cotton Breeding and Technology Center,** in Lubbock. Monsanto's new "research megasite" exemplifies its commitment to the Texas cotton industry and to developing varieties adapted to the region, which produces more cotton than any other state.

Monsanto, however, is not the only global agricultural biotech firm in Texas. Since 1998, German conglomerate **Bayer** has operated its **CropScience** division's global cotton headquarters in Lubbock. The company has eleven facilities in and around the city, including a state-of-the-art R&D lab, two breeding stations, a seed processing plant, a seed warehousing facility, a quality assurance lab, and it supports two of its global cotton seed brands, Stoneville and FiberMax.

In September 2014, Bayer CropScience announced it plans to invest approximately $90 million in its **Cotton Research & Development Laboratory** in Lubbock as part of a $1 billion nationwide R&D ramp up.

Monsanto's Lubbock Cotton R&D Center

Monsanto and Bayer CropScience have developed cotton R&D partnerships with Texas universities, including two of the state's leading research institutions, **Texas Tech University (TTU)** and **Texas A&M University**. Monsanto offers technology internships to TTU students and has donated cotton genetic materials for R&D and breeding purposes to TAMU AgriLife Research. Bayer CropScience and TTU have been working together to develop new cotton technology. (See collaboration details below.)

Texas Universities Partner with Bayer in Agricultural Genomics R&D

Located in the heart of the cotton belt, Lubbock-based **Texas Tech University (TTU)** is a national leader in agricultural and cotton research. TTU has been a major partner to **Bayer CropScience (BCS)** for many years. Since 1998, Bayer's total contributions to TTU have totaled over $27 million. With leveraged state matching funds, that comes to approximately $55 million, making Bayer one of TTU's largest corporate donors.

Bayer has substantially funded and supported cotton research at TTU over the years. In 2009, TTU and BCS signed an exclusive licensing agreement for new cotton technology. In 2010, Bayer contributed $7.5 million to **TTU's Dept. of Plant and Soil Science (DPSS)** to support new research initiatives and facilities development. In 2014, TTU announced a $19.3 million contribution from Bayer to support new cotton research and other projects at TTU's DPSS.

Bayer has also partnered with **Texas A&M University (TAMU)** over the years. Since 2004, the company has supported **TAMU's Kingsville Citrus Center**, where groundbreaking R&D is being conducted to improve crop safety and productivity of specialty crops including fruit, tree nuts, and vegetables. In 2011, Bayer signed a multi-year agreement to advance wheat breeding with **TAMU's Texas AgriLife Research**, utilizing TAMU's extensive collection of wheat cultivars and germplasm.

Environmental Tech & Biofuels

Environmental biotechnology and biofuels are transforming many industrial processes to better conserve and sustain natural resources, ensure food and water safety, utilize crop residues for feed stocks and energy sources, and assist mature industries such as food processing, public water systems, and petrochemicals to become more competitive. Biofuels and biomass are playing an increasingly important role in Texas' and the nation's energy mix. Renewable biofuels, including ethanol and biodiesel, can be created from nonfood biomass such as algae, lumber scrap, switchgrass, animal waste, and agricultural residues like corn husks.

Texas ranks No. 1 nationally for biodiesel production capacity

As the nation's No. 3 agricultural production state and home to a large forest and cattle industry, Texas is rich in biomass resources. The U.S. Department of Energy (DOE) ranks Texas No. 5 in the nation for biomass potential, including crop and forest residues, methane emissions, and potential energy crop farming.

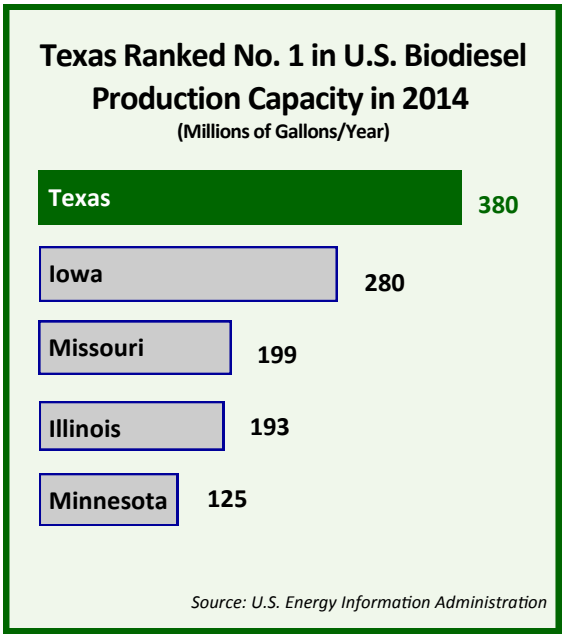
Building on the state's strong agricultural and forestry production base, Texas researchers and businesses are investing in new renewable energy technologies to maintain the state's position as the nation's energy capital. Research in Texas ranges from exploring new methods to convert nonfood stock materials to investigating ways to turn algae into biofuels.

In FY 2013, Texas institutions of higher education spent over $242.6 million on environmental sciences R&D, according to the Texas Higher Education Coordinating Board. Additionally, the Texas Emerging Technology Fund has invested over $23 million to date into environmental and biofuels-related projects.

Biofuels in Texas

Ethanol and biodiesel are alternative fuels defined by their feedstock. **Biodiesel** is produced from vegetable or animal oils that are processed into an alcohol ester, while **ethanol** is produced from corn, sugar cane, or non-crop plant materials, which are fermented and turned into alcohol. Since Texas laid out plans for a statewide bioenergy initiative in 2007, Texas has focused on developing alternative fuels from woody grasses and other plants, rather than food crops like corn.

Texas is the No. 1 biodiesel producing state, with 380 million gallons of production capacity from nine refineries, according to the latest data from the U.S. Energy Information Administration. Furthermore, Texas is home to the nation's largest biodiesel plant,



Houston-based **Renewable Biofuel's RBF Port Neches Biodiesel Facility** in Port Neches, Texas.

While the Midwestern corn belt accounts for most of the nation's ethanol production, four ethanol plants with a total of 355 million gallons per year capacity have been built in the Texas Panhandle. Texas ranks No. 11 nationally for ethanol production capacity; however, the state's massive agricultural and forestry assets represent potential feedstock sources for next-generation biofuels.

Texas is home to the nation's largest biodiesel plant

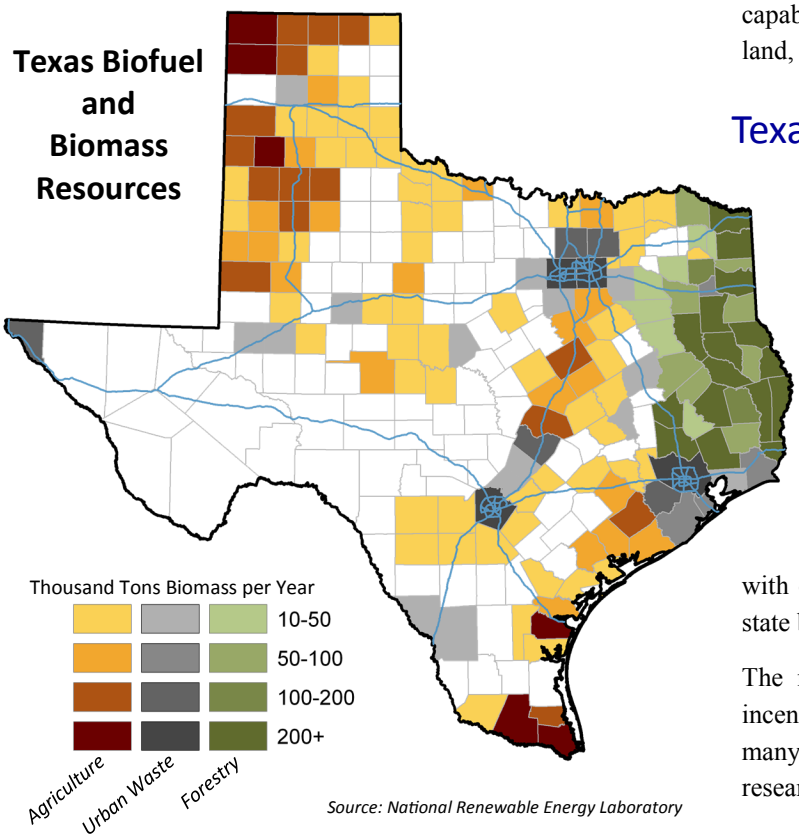
Cellulosic ethanol is produced using feedstock from almost any plant material. Agricultural and forestry waste are prime candidates. Current cellulosic biofuels research focuses on crops that can flourish on low value land, in semiarid climates, and using brackish water. For example, **Texas A&M University** researchers are studying potential feedstocks suitable for arid climates, such as switchgrass, a fast-growing native grass that can be cultivated on marginal land.

Algae biofuels utilize algae as a feedstock. Algae cells are oil-rich and grow rapidly. Algae-derived biofuels are also attractive because microalgae are capable of thriving with brackish water and marginal land, which don't compete with food crops.

Shell Plans Cellulosic Ethanol Pilot Plant in Houston

In 2015, **Royal Dutch Shell** plans to build a **pilot plant** to test technology that produces cellulosic ethanol at the largest of its three global **Shell Technology Centers in Houston (the STCH)**.

The STCH is one of the largest industrial technology centers in the world and staffed by 2,000 Shell scientists and engineers, who are focused on finding solutions for current and future energy challenges. The facility includes a **Shell biofuels plant**, allowing staff scientists to study ways to replace gasoline with biofuels made from waste and inedible crops.



Source: National Renewable Energy Laboratory

Texas and U.S. Biofuels Regulation

In 2011, the Texas Commission on Environmental Quality (TCEQ) enacted new state guidelines in the Texas Tax Code allowing biodiesel to be blended at any ratio into any compliant fuel. Former limitations, such as requirements to use more additives within the biodiesel and producers having to report blending requirements, ended. Texas biodiesel producers are now exempt from paying the excise tax when biodiesel or ethanol is blended with conventional diesel. The TCEQ also authorizes state bioenergy facilities.

The national biofuels industry has received federal incentives for R&D, production, and fuel taxes for many years. They include biofuel production and research-related subsidies.

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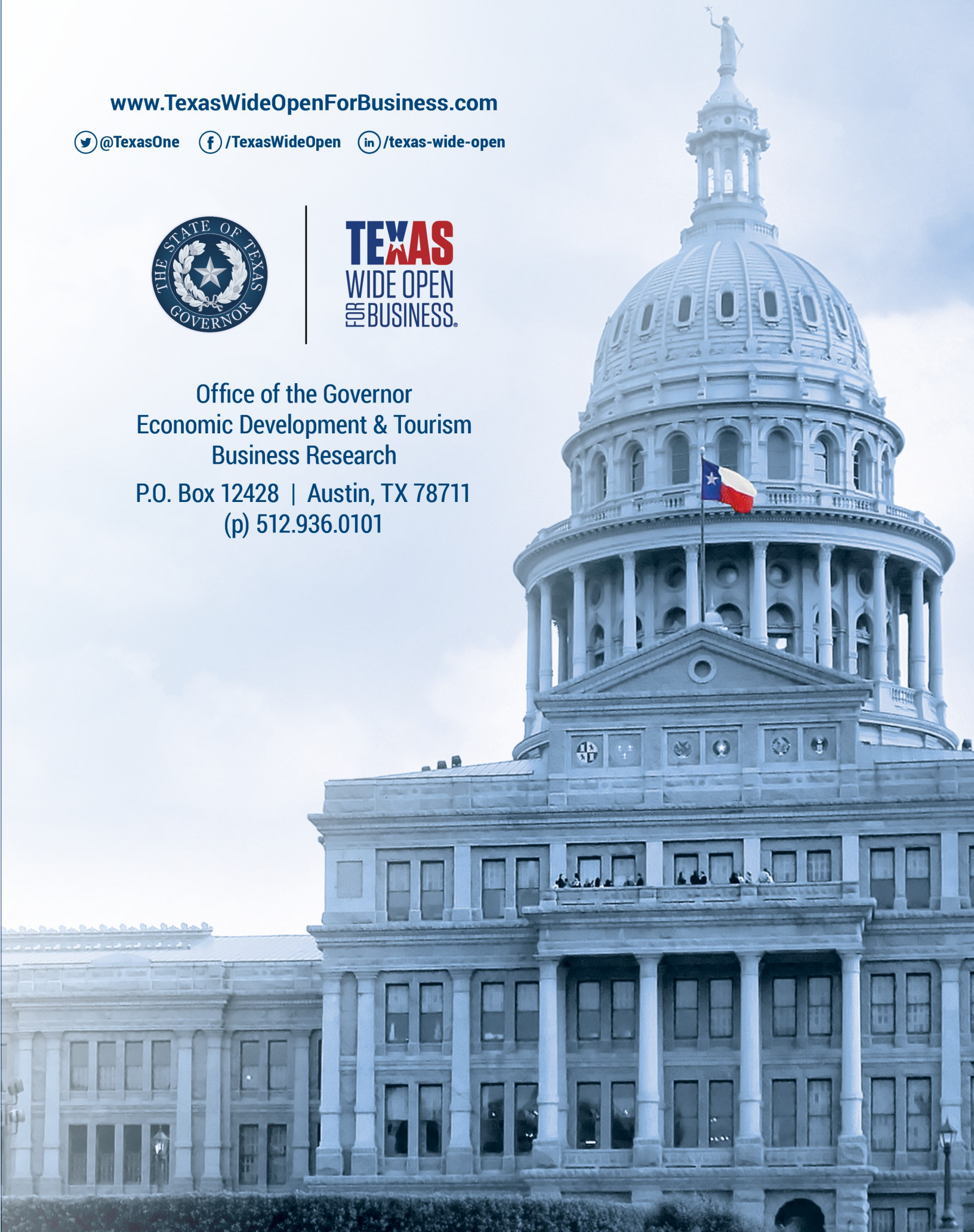

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