



**NEEDS ANALYSIS
FOR
IDFS, INC., 6.7 BILLION
SYNCHRONIZATION AND POWER PROJECTS
IN
TEXAS URBAN TRIANGLE**

NEEDS ANALYSIS

PART ONE: PREAMBLE

The viability and necessity of the proposed **IDFS, INC.**, Power Production and Grid Synchronization Projects in the **Texas Triangle** portion of Texas is the subject of this section of the **Feasibility Study**.

In order to maximize the importance of this energy production project we will be including details of the **Green and Sustainable** portions of the overall project. The **Green/Sustainable** portions of this overall project shall consist of the following:

- Design, permit and build one 100 MWe Solar Farms in South Texas
- Design, permit and build one 100 MWe Wind Farms in South Texas
- Developing a synchronization and phase balancing technology to allow more wind and solar energy on the Texas Grid.
- Research and development of new **carbon Sequestration technologies**
 - a. Conversion of Carbon dioxide into syngas using the **Fischer-Trope** process.
 - b. Conversion of Carbon Dioxide into limestone

This section of the document (**Needs Analysis**) will begin with an outline of the pertinent sections of the **Needs Analysis**. The analysis will then center on the **Demographics** of the State of Texas and in particular the demographics of **The Texas Triangle**. The Texas Triangle is composed of the Dallas-Fort Worth Metroplex at the northern tip; Houston at the southeast corner; and Austin-San Antonio at the southwest corner.

The needs analysis will also consider the Energy demands and the growth rate of this demand in the Texas Urban Triangle. From this growth rate we will see that the Texas Triangle will require an additional two gigawatts of electrical production in the next two-three years. This requirement does not include any additional requirements from the closure of any operating coal-fired electrical production facilities.

The last section will include the selection of Matagorda County, specifically the Tax incentives that can accrue from this selection.

PART TWO: OUTLINE

PART THREE

1. **Summary of Needs Analysis of the Projects**
2. **Introduction**
3. **History of Regulation of Electricity in Texas**
4. **Electricity Deregulation**
5. **ERCOT**
6. **Key Players in Texas' Energy Markets**
7. **Benefits of Electricity Deregulation**
8. **Texas Utilities**

PART FOUR: ENERGY PROFILE OF TEXAS

- 1. Introduction**
- 2. Petroleum**
- 3. Natural Gas**
- 4. Coal**
- 5. Electricity**
- 6. Renewable Energy**
- 7. Texas Energy Profile**

PART FIVE: DEMOGRAPHICS OF TEXAS

- 1. General and Geography**
- 2. Population**
- 3. Economy of Texas**
- 4. Industries**
- 5. Texas Urban Triangle**
- 6. Demographics of Cities in Urban Triangle**

PART THREE: NEEDS ANALYSIS

1. SUMMARY OF NEEDS ANALYSIS FOR THE PROJECTS:

- On January 1, 2002, the Texas State Legislature decided to deregulate the electricity industry and open up the supply of electricity to competition.
- Texas is the number two State in terms of its area with a wealth of energy resources.
- The State of Texas leads the nation in energy production.
- Texas has the nation's second-largest population and second-largest economy after California.
- Texas uses more energy than any other state and accounts for almost one-seventh of the U.S. total consumption.
- Eighty percent of the State of Texas is not interconnected to any of the other pieces of the National Grid which falls under the licensing of **FERC (Federal Energy Regulatory Commission)**.
- The **Texas Triangle** (also known as **Texaplex**) is one of 11 megaregions in the United States. The 60,000-square-mile (160,000 km²) region contains most of the state's largest cities and metropolitan areas, and in 2018 had a total of 19 million people, nearly 75% of Texas's total population.
- The production margins for the Texas Urban Triangle, not including close coal-fired power plants is zero. This means that on hot days in the summer some of the closed coal-fired power plants have to be re-activated.
- **ERCOT** estimates that they will need an extra two gigawatts of production capability to satisfy the growth demand in the **Texas Urban Triangle** of Texas.

- The State power production and grid are controlled by **ERCOT (Electric Reliability Council of Texas)** and the **PUC (Public Utility Commission) of Texas**.
- The Federal Government, through the **EPA (Environmental Protection Agency)**, is mandating the closure of many of the coal-fired power production facilities throughout the State.
- There is a massive shortfall of electrical Energy production in the State. This shortfall is the subject of this funding proposal.
- Below is the list of Coal-fired power plants which were decommissioned in 2018. The total production of this decommissioned facilities is 5,350 MW.

Name	Location	Capacity (MW)	Decommissioned
Big Brown	Freestone County	1,186	2018
J.T. Deely	Bexar County	932	2018
Monticello	Titus County	1,980	2018
Sandow	Milam County	1,252	2018

- There are an additional 18 coal-fired power plants in Texas that the **EPA** is trying to force into decommissioning.

The conclusion to be drawn from this analysis (Section Two- Needs Analysis) of this document is crystal clear. To meet the growing demand for Electricity we need a coordinated effort to increase energy production.

2. INTRODUCTION:

The Senior Engineer of **AscenTrust** has been living and working in the **Urban Triangle of Texas** since he moved here from California after the real estate collapse of the early 1980's. The Senior Engineer was involved in the de-regulation of the Energy sector in Texas. On January 1, 2002, the Texas State Legislature decided to deregulate the electricity industry and open up the supply of electricity to competition. But the path to the present situation in the energy sector of the State is long and tortuous.

Texas is the number two State in terms of its area with a wealth of energy resources. The State of Texas leads the nation in energy production. Texas has the nation's second-largest population and second-largest economy after California. Texas uses more energy than any other state and accounts for almost one-seventh of the U.S. total consumption.

Texas, a large state with a wealth of energy resources, leads the nation in energy production. The state provides more than one-fifth of U.S. domestically produced energy. Second only to Alaska in total land area, Texas stretches 800 miles at its widest points, east to west and north to south, and crude oil and natural gas fields are present across much of that expanse. Coal is found in bands that cut across the eastern Texas coastal plain and in other areas in the north-central and southwestern parts of the state.

Texas also has abundant renewable energy resources and is first in the nation in wind-generated electricity. With a significant number of sunny days across vast distances, Texas is also among the leading states in solar energy potential. Geothermal resources suitable for power generation are present in East Texas, and uranium—the fuel for nuclear reactors—has been found in South Texas.

Texas has the nation's second-largest population and second-largest economy after California. Texas uses more energy than any other state and accounts for almost one-seventh of the U.S. total consumption. The state is sixth in the nation in per capita energy consumption and is the third-largest net energy supplier despite its high energy use. The industrial sector, which includes the energy-intensive petroleum refining and chemical manufacturing industries, is the largest energy consuming end-use sector and accounts for half of the state's end-use energy consumption. Transportation is the second-largest end user, in part because of the large number of registered motor vehicles in Texas, the great distances across the state, and the high number of vehicle miles traveled annually.

The Texas climate varies significantly from east to west. Warm, moist air from the Gulf of Mexico sweeps westward across the state, losing moisture as it goes. The result is a climate that ranges from humid and subtropical along the coast, where much of the state's population resides, to semi-arid on the high plains of central and western Texas, and arid in the state's mountainous west. Frequent freezing temperatures occur in winter in the lightly populated high plains.

3. HISTORY OF ELECTRICITY REGULATION IN TEXAS

Prior to 1975, cities within the state of Texas were responsible for regulating their electric utility service and rates. Then, in 1975, The Texas Legislature enacted the **Public Utility Regulatory Act (PURA)**. A copy of the Act is attached to this documentation as **Attachment Five**. The purpose of this act was to give more power to the state over regulating some aspects of the rates and service of its electric utilities. However, this act remained quite limited as it still allowed Texas cities to continue to control their rates.

Around the same time, electric utilities started to integrate themselves within every step of the electricity process — from customer service to generation. It seemed that the utilities had started to monopolize the market, despite PURA and city efforts to maintain fair and reasonable rates.

This monopoly was actually caused by several factors. In 1978, Congress passed the United States Fuel Use Act in order to deal with the oil and gas crisis. This act forced utilities to stop using natural gas in electric power plants and industrial boilers. Instead, utilities were required to use nuclear and coal.

This shift in fuel consumption type, in combination with a turbulent and inflated market, established the need for additional generation capacity for Texas. In turn, this caused electricity rates to rise — and continue to rise. Electricity consumers grew concerned about these soaring rates and the number of times in which the rates were increased within a short period

of time. Utilities on the other hand grew concerned about the Public Utility Commission of Texas granting cost disallowances.

It took until 1995 for the state of Texas to finally enact a solution to this problem.

4. ELECTRICAL DEREGULATION

A. Senate Bill 373: In 1995, the Texas Senate passed Bill 373. This bill outlines several important changes to the electricity market, which primarily affected the **Electric Reliability Council of Texas (ERCOT)**. Formed in the 1970, ERCOT was (and still is) the organization responsible for managing the flow of electricity to the majority of customers living in Texas via an electric grid. ERCOT was also partly responsible for helping to manage regulations for Texas utilities.

Bill 373 required ERCOT to enforce some of the following changes:

- Utilities needed to give independent energy generators access to transmission capabilities in order to provide support for a wholesale market.
- The utilities needed to acknowledge new, unregulated entities or participants in the wholesale market such as, power marketers and exempt wholesale generators.
- Utilities were required to give non-utility wholesale market entities the ability to offer market-based prices.
- Deregulate rates previously regulated by the Public Utility Commission of Texas for electric cooperative distribution.

B. SENATE BILL 7

Unfortunately, the initial effort to move to a wholesale, energy deregulated market failed. Despite this, in 1999 the effort finally saw success. Senate Bill 7 was passed, a bill that forced **ERCOT** to create competition within the retail electricity industry. The driving force behind Senate Bill 7 was the concept of Price to Beat. The idea behind Price to Beat established the concept of a regulated rate that would help to control the way utilities priced electricity.

A major concern in establishing a deregulated market is that established energy providers would undersell to prevent competition with emerging retail energy providers. Senate Bill 7 hoped to prevent this by establishing a “price floor,” which would give new retail energy providers the time they needed to develop their business. A new Retail Energy Provider could charge rates that were lower than the Price to Beat, while existing providers had to offer rates that were equal to or above the Price to Beat.

Definition of a Retail Energy Provider (Senate Bill 7): The role, responsibility and regulations for Retail Energy Providers (REPs) are defined in detail within Senate Bill 7. The Bill itself is available online, however we’ve included, word for word, the basic definition of what an REP is and how they are allowed to operate:

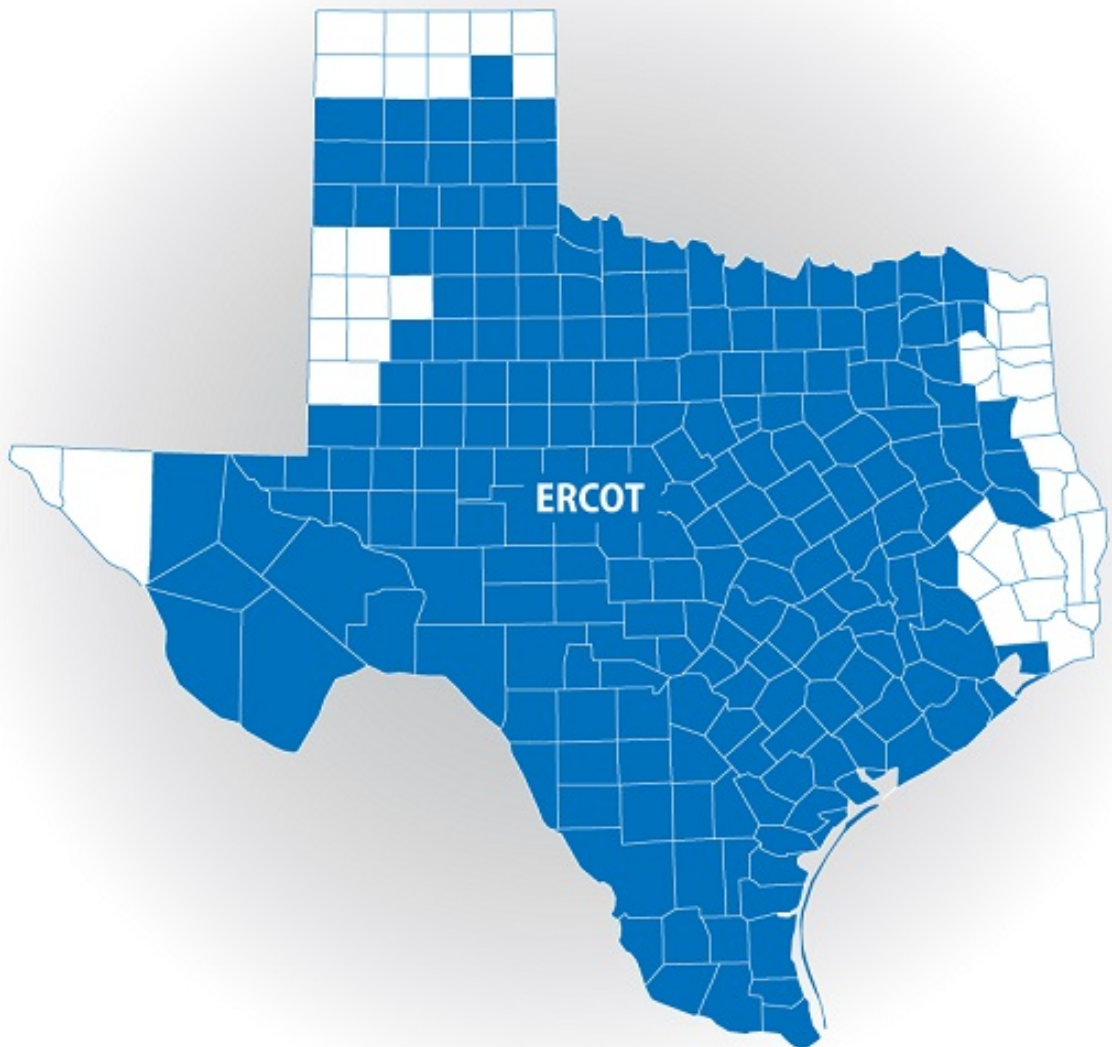
“Retail electric utility’ means a person, political subdivision, electric cooperative, or agency that operates, maintains, or controls in this state a facility to provide retail electric utility service. The term does not include a corporation described by Section 32.053 to the extent that the corporation sells electricity exclusively at wholesale and not to the ultimate consumer.

A qualifying co-generator that sells electric energy at retail to the sole purchaser of the co-generator’s thermal output under Sections 35.061 and 36.007 is not for that reason considered to be a retail electric utility. The owner or operator of a qualifying cogeneration facility who was issued the necessary environmental permits from the Texas Natural Resource Conservation Commission after January 1, 1998, and who commenced construction of such qualifying facility before July 1, 1998, may provide electricity to the purchasers of the thermal output of that qualifying facility and shall not for that reason be considered an electric utility or a retail electric utility, provided that the purchasers of the thermal output are owners of manufacturing or process operation facilities that are located on a site entirely owned before September, 1987, by one owner who retained ownership after September, 1987, of some portion of the facilities and that those facilities now share some integrated operations, such as the provision of services and raw materials.”

Throughout Senate Bill 7, there are many other references to REPs, some of which include:

- “Retail electric provider” means a person that sells electric energy to retail customers in this state. A retail electric provider may not own or operate generation assets.
- “Separately metered” means metered by an individual meter that is used to measure electric energy consumption by a retail customer and for which the customer is directly billed by a utility, retail electric provider, electric cooperative, or municipally owned utility.
- The commission shall ensure that an electric utility or transmission and distribution utility provides nondiscriminatory access to wholesale transmission service for qualifying facilities, exempt wholesale generators, power marketers, power generation companies, retail electric providers, and other electric utilities or transmission and distribution utilities.
- LIMIT IN CERTAIN AREAS. Sections 35.102 and 35.103 do not apply to the rates, retail service area, facilities, or public retail customers of a municipally owned electric utility that has not adopted customer choice or an electric cooperative that has not adopted customer choice. In a certificated service area of an electric utility in which customer choice has not been introduced, the state may not engage in retail transactions that exceed 2.5 percent of a retail electric utility’s total retail load.

5. **ERCOT** (Electric Reliability Council of Texas) : This council manages and maintains the flow of electricity from the Texas Interconnection and handles 85% of Texas' electric load. **ERCOT** also helps to supply 24 million Texans with stable electricity and is managed by the Public Utility Commission of Texas, in response to Texas Legislature. Major cities within **ERCOT**'s service areas include, Houston, Fort Worth, Dallas, San Antonio, Corpus Christi, Midland and more.



In 2002, the Public Utility Commission appointed **ERCOT** as an independent organization, giving them the responsibility to maintain reliability of the electricity system, as well as to manage and monitor a competitive wholesale and retail electricity market.

Deregulation forced utilities in Texas to change their existing structure. Instead of managing the entire electricity process from generation to customer service, they now had to separate their business into three parts:

- a. **Retail Electric Providers** – These organizations must successfully register with the Public Utility Commission of Texas and are responsible for the supply of energy to consumers. Electricity customers in deregulated energy areas of Texas have the option to choose their Retail Electric Provider.
- b. **Distribution and Transmission (utility company)** – Remain regulated. These companies are responsible for the delivery of electricity as well as the maintenance of poles and wires.
- c. **Power Generation** – These companies must be registered with the Public Utility Commission of Texas. They must also abide by outlined market rules. They are responsible for the generation of electricity.

While energy deregulation is currently available to most cities within Texas, there are still some areas that are energy regulated. Today, approximately 85% of energy consumers in Texas have the ability to choose their Retail Energy Supplier.

6. KEY PLAYERS IN TEXAS ENERGY MARKETS

There are several groups or organizations that are involved in monitoring, maintaining, regulating and selling energy in Texas. These key players include:

- **Public Utility Commission of Texas:** The PUC of Texas is responsible for maintaining and enforcing regulations surrounding the generation, transmission and supply of electricity. It also offers customer service related to its services in order to resolve disputes between consumers, utilities or REPs.
- **Electric Reliability Council of Texas (ERCOT):** This council manages and maintains the flow of electricity from the Texas Interconnection and handles 85% of Texas' electric load. **ERCOT** also helps to supply 24 million Texans with stable electricity and is managed by the Public Utility Commission of Texas, in response to Texas Legislature. Major cities within **ERCOT's** service areas include, Houston, Fort Worth, Dallas, San Antonio, Corpus Christi, Midland and more.
- **Utilities:** In many countries around the world, a utility is primarily responsible for the generation and distribution of electricity within all spaces: residential, commercial, industrial, etc. There are several major utilities in Texas. A few examples of these utilities include, Oncor Energy, TXU Energy, and Texas New Mexico Power. Not all utilities provide electricity services to all cities within the state.
- **Electric Cooperatives (Co-ops):** Co-ops provide electricity to residential customers via low-voltage power lines. In Texas, co-ops are a part of the Texas Electric Cooperatives (TEC). It includes, 11 generation and transmission and 64 distribution cooperatives. Established in 1941, TEC continues to operate today, with a focus on 7 principles including, voluntary and open membership, democratic member control, members' economic participation, autonomy and independence, education, training and information, cooperation amongst cooperatives, and concern for community.

7. BENEFITS OF ELECTRICITY DEREGULATION

The main benefit to an energy deregulated market is that the rates for electricity lower (over time). While the years following 2002 saw an increase for residential customer electricity rates, the years between 2010 and 2015 have seen a significant decrease. Texas rates during this time fell well below the national average.

Introducing competition to the electricity market is also a significant benefit to Texans. Naturally, when you have more companies with similar products to choose from, those companies need to ensure that their products (and rates) are the best in the business. If a customer is not satisfied with their rates with one REP for example, they can switch to another REP with relative ease. Overall, energy deregulation prevents companies from turning into monopolies that have complete control over the cost of electricity.

As of 2011, 56% of the residential electricity load and 83% of the small commercial business load have switched to a Retail Electricity Provider.

8. TEXAS UTILITIES

There are 5 major utilities that provide transmission and delivery services to customers in Texas. These utilities include:

1. Oncor Electric Delivery
2. CenterPoint Energy
3. TNMP
4. AEP North
5. AEP Central

The Eastern part of Texas is connected to the Eastern Grid and the main Energy Company is **Entergy Texas**.

In an energy deregulated market, utilities take care of the transmission and distribution electricity elements. This means that they are responsible for maintenance of poles, wires, and how electricity reaches residential or business buildings.

Depending on where you live in Texas, you may or may not have a choice over the utility that provides your transmission and distribution services. Many utilities provide service to a specific area and every customer within that service area must use that utility for the transmission and supply of their electricity.

PART FOUR: ENERGY PROFILE OF TEXAS

1. INTRODUCTION

Texas, a large state with a wealth of energy resources, leads the nation in energy production. The state provides more than one-fifth of U.S. domestically produced energy. Second only to Alaska in total land area, Texas stretches 800 miles at its widest points, east to west and north to south, and crude oil and natural gas fields are present across much of that expanse. Coal is found in bands that cut across the eastern Texas coastal plain and in other areas in the north-central and southwestern parts of the state. Texas also has abundant renewable energy resources and is first in the nation in wind-generated electricity. With a significant number of sunny days across vast distances, Texas is also among the leading states in solar energy potential. Geothermal resources suitable for power generation are present in East Texas, and uranium—the fuel for nuclear reactors—has been found in South Texas.

Texas has the nation's second-largest population and second-largest economy after California. Texas uses more energy than any other state and accounts for almost one-seventh of the U.S. total consumption. The state is sixth in the nation in per capita energy consumption and is the third-largest net energy supplier despite its high energy use. The industrial sector, which includes the energy-intensive petroleum refining and chemical manufacturing industries, is the largest energy consuming end-use sector and accounts for half of the state's end-use energy consumption. Transportation is the second-largest end user, in part because of the large number of registered motor vehicles in Texas, the great distances across the state, and the high number of vehicle miles traveled annually.

The Texas climate varies significantly from east to west. Warm, moist air from the Gulf of Mexico sweeps westward across the state, losing moisture as it goes. The result is a climate that ranges from humid and subtropical along the coast, where much of the state's population resides, to semi-arid on the high plains of central and western Texas, and arid in the state's mountainous west. Frequent freezing temperatures occur in winter in the lightly populated high plains.

Summer temperatures average above 90°F in the most densely populated parts of Texas where energy use for cooling is high. Even so, the residential sector accounts for just one-eighth of state end-use energy consumption. Because of the state's large population, Texas leads the nation in state residential energy use, but it ranks near the lowest one-fifth of states in per capita residential energy consumption.

2. PETROLEUM

Texas leads the nation in crude oil production, as it has in every year but one since 1970. The state has more than 40% of U.S. crude oil proved reserves and produces 40% of the nation's crude oil, not only more than any other state but also exceeding that of all the federal offshore producing areas combined. More than one-fourth of the nation's 100 largest oil fields by reserves are in Texas. Most of those are in the Permian Basin of West Texas and in the south-

central part of the state. However, the first major oil boom in Texas began in 1901 with the discovery of the Spindletop oil field in southeast Texas. Later discoveries led to increased crude oil production until 1972 when the state's annual production rose to slightly more than 1.26 billion barrels. Output fell in subsequent years to a low of less than one-third of the 1972 peak in 2007. Production began to rise again, most sharply after 2010, as hydraulically fractured horizontal wells drilled in both the Permian Basin in western Texas and the Eagle Ford shale in southern and eastern Texas led to increased crude oil production. In 2017, Texas oil production exceeded the state's 1972 peak for the first time when it rose to more than 1.27 billion barrels, and in 2019, annual production increased to more than 1.8 billion barrels.

West Texas Intermediate (WTI), a light (low density), sweet (low sulfur content) crude oil produced in Texas and elsewhere, is the benchmark for crude oil pricing in North America in both the physical and futures markets. It is used as a standard in part because of its ample supply and proximity to a major market hub. Some of the nation's crude oil supplies are stored in the U.S. Strategic Petroleum Reserve as a buffer against supply disruptions. Texas has two of the four U.S. Strategic Petroleum Reserve crude oil storage facilities. They are located in salt caverns in the Texas Gulf Coast region.

More than 30% of the nation's crude oil refining capacity is in Texas.

Texas leads the nation in crude oil refining. It has more than one-fifth of the nation's refineries and more than three-tenths of U.S. total refining capacity. The state's 30 operable petroleum refineries can process a combined total of almost 5.8 million barrels of crude oil per calendar day. The majority of the state's refineries are clustered near ports along the Gulf Coast, including the nation's largest refinery in Port Arthur. The Texas Gulf Coast region has the largest concentration of oil refineries in the United States. Many of the Texas refineries are complex facilities that can process a wide variety of crude oil types into high-value products, such as motor gasoline. The petroleum products refined in Texas are shipped from the state's refineries by interstate pipeline, barge, and tanker to U.S. markets, primarily in the eastern and central states but also as far west as Arizona, as well as to foreign markets.

Texas also leads the nation in petroleum consumption and ranked third in per capita petroleum use in 2017. Unlike most states, the industrial sector is the largest petroleum consumer in the state, followed by the transportation sector. Texas is the nation's largest consumer of hydrocarbon gas liquids (HGLs), distillate fuel oil, and residual fuel oil. HGLs include ethane, propane, normal butane, isobutane, natural gasoline, and their associated olefins. In 2017, Texas HGL use was greater than the HGL consumption of all other states combined. Almost all the HGLs are consumed by the industrial sector, where they are used in a variety of applications, particularly as feedstock for the state's petrochemical industry. While much of Texas can use conventional motor gasoline without ethanol, the eastern half of the state and El Paso County at the state's extreme western tip require several different motor gasoline blends to meet diverse air-quality requirements. In the metropolitan areas of Greater Houston and Dallas-Fort Worth, reformulated motor gasoline blended with ethanol is required. The state has four ethanol plants

that can produce more than 9 million barrels of ethanol per year, but Texans consume almost four times as much ethanol as is produced in the state. The residential and commercial sectors together use less than 1% of the petroleum consumed in Texas.

3. NATURAL GAS

More than one-fourth of the nation's proved natural gas reserves and about three-tenths of the 100 largest natural gas fields are located, in whole or in part, in Texas. The state leads the nation in natural gas production, accounting for one-fourth of U.S. gross withdrawals in 2019. The state's natural gas production reached a peak in 1972. From that peak of more than 9.5 trillion cubic feet, yearly production declined to about 5.5 trillion cubic feet in the late 1990s. Since then, natural gas production levels have rebounded, largely because of increased production from the Eagle Ford and Permian Basin regions. In 2019, the state exceeded its earlier peak and produced more than 10.2 trillion cubic feet of natural gas. Much of the last decade's rise in production resulted from advances in horizontal drilling and hydraulic fracturing technologies that increased production from shale and other low permeability formations.

With more than 18,000 miles of interstate natural gas pipelines within its borders, Texas has more natural gas market hubs than any other state. Because of that infrastructure, Texas is well connected to markets throughout the country. Natural gas is shipped from Texas across the nation and into Mexico. Large volumes of natural gas also enter the state, primarily through Oklahoma, Louisiana, and New Mexico, but more natural gas leaves the state than enters. Most of it continues on to Louisiana and Mexico. Texas had two liquefied natural gas (LNG) import terminals along its Gulf Coast, one each at Freeport and Sabine Pass. The Freeport Terminal has since been transformed into an export terminal and the Sabine Pass facility has also added export capabilities. There is also an export terminal at Corpus Christi. Several other export terminals have been approved but are not yet built. Because Texas produces more natural gas than it consumes or sends out of state, some natural gas is placed in underground storage. The state has more than one-tenth of the nation's total working natural gas storage capacity. More than half of the state's 35 active storage facilities—about 70% of the state's natural gas working gas storage capacity—are in depleted oil and gas fields converted for storage use. The rest are in salt caverns.

Texas leads the nation in natural gas consumption, accounting for almost 15% of the U.S. total. The industrial and electric power sectors accounted for nearly four-fifths of Texas natural gas use. The industrial sector alone was responsible for more than two-fifths of the state's consumption and more than one-fifth of the nation's total industrial sector consumption of natural gas in 2019. The amount of natural gas used for electricity generation in Texas is greater than in any other state and accounted for more than 15% of the total used by the U.S. electric power sector in 2019.

Less than one-tenth of the total natural gas consumed in Texas goes to the residential and commercial end-use sectors. More natural gas is used in the recovery, processing, and distribution of natural gas than is consumed by those two end-use sectors combined. More than

one-third of Texas households rely on natural gas as their primary heating fuel, but the state's per capita residential natural gas consumption ranks among the lowest one-fifth of states.

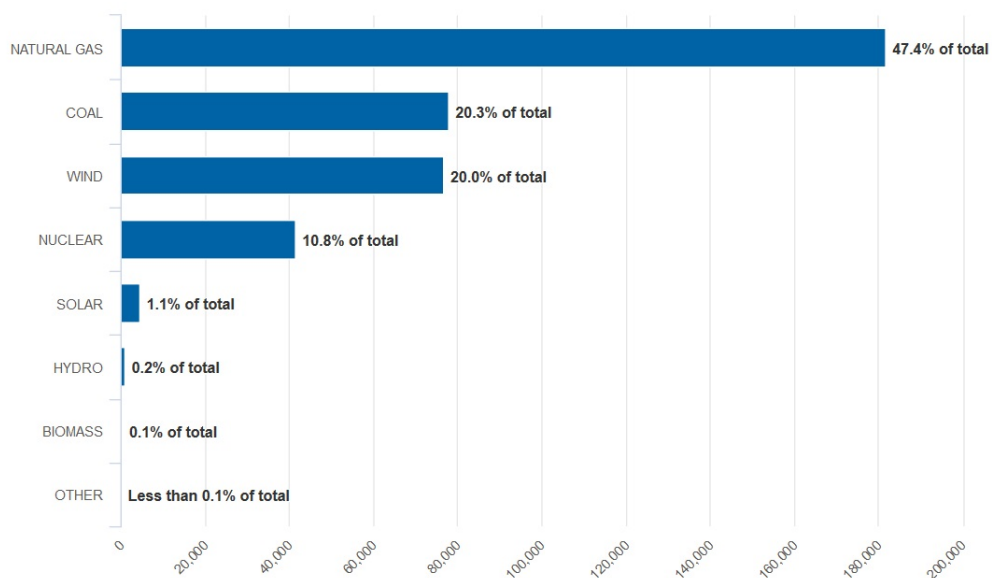
4. COAL

Texas has more than 9 billion tons of estimated recoverable coal reserves, almost 4% of the nation's total. The state is the largest lignite producer in the nation and is among the top 10 coal producers overall. Lignite is the rank of coal with the lowest heat value. It is used almost exclusively for power generation, usually at coal-fired power plants near the mines. Substantial lignite deposits are found in narrow bands in the Texas Gulf Coast region. Higher-grade bituminous coal is located in deposits that run southward from north-central Texas to the Rio Grande Valley at the state's southern border. Although coal was primarily produced from underground mines in Texas before the mid-1950s, production at those mines ceased decades ago, and now all of the state's coal production is from surface mines. Lignite is recovered at eight surface mines, and one surface mine produces bituminous coal. In 2017, one of the state's lignite mines closed because the power plant it supplied with fuel shut down.

Texas is also the largest coal-consuming state. On a tonnage basis, Texas lignite accounts for more than one-third of the state's coal consumption, with nearly all the rest of the state's needs met by subbituminous coal brought from Wyoming by rail. The lignite mined in Texas is consumed entirely within the state, and almost all of it is used to generate electricity. Lignite is delivered directly to Texas power plants by conveyor belt, truck, or rail. A small amount of coal is delivered to industrial facilities in the state.

5. ELECTRICITY: Texas generates more electricity than any other state, almost twice as much as the second-highest electricity-producing state.

ENERGY SOURCES FOR ELECTRICAL PRODUCTION IN TEXAS



Texas produces more electricity than any other state, generating almost twice as much as Florida, the second-highest electricity-producing state. Natural gas-fired power plants supplied more than half of the state's electricity net generation in 2019.

About 5,000 megawatts of Texas coal-fired generating capacity have been retired since 2016. As a result, coal-fired power plants supplied less than one-fifth of state generation in 2019, down from about one-third as recently as 2014. Wind-powered generation in Texas has rapidly increased during the past two decades. In 2019, wind energy provided more than one-sixth of Texas' generation.

The state's two operating nuclear power plants typically supply almost one-tenth of the state's electricity net generation. Most of the capacity added in Texas since 2010 is fueled by natural gas or wind.

Among the contiguous 48 states, Texas is the only state with a stand-alone electricity grid.

Although there are four electricity grids that serve Texas, the state's main electricity grid is operated by the Electricity Reliability Council of Texas (ERCOT). The ERCOT grid serves about three-fourths of the state and is largely isolated from the other interconnected power systems serving the eastern and western contiguous United States.

This isolation means the ERCOT grid is not subject to federal oversight and is, for the most part, dependent on its own resources to meet the state's electricity needs. The state's electricity supply has increased each year, but so has demand.

Texas is the largest electricity consumer among the states.

The largest share of its electricity retail sales go to the residential sector, followed by the commercial sector, and then the industrial sector. Three in five households in Texas use electricity as their primary source for home heating, but demand peaks during the hot summer months with the increased use of electricity for cooling.

In 1999, Texas became the first state to establish an energy efficiency resource standard (EERS). The standard requires investor-owned electric utilities in the state to reduce energy use and demand. The initial savings goal for each utility is equal to 30% of the utility's annual growth in peak demand. After that target is met, the EERS requires that annual savings equal up to 0.4% of each utility's peak demand.

6. RENEWABLE ENERGY

a. Wind Generation: Texas leads the nation in wind-powered electricity generation, producing almost 30% of the U.S. total in 2019.

Renewable energy sources contribute nearly one-fifth of the net electricity generated in Texas and account for one-fifth of the total U.S. utility-scale electricity generation from all nonhydroelectric renewable sources. The state has encouraged renewable energy use by

authorizing construction of transmission lines to bring electricity from remote wind farms to urban market centers. Wind accounts for nearly all of the electricity generated from renewable resources in Texas, and the state leads the nation in wind-powered electricity generation, producing almost 30% of the U.S. total. In 2011, Texas was the first state to reach 10,000 megawatts of installed wind generating capacity. At the end of 2018, Texas had about 24,185 megawatts of wind capacity installed, and, by the end of 2019 installed capacity was about 28,800 megawatts. Utility-scale wind facilities in Texas (those with capacities of 1 megawatt or greater) accounted for more than one-fifth of the state's total generating capacity and produced more than one-sixth of the state's net generation in 2019. More than 6,200 megawatts of additional wind generation capacity are under construction.

b. Solar Generation

The high levels of direct solar radiation in the western part of the state give Texas some of the greatest solar power potential in the nation, and the state was the country's sixth-largest producer of solar power in 2019. Decreased costs for solar photovoltaic (PV) panels and improved transmission access have resulted in rapid increases in solar PV capacity in Texas. Installed solar capacity in the state doubled between 2017 and 2019, exceeding 3,100 megawatts in 2019. Nearly one-fifth of Texas solar generation came from customer-sited, small-scale (less than 1 megawatt) facilities in 2019.

c. Other Renewable Generation Sources

1. Biomass

Texas has abundant biomass and biofuel resources. Biomass fuels less than 0.5% of the state's electricity generation, but Texas does produce liquid biofuels. The state has four biofuels plants in the agriculturally rich high plains region in the Texas Panhandle. Those plants have the capacity to produce almost 400 million gallons of ethanol per year from corn and sorghum feedstocks. The state also has 8 biodiesel producers capable of providing about 375 million gallons of biodiesel per year. There are two wood pellet plants in Texas with a combined capacity of nearly 550,000 tons per year.

2. Hydroelectric Power

Texas has two dozen hydroelectric power plants that typically contribute less than 0.5% to in-state electricity generation. The relatively gentle terrain and low rainfall throughout much of the state are not conducive to hydroelectric power development. Despite a large number of non-powered dams in Texas, the potential for further hydroelectric development is limited.

3. Geothermal

The large number of crude oil and natural gas wells in Texas provide a unique untapped geothermal resource. Billions of barrels of non-potable water are produced annually as a byproduct from the state's crude oil and natural gas wells. That water can be as hot as 200°C and could be used to generate electricity. Low-temperature geothermal

resources are already used in direct-use applications, such as ground-source heat pumps, at locations around the state.

7. Texas Electrical Energy Profile (EIA Report for 2018)

Texas Electricity Profile 2018

Table 1. 2018 Summary statistics (Texas)

Item	Value	Rank
Primary energy source		Natural gas
Net summer capacity (megawatts)	122,159	1
Electric utilities	29,542	2
IPP & CHP	92,617	1
Net generation (megawatthours)	477,352,425	1
Electric utilities	92,964,516	8
IPP & CHP	384,387,908	1
Emissions		
Sulfur Dioxide (short tons)	224,145	1
Nitrogen Oxide short tons)	188,316	1
Carbon Dioxide (thousand metric tons)	230,076	1
Sulfur Dioxide (lbs/MWh)	0.9	15
Nitrogen Oxide (lbs/MWh)	0.8	23
Carbon Dioxide (lbs/MWh)	1,060	23
Total retail sales (megawatthours)	424,418,628	1
Full service provider sales	424,418,628	1
Energy-only provider sales	.	.
Direct use (megawatthours)	38,490,458	1
Average retail price (cents/kWh)	8.48	44

Sources: U.S. Energy Information Administration, Form EIO, *Annual Electric Generator Report*

PART FIVE: TEXAS DEMOGRAPHICS

1. GENERAL AND GEOGRAPHY

Texas is a state in the South Central Region of the United States. It is the second largest U.S. state by both area (after Alaska) and population (after California). Texas shares borders with the states of Louisiana to the east, Arkansas to the northeast, Oklahoma to the north, New Mexico to the west, and Mexico to the southwest, and has a coastline with the Gulf of Mexico to the southeast.

Houston is the most populous city in Texas and the fourth largest in the U.S., while San Antonio is the second-most populous in the state and seventh largest in the U.S. Dallas–Fort Worth and Greater Houston are the fourth and fifth largest metropolitan statistical areas in the country, respectively. Other major cities include Austin, the second-most populous state capital in the U.S., and El Paso. Texas is nicknamed the "**Lone Star State**" for its former status as an independent republic, and as a reminder of the state's struggle for independence from Mexico. The "Lone Star" can be found on the Texas state flag and on the Texas state seal.

Due to its size and geologic features, Texas contains diverse landscapes common to both the U.S. Southern and the Southwestern regions. Although Texas is popularly associated with the U.S. southwestern deserts, less than ten percent of Texas's land area is desert. Most of the population centers are in areas of former prairies, grasslands, forests, and the coastline. Traveling from east to west, one can observe terrain that ranges from coastal swamps and piney woods, to rolling plains and rugged hills, and finally the desert and mountains of the Big Bend.

Historically four major industries shaped the Texas economy prior to World War II: cattle and bison, cotton, timber, and oil. Before and after the U.S. Civil War the cattle industry, which Texas came to dominate, was a major economic driver for the state, thus creating the traditional image of the Texas cowboy. In the later 19th century cotton and lumber grew to be major industries as the cattle industry became less lucrative. It was ultimately, though, the discovery of major petroleum deposits (Spindletop in particular) that initiated an economic boom which became the driving force behind the economy for much of the 20th century.

With strong investments in universities, Texas developed a diversified economy and high tech industry in the mid-20th century. As of 2015, it is second on the list of the most Fortune 500 companies with 54. With a growing base of industry, the state leads in many industries, including tourism, agriculture, petrochemicals, energy, computers and electronics, aerospace, and biomedical sciences. Texas has led the U.S. in state export revenue since 2002 and has the second-highest gross state product. If Texas were a sovereign state, it would have the 10th largest economy in the world.

2. POPULATION

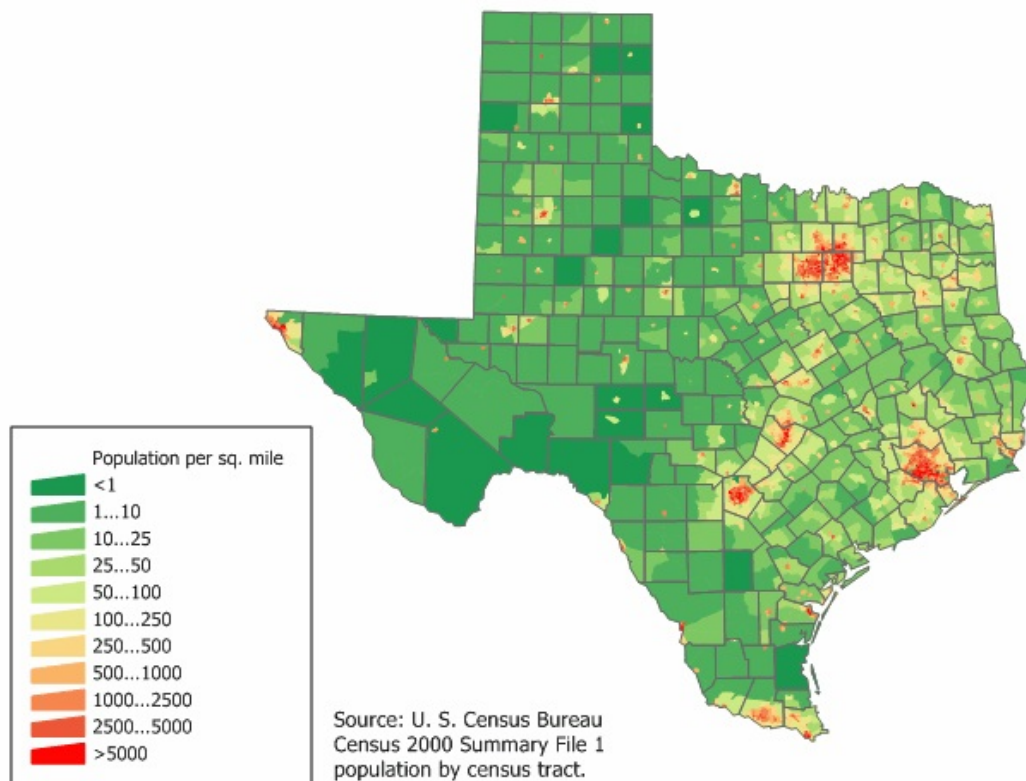
The 2010 US Census recorded Texas as having a population of 25.1 million—an increase of 4.3 million since the year 2000, involving an increase in population in all three subcategories of population growth: natural increase (births minus deaths), net immigration, and net migration.

Texas passed New York in the 1990s to become the second-largest U.S. state in population, after California. The state also is the most populous state in the South Central United States, and the most populous state in the South.

Texas' population growth between 2000 and 2010 represents the highest population increase, by number of people, for any U.S. state during this time period. The large population increase can somewhat be attributed to Texas' relative insulation from the US housing bubble.

As of 2018, the state has an estimated 5.1 million foreign-born residents, constituting approximately 15% of the state population. An estimated 1.7 million people are undocumented immigrants.

U.S. Census data from 2010 indicate that 7.7% of Texas' population is under 5 years old, 27.3% is under 18, and 10.3% is aged 65 and older. Females make up 50.4% of the population.



3. ECONOMY OF TEXAS

The **economy of Texas** is the second largest in the United States. It has a gross state product of \$1.887 trillion (2019), the second largest in the U.S. As of 2015, Texas is home to six of the top 50 companies on the Fortune 500 list and 51 overall (third most after New York and California). In 2017, Texas grossed more than \$264.5 billion a year in exports—more than the exports of California (\$172 billion) and New York (\$77.9 billion) combined.

As a sovereign country (2016), Texas would be the 10th largest economy in the world by GDP (ahead of South Korea and Canada) Texas's household income was \$48,259 in 2010 ranking 25th in the nation. The state debt in 2012 was calculated to be \$121.7 billion, or \$7,400 per taxpayer. Texas has the second largest population in the country after California.

4. INDUSTRIES

a. Agriculture

Texas has the most farms of all United States both in terms of number and acreage. Texas leads the nation in number of cattle, usually exceeding 16 million head. The sprawling 320,000 deeded acre (1,200 km²) *La Escalera Ranch*, located 20 miles (32 km) south of Fort Stockton, Texas, is one of the largest cattle ranches in the Southwestern United States.

Cultivation of mung bean in Texas began during World War II when a Chinese native by the name of Henry Huie who worked as a U.S. Army cook planted the staple crop in the clay plains near Vernon, Texas.

The state leads nationally in production of sheep and goat products. Texas is king of cotton leading the nation in cotton production, its leading crop and second-most-valuable farm product. Texas is a leader in cereal crop production.

Three counties in the state—Colorado, Wharton and Matagorda—take advantage of water from the Lower Colorado River Authority to grow rice and are responsible for about 5% of annual U.S. rice production. Texas is also a large producer of watermelons, grapefruits, and cantaloupes.

The Rio Grande valley is one of the best areas for the cultivation of grapefruit. Early varieties like the Duncan had many seeds and pale flesh, but in the 1880s citrus growers in Texas and Florida discovered pink-fleshed seedless grapefruit mutations like the Ruby, which along with red-fleshed varieties like the Rio Red and Star Ruby are preferred varieties for modern commercial production.

b. Aeronautics

Lyndon B. Johnson Space Center, the center of the National Aeronautics and Space Administration (NASA), is located in Houston. It is a leading hub for the Aeronautics industry. The National Space and Biomedical Research Institute is headquartered in Houston.

Dallas-Fort Worth International Airport, located nearly equidistant from downtown Dallas and downtown Fort Worth, is the largest airport in the state, the second-largest in the US, and the fourth-largest in the world. In terms of traffic, DFW is the busiest in the state, the third-busiest in the nation, and the sixth-busiest in the world. The airport serves 135 domestic destinations and 40 international. DFW is the largest and main hub for American Airlines, one of the world's largest in terms of total passengers-miles transported and passenger fleet size.

Texas's second-largest air facility is Houston's George Bush Intercontinental Airport (IAH), the largest hub of United Airlines. IAH offers service to the most Mexican destinations of any U.S. airport. IAH is currently ranked second among all U.S. airports with scheduled non-stop domestic and international service.

Headquartered in Fort Worth, American Airlines is the world's largest airline by passenger miles, passengers carried, and revenue. Southwest Airlines, also a leader in the commercial passenger market, is based near Love Field airport in Dallas. Lockheed Martin Aeronautics, the aviation division of Lockheed Martin, is also headquartered in Fort Worth, and the company's Missiles and Fire Control division is based in nearby Grand Prairie, along with the American division of Airbus Helicopters, Airbus Helicopters, Inc.. Bell Helicopter is headquartered in Fort Worth as well.

c. Defense

Texas is home to two of the United States Army's largest facilities (in terms of geographic size), Fort Hood in Central Texas near Killeen and Fort Bliss near El Paso. In addition, Fort Sam Houston in San Antonio is home to the Brooke Army Medical Center, one of the Army's major hospitals and its only burn facility, and the Corpus Christi Army Depot in Corpus Christi, Texas is home to the world's largest helicopter repair and maintenance facility.

The United States Air Force operates several bases in the state – Sheppard (Wichita Falls), Dyess (Abilene), Goodfellow (San Angelo), Laughlin (Del Rio), and Lackland and Randolph (San Antonio) Ellington Airport, (Houston).

The United States Navy operates Naval Air Station Joint Reserve Base Fort Worth (the former Carswell Air Force Base facility) as well as NAS Corpus Christi and NAS Kingsville.

d. Defense contracting

Texas (specifically Dallas and Houston) has a large number of defense contractors which creates sizable employment for the state.

Two divisions of Lockheed Martin have their divisional headquarters in the DFW area – Lockheed Martin Aeronautics in Fort Worth (where the F-16 Fighting Falcon, the largest Western fighter program, is manufactured, as well as its successor, the F-35 Lightning II and the F-22 Raptor) and Lockheed Martin Missiles and Fire Control in Grand Prairie.

Fort Worth is also the home of Bell Helicopter Textron, which manufactures several helicopters for the military, including the V-22 and the H-1, on which final assembly is performed in Amarillo. Furthermore, three major defense service contractors (DynCorp, AECOM, and DXC Technology) have substantial operations in Fort Worth.

Other major defense contractors with DFW presence include Boeing (Richardson), Rockwell Collins (Richardson), Vought Corporation (headquarters in Dallas; facilities in Dallas and Grand Prairie), Raytheon (plants in Garland, Dallas, and McKinney), L-3 Communications (plants in Arlington, Carrollton, and Greenville; also has a facility in Waco), BAE Systems

(facility in Fort Worth), Leonardo DRS (Dallas), Hewlett Packard Enterprise and NTT Data (Plano), Alliant Techsystems (facility in Fort Worth), and Elbit Systems (facility and US headquarters in Fort Worth). The Defense Contract Audit Agency maintains its Central Region office in Irving.

Outside the DFW area, KBR (the former Halliburton subsidiary) maintains its headquarters in Houston, while the Southwest Research Institute is located in San Antonio. BAE Systems also manufactures the Family of Medium Tactical Vehicles at its facility in Sealy, Texas.

e. Computer technology

Texas is one of the major hubs in the U.S. for development of computer components, systems, software and information infrastructure. Austin, Dallas, and Houston are the major centers for this industry in Texas. The Austin area is often nicknamed "Silicon Hills" because of the concentration of semiconductor design companies including AMD, Cirrus Logic, Freescale Semiconductor, Intel and Silicon Labs. Dell's headquarters is located in the city's suburb, Round Rock, and major offices for Google, Facebook, EA Games, and Apple are also open in the Austin area. Austin is also the home of the Texas Advanced Computing Center at The University of Texas at Austin. Dallas is the birthplace of the integrated circuit.

The North Dallas area is called the "Telecom Corridor" or the "Silicon Prairie" for the area's high concentration of information technology companies such as Texas Instruments, Perot Systems, and EDS, as well as telecommunications giant AT&T. San Antonio is the home of cloud computing giant Rackspace, as well as computing pioneer Datapoint. Harris County-based Compaq,^[36] was once one of the world's largest computer companies. After Compaq's merger with Hewlett-Packard, the new owner currently employs more employees in the Houston area than anywhere else in the world.

f. Oil and Gas

Texans consume the most energy in the nation both in per capita and as a whole. Texas is a global leader in the energy industry and Houston is the petroleum capital of the world. Since 2003, Texas state officials have created various initiatives like the Texas Enterprise Fund and the Texas Emerging Technology Fund to develop the economy of Texas.

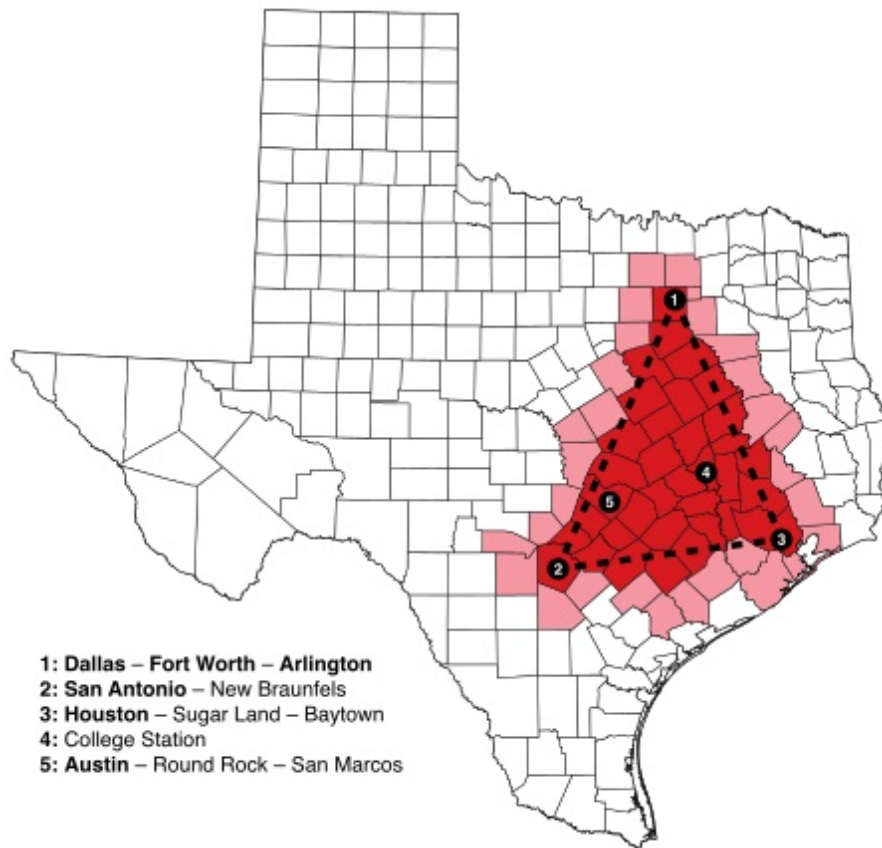
g. Healthcare

Healthcare is a growing industry in the state of Texas. The Texas Medical Center, located in southwest Houston, is the largest medical center in the world. It is home to The University of Texas Health Science Center which trains medical students and residents and includes The University of Texas M.D. Anderson Cancer Center, a global leader of cancer research and treatment. The medical complex also hosts a private medical college, The Baylor College of Medicine.

The University of Texas medical system^[46] has additional branches in Dallas, San Antonio, Tyler, and Galveston. The South Texas Medical Center in San Antonio with nearly 27,000

employees^[47] has a \$14.3 Billion economic impact on the state of Texas.^[48] In addition to these facilities, the Texas College of Osteopathic Medicine, the Texas A&M Health Science Center, and Texas Tech University Health Sciences Center in Lubbock and El Paso provide the state with a total of nine centers of medical research.

5. THE TEXAS URBAN TRIANGLE



The **Texas Triangle** (also known as **Texaplex**) is one of 11 megaregions in the United States. These are urban areas that are much greater in scale than a metropolitan statistical area (MSA), defined by the US Census Bureau. These regions also are known as megapolitan areas. The Texas Triangle is formed by the state's four main urban centers, Houston, Dallas-Fort Worth, San Antonio, and Austin, connected by Interstate 45, Interstate 10, and Interstate 35.

The megaregion is defined in work by America 2050 and others. Dr. Robert Lang of the Metropolitan Institute at Virginia Tech characterized Dallas–Fort Worth as one of the earliest recognized megapolitans. Although each city is distinct, Dallas and Fort Worth developed closely enough to form the urban area widely known as "The Metroplex".

The 60,000-square-mile (160,000 km²) region contains most of the state's largest cities and metropolitan areas, and in 2008 had a total of 17 million people, nearly 75% of Texas's total

population. The region is comparable to Florida in population and comparable to Georgia in area, but the Texas Triangle comprises less than a quarter of Texas's total land area.

According to the University of Texas at Austin Center for Sustainable Development, "the Texas Triangle has three sides measuring 271, 198, and 241 miles in ground distance."

In 2016, the Texas Triangle contained five of the 20 largest cities in the US, and was home to more than 70% of all Texans, with a population of 15.8 million. In the next 40 years, the population of the Texas Triangle has been projected to grow more than 65%, or an additional 10 million people, leading to 78% of Texans living and working within the Texas Triangle. From a resident's perspective, the Triangle is gradually becoming synonymous with Texas.

6. DEMOGRAPHICS OF PERTINENT CITIES IN TEXAS

a. HOUSTON:

Houston is the most populous city in the state of Texas and the fourth most populous city in the U.S. as well as the sixth most populous in North America, with an estimated 2019 population of 2,320,268. Located in Southeast Texas near Galveston Bay and the Gulf of Mexico, it is the seat of Harris County and the principal city of the Greater Houston metropolitan area, which is the fifth most populous metropolitan statistical area in the United States and the second most populous in Texas after the Dallas-Fort Worth metroplex, with a population of 7,066,141 in 2019.

Comprising a total area of 637.4 square miles (1,651 km²), Houston is the eighth most expansive city in the United States (including consolidated city-counties). It is the largest city in the United States by total area, whose government is not consolidated with that of a county, parish or borough. Though primarily in Harris County, small portions of the city extend into Fort Bend and Montgomery counties, bordering other principal communities of Greater Houston such as Sugar Land and The Woodlands.

The city of Houston was founded by land investors on August 30, 1836, at the confluence of Buffalo Bayou and White Oak Bayou (a point now known as Allen's Landing) and incorporated as a city on June 5, 1837. The city is named after former General Sam Houston, who was president of the Republic of Texas and had won Texas' independence from Mexico at the Battle of San Jacinto 25 miles (40 km) east of Allen's Landing. After briefly serving as the capital of the Texas Republic in the late 1830s, Houston grew steadily into a regional trading center for the remainder of the 19th century.

The arrival of the 20th century saw a convergence of economic factors which fueled rapid growth in Houston, including a burgeoning port and railroad industry, the decline of Galveston as Texas' primary port following a devastating 1900 hurricane, the subsequent construction of the Houston Ship Channel, and the Texas oil boom. In the mid-20th century, Houston's economy diversified as it became home to the Texas Medical Center—the world's largest concentration of healthcare and research institutions—and NASA's Johnson Space Center, where the Mission Control Center is located.

Houston's economy since the late 19th century has a broad industrial base in energy, manufacturing, aeronautics, and transportation. Leading in healthcare sectors and building oilfield equipment, Houston has the second most Fortune 500 headquarters of any U.S. municipality within its city limits (after New York City). The Port of Houston ranks first in the United States in international waterborne tonnage handled and second in total cargo tonnage handled. Nicknamed the "Bayou City", "Space City", "H-Town", and "the 713", Houston has become a global city, with strengths in culture, medicine, and research. The city has a population from various ethnic and religious backgrounds and a large and growing international community. Houston is the most diverse metropolitan area in Texas and has been described as the most racially and ethnically diverse major metropolis in the U.S. It is home to many cultural institutions and exhibits, which attract more than 7 million visitors a year to the Museum District. Houston has an active visual and performing arts scene in the Theater District and offers year-round resident companies in all major performing arts.

The 2010 United States Census reported that Houston had a population of 2,100,263 residents. In 2017, the census-estimated population rose to 2,312,717, and in 2018 to 2,325,502. An estimated 600,000 undocumented immigrants resided in the Houston area in 2017, comprising nearly 9% of the city's metropolitan population.

Per the American Community Survey's 2014-2018 estimates, Houston's age distribution was 486,083 under 15; 147,710 aged 15 to 19; 603,586 aged 20 to 34; 726,877 aged 35 to 59; and 357,834 aged 60 and older. The median age was 33.1, up from 32.9 in 2017 and down from 33.5 in 2014; the city's youthfulness was attributed to an influx of an African American New Great Migration, Hispanic or Latin American, and Asian immigrants into Texas. For every 100 females, there were 98.5 males.

There were 976,745 housing units in 2018 and 849,105 households. An estimated 42.9% of Houstonians owned housing units with an average of 2.67 persons per household. The median monthly owner costs with a mortgage were \$1,598, and \$524 without a mortgage. Houston's median gross rent from 2014-2018 was \$990. The median household income in 2018 was \$51,140 and 20.6% of Houstonians lived at or below the poverty line.

Houston is recognized worldwide for its energy industry—particularly for oil and natural gas—as well as for biomedical research and aeronautics. Renewable energy sources—wind and solar—are also growing economic bases in the city. The Houston Ship Channel is also a large part of Houston's economic base. Because of these strengths, Houston is designated as a global city by the Globalization and World Cities Study Group and Network and global management consulting firm A.T. Kearney. The Houston area is the top U.S. market for exports, surpassing New York City in 2013, according to data released by the U.S. Department of Commerce's International Trade Administration. In 2012, the Houston–The Woodlands–Sugar Land area recorded \$110.3 billion in merchandise exports. Petroleum products, chemicals, and oil and gas extraction equipment accounted for roughly

two-thirds of the metropolitan area's exports last year. The top three destinations for exports were Mexico, Canada, and Brazil.

The Houston area is a leading center for building oilfield equipment. Much of its success as a petrochemical complex is due to its busy ship channel, the Port of Houston. In the United States, the port ranks first in international commerce and 16th among the largest ports in the world. Unlike most places, high oil and gasoline prices are beneficial for Houston's economy, as many of its residents are employed in the energy industry. Houston is the beginning or end point of numerous oil, gas, and products pipelines.

The Houston–The Woodlands–Sugar Land metro area's gross domestic product (GDP) in 2018 was \$478 billion, making it the sixth-largest of any metropolitan area in the United States and larger than Iran's, Colombia's, or the United Arab Emirates' GDP. Only 27 countries other than the United States have a gross domestic product exceeding Houston's regional gross area product (GAP). In 2010, mining (which consists almost entirely of exploration and production of oil and gas in Houston) accounted for 26.3% of Houston's GAP up sharply in response to high energy prices and a decreased worldwide surplus of oil production capacity, followed by engineering services, health services, and manufacturing.

The University of Houston System's annual impact on the Houston area's economy equates to that of a major corporation: \$1.1 billion in new funds attracted annually to the Houston area, \$3.13 billion in total economic benefit, and 24,000 local jobs generated. This is in addition to the 12,500 new graduates the U.H. System produces every year who enter the workforce in Houston and throughout Texas. These degree-holders tend to stay in Houston. After five years, 80.5% of graduates are still living and working in the region.

In 2006, the Houston metropolitan area ranked first in Texas and third in the U.S. within the category of "Best Places for Business and Careers" by *Forbes* magazine. Ninety-one foreign governments have established consular offices in Houston's metropolitan area, the third-highest in the nation. Forty foreign governments maintain trade and commercial offices here with 23 active foreign chambers of commerce and trade associations. Twenty-five foreign banks representing 13 nations operate in Houston, providing financial assistance to the international community.

In 2008, Houston received top ranking on *Kiplinger's Personal Finance* "Best Cities of 2008" list, which ranks cities on their local economy, employment opportunities, reasonable living costs, and quality of life. The city ranked fourth for highest increase in the local technological innovation over the preceding 15 years, according to *Forbes* magazine. In the same year, the city ranked second on the annual *Fortune* 500 list of company headquarters, first for *Forbes* magazine's "Best Cities for College Graduates", and first on their list of "Best Cities to Buy a Home". In 2010, the city was rated the best city for shopping, according to *Forbes*.

In 2012, the city was ranked number one for paycheck worth by *Forbes* and in late May 2013, Houston was identified as America's top city for employment creation.

In 2013, Houston was identified as the number one U.S. city for job creation by the U.S. Bureau of Statistics after it was not only the first major city to regain all the jobs lost in the preceding economic downturn, but also after the crash, more than two jobs were added for every one lost. Economist and vice president of research at the Greater Houston Partnership Patrick Jankowski attributed Houston's success to the ability of the region's real estate and energy industries to learn from historical mistakes. Furthermore, Jankowski stated that "more than 100 foreign-owned companies relocated, expanded or started new businesses in Houston" between 2008 and 2010, and this openness to external business boosted job creation during a period when domestic demand was problematically low. Also in 2013, Houston again appeared on *Forbes'* list of "Best Places for Business and Careers".

b. SAN ANTONIO

San Antonio is the seventh-most populous city in the United States, and the second-most populous city in both Texas and the Southern United States, with 1,547,253 residents in 2019.^[9] Founded as a Spanish mission and colonial outpost in 1718, the city became the first chartered civil settlement in present-day Texas in 1731. The area was still part of the Spanish Empire, and later of the Mexican Republic. It is the state's oldest municipality, having celebrated its 300th anniversary on May 1, 2018.

The city's deep history is contrasted with its rapid growth over the past few decades. It was the fastest-growing of the top ten largest cities in the United States from 2000 to 2010, and the second from 1990 to 2000. Straddling the regional divide between South and Central Texas, San Antonio anchors the southwestern corner of the urban megaregion colloquially known as the "Texas Triangle". The Greater San Antonio and Greater Austin areas are separated from each other by 80 miles along Interstate 35.

San Antonio serves as the seat of Bexar County; San Antonio is the center of the San Antonio–New Braunfels metropolitan statistical area. Commonly called Greater San Antonio, the metro area has a population of 2,550,960 based on the 2019 U.S. census estimate, making it the 24th-largest metropolitan area in the United States and third-largest in Texas.

According to the San Antonio Convention and Visitors Bureau, the city is visited by about 32 million tourists a year. It is home to the five-time NBA champion San Antonio Spurs, and hosts the annual San Antonio Stock Show & Rodeo, one of the largest such events in the U.S.

The U.S. Armed Forces have numerous facilities in and around San Antonio; Fort Sam Houston is the only one within the city limits. Lackland AFB/Kelly Field Annex, Camp Bullis, and Camp Stanley are outside the city limits. Kelly Air Force Base operated out of San Antonio until 2001, when the airfield was transferred to Lackland AFB. The remaining parts of the base were developed as Port San Antonio, an industrial/business park and aerospace complex.

San Antonio is home to six Fortune 500 companies and the South Texas Medical Center, the only medical research and care provider in the South Texas region.

San Antonio has a diversified economy with a gross domestic product (GDP) of approximately \$96.8 billion. This ranks the city fourth in Texas and 38th in the United States. San Antonio's economy focuses primarily on military, health care, government-civil service, financial services, oil and gas, and tourism. Within the past twenty years, the city has become a significant location for American-based call centers and has added a sizable manufacturing sector centered around automobiles.

Located about 10 miles northwest of Downtown is South Texas Medical Center, a conglomerate of various hospitals, clinics, and research and higher educational institutions.

Over twenty million tourists visit the city and its attractions every year, contributing substantially to its economy, primarily due to The Alamo and the River Walk. The Henry B. Gonzalez Convention Center alone hosts over 300 events annually with more than 750,000 convention delegates from around the world. Tourism provided over 130,000 jobs, and it had an economic impact of \$13.6 billion in the local economy. The city of San Antonio received \$195 million in the same year from the hospitality industry, with revenues from hotel occupancy tax, sales taxes and others.

Unlike most large cities in the U.S., San Antonio is not completely surrounded by independent suburban cities, and under Texas state law it exercises extraterritorial jurisdiction (ETJ) over much of the surrounding unincorporated land, including planning major thoroughfares and enforcing rules for platting and subdivision. It pursues an aggressive annexation policy and opposes the creation of other municipalities within its ETJ. Nearly three-fourths of its land area has been annexed since 1960.

Involuntary annexation is a controversial issue in those parts of unincorporated Bexar County affected by it. Residents attracted to the outlying areas by lower taxes and affordable real estate values often see annexation as a mechanism to increase property tax rates (which are primarily driven by school district taxes, not city taxes) without a corresponding improvement in services such as police and fire protection, while the city regards its annexation policy as essential to its overall prosperity.

c. AUSTIN

Austin is the capital city of the State of Texas as well as the seat and largest city of Travis County, with portions extending into Hays and Williamson counties. Incorporated on December 27, 1839, it is the 11th-most populous city in the United States, the fourth-most-populous city in Texas, and the second-most-populous state capital city. It was also the fastest growing large city in the United States in 2015 and 2016.

As of the U.S. Census Bureau's July 1, 2019, estimate, Austin had a population of 978,908, up from 790,491 at the 2010 census. The city is the cultural and economic center of the Austin–Round Rock metropolitan statistical area, which had an estimated population of

2,227,083 as of July 1, 2019, nearly an 80% increase from the year 2000. Located in Central Texas within the greater Texas Hill Country, it is home to numerous lakes, rivers, and waterways, including Lady Bird Lake and Lake Travis on the Colorado River.

Residents of Austin include a diverse mix of government employees, college students, musicians, high-tech workers, and blue-collar workers. The city's official slogan promotes Austin as "The Live Music Capital of the World", a reference to the city's many musicians and live music venues. The city also adopted "Silicon Hills" as a nickname in the 1990s due to a rapid influx of technology and development companies.

Emerging from a strong economic focus on government and education, since the 1990s Austin has become a center for technology and business. A number of Fortune 500 companies have headquarters or regional offices in Austin. Dell's worldwide headquarters is located in the nearby suburb of Round Rock.

Educationally, Austin is the home of the University of Texas at Austin, attended by over 50,000 students.

At the 2000 United States Census, there were 656,562 people, 265,649 households, and 141,590 families residing in the city. The population density was 2,610.4 inhabitants per square mile (1,007.9/km²). There were 276,842 housing units at an average density of 1,100.7 per square mile (425.0/km²). There were 265,648 households, out of which 26.8% had children under the age of 18 living with them, 38.1% were married couples living together, 10.8% had a female householder with no husband present, and 46.7% were non-families. 32.8% of all households were made up of individuals, and 4.6% had someone living alone who was 65 years of age or older. The average household size was 2.40 and the average family size was 3.14.

In the city, the population was spread out, with 22.5% under the age of 18, 16.6% from 18 to 24, 37.1% from 25 to 44, 17.1% from 45 to 64, and 6.7% who were 65 years of age or older. The median age was 30 years. For every 100 females, there were 105.8 males.

The median income for a household in the city was \$42,689, and the median income for a family was \$54,091. Males had a median income of \$35,545 vs. \$30,046 for females. The per capita income for the city was \$24,163. About 9.1% of families and 14.4% of the population were below the poverty line, including 16.5% of those under age 18 and 8.7% of those age 65 or over. The median house price was \$185,906 in 2009, and it has increased every year since 2004. The median value of a house in which the owner occupies it was \$227,800 in 2014, which is higher than the average American home value of \$175,700.

The Greater Austin metropolitan statistical area had a gross domestic product (GDP) of \$86 billion in 2010. Austin is considered to be a major center for high tech. The region's rapid growth has led Forbes to rank the Austin metropolitan area number one among all big cities for jobs for 2018 in their annual survey and WSJ Marketwatch to rank the area number one for growing businesses.

The proliferation of technology companies has led to the region's nickname, "Silicon Hills," and spurred development that greatly expanded the city. Austin is also emerging as a hub for pharmaceutical and biotechnology companies; the city is home to about 85 of them. The city was ranked by the Milken Institute as the No.12 biotech and life science center in the United States.

In 2018, Austin metro-area companies saw a total of \$1.33 billion invested. Austin's VC numbers were so strong in 2018 that they accounted for more than 60 percent of Texas' total investments.

d. DALLAS-FORT WORTH METROPLEX

a. Geography

The United States Census Bureau determined the Metroplex encompasses 9,286 square miles (24,100 km²) of total area; 8,991 sq mi (23,290 km²) is land, and 295 sq mi (760 km²) is covered by water. The conurbated metropolitan area is larger in area than the U.S. states of Rhode Island and Connecticut combined,^[25] and larger than New Jersey.^[25] If the metropolitan area were a sovereign state, it would rank the 162nd largest state by total area after Lebanon. The U.S. Office of Management and Budget combines the Dallas–Fort Worth metroplex with the Sherman–Denison metropolitan area and seven micropolitan statistical areas to form the Dallas–Fort Worth, TX–OK combined statistical area.

The Dallas–Fort Worth metroplex overlooks mostly prairie land with a few rolling hills dotted by man-made lakes cut by streams, creeks and rivers surrounded by forested land. The Dallas–Fort Worth metroplex is situated in the Texas blackland prairies region,^[26] so named for its fertile black soil found especially in the rural areas of Collin, Dallas, Ellis, Hunt, Kaufman, and Rockwall counties. Many areas of Denton, Johnson, Parker, Tarrant, and Wise counties are located in the Fort Worth Prairie region of North Texas,¹ which has less fertile and more rocky soil than that of the Texas blackland prairie; most of the rural land on the Fort Worth Prairie is ranch land. A large onshore natural gas field, the Barnett Shale, lies underneath this area; Denton, Tarrant and Wise counties feature many natural gas wells. Continuing land use change results in scattered crop fields surrounded by residential or commercial development. South of Dallas and Fort Worth is a line of rugged hills that goes north to south about 15 miles (24 km) that looks similar to the Texas Hill Country 200 miles (320 km) to the south.

b. Metropolitan divisions and counties

The Dallas–Fort Worth–Arlington metroplex is formed by a combination of two separate metropolitan statistical divisions. The Dallas–Plano–Irving MDA and Fort Worth–Arlington–Grapevine MDA come together to form one full metropolitan area or conurbation.

1. Dallas–Plano–Irving metropolitan division

- Collin County
- Dallas County
- Delta County
- Denton County
- Ellis County
- Hunt County
- Kaufman County
- Rockwall County

2. Fort Worth–Arlington–Grapevine metropolitan division

- Johnson County
- Parker County
- Tarrant County

C. Economy

The cities of Dallas and Fort Worth are the two central cities of the Metroplex, with Arlington being a third economically important city; it is a center for sporting events, tourism and manufacturing. Most other incorporated cities in the Metroplex are "bedroom communities" serving largely as residential and small-business centers, though there are several key employers in these regions. Due to the large number of smaller, less well-known cities, metroplex residents commonly divide the region roughly in half along Texas Interstate 35, which runs north–south, splitting into two 'branches' (I-35E in Dallas and I-35W in Fort Worth) through the Metroplex. They refer to places as being on the "Dallas side" or the "Fort Worth side", or in "the Arlington area", which is almost directly south of the airport. It is nominally between the two major east–west interstates in the region (I-20, passing to the south of both downtowns, and I-30, connecting Dallas and Fort Worth city centers).

Business management and operations play a central role in the area's economy. Dallas and its suburbs have the third-largest concentration of corporate headquarters in the United States. Moreover, it is the only metro area in the country home to three of the top-ten largest Fortune 500 companies by revenue. The area continues to draw corporate relocation from across the nation, and especially from California. From late 2018 to early 2019, both McKesson and Charles Schwab announced they would be relocating from San Francisco to the DFW area.^[42] Later in 2019, San Francisco-based Uber announced a massive corporate expansion just east of downtown Dallas. The trend of major corporate moves and expansions has influenced the booming DFW construction industry, which ranks first nationally in new apartment development as of 2019.

Banking and finance play a key role in the area's economy. DFW recently surpassed Chicago to become the second-largest financial services hub in the nation, eclipsed only by New York.^[44] Bank of America, JP Morgan Chase, Liberty Mutual, Goldman Sachs, State Farm, TD Ameritrade, Charles Schwab, and Fidelity Investments maintain significant operations in the area. The Metroplex also contains the largest Information Technology industry base in the state (often referred to as Silicon Prairie or the Telecom Corridor, especially when referring to US-75 through Richardson, Plano and Allen just north of Dallas itself). This area has a large number of corporate IT projects and the presence of numerous electronics, computing and telecommunication firms such as Microsoft, Texas Instruments, HP Enterprise Services, Dell Services, Samsung, Nokia, Cisco, Fujitsu, i2, Frontier, Alcatel, Ericsson, CA, Google, and Verizon. AT&T, the largest telecommunications company in the world, is headquartered at the Whitacre Tower in downtown Dallas. ExxonMobil and McKesson, respectively the 2nd and 7th largest Fortune 500 companies by revenue, are headquartered in Irving, Texas. Fluor, the largest engineering & construction company in the Fortune 500, is also headquartered in Irving.^[45] In October 2016, Jacobs Engineering, a Fortune 500 company and one of the world's largest engineering companies, relocated from Pasadena, California to Dallas. Toyota USA, in 2016, relocated its corporate headquarters to Plano, Texas. Southwest Airlines is headquartered in Dallas. The airline has more than 53,000 employees as of October 2016 and operates more than 3,900 departures a day during peak travel season.

On the other side of the Metroplex, the Texas farming and ranching industry is based in Fort Worth, though the area's economy is diverse. American Airlines, the largest airline in the world, recently completed their new \$350M corporate HQ complex in Fort Worth.^[47] American Airlines is the largest employer in the Metroplex. Several major defense manufacturers, including Lockheed Martin, Bell Helicopter Textron, and Raytheon, maintain significant operations in the Metroplex, primarily on the "Fort Worth side." They are concentrated along State Highway 170 near I-35W, commonly called the "Alliance Corridor" due to its proximity to the Fort Worth Alliance regional airport.

Changes in house prices for the Metroplex are publicly tracked on a regular basis using the Case–Shiller index; the statistic is published by Standard & Poor's and is also a component of S&P's 20-city composite index of the value of the U.S. residential real estate market.

PART FIVE: NEEDS OF MATAGORDA COUNTY

Selection of Matagorda County as R&D Hub: is a county located in the State of Texas. As of the 2010 census, the population was 36,702. Its county seat is Bay City. Matagorda County is named for the canebrakes that once grew along the coast (*matagorda* is a Spanish word meaning "thick bush").

Matagorda County comprises the Bay City, TX Micropolitan Statistical Area, which is also included in the Houston-The Woodlands, TX combined statistical area.

Of the 13,901 households, 36.70% had children under the age of 18 living with them, 53.80% were married couples living together, 12.70% had a female householder with no husband present, and 28.60% were not families. About 25.10% of all households were made up of individuals, and 10.40% had someone living alone who was 65 years of age or older. The average household size was 2.70, and the average family size was 3.25.

In the county, the age distribution was 30.00% under the age of 18, 8.90% from 18 to 24, 26.90% from 25 to 44, 21.80% from 45 to 64, and 12.40% who were 65 years of age or older. The median age was 35 years. For every 100 females, there were 98.60 males. For every 100 females age 18 and over, there were 95.50 males.

The median income for a household in the county was \$32,174, and for a family was \$40,586. Males had a median income of \$37,733 versus \$21,871 for females. The per capita income for the county was \$15,709. About 14.90% of families and 18.50% of the population were below the poverty line, including 23.00% of those under age 18 and 13.60% of those age 65 or over.

Economy

Rice is grown extensively in Matagorda County, as are St. Augustine and other turf grasses. In addition to a wealth of offshore oil rigs and natural gas extraction facilities all over the county, the County is the home of two petrochemical processing plants (Celanese and Equistar).

The County is the home of the South Texas Power Project. The **STPP** is a nuclear power plant which consists of two **Westinghouse Pressure Water Reactors**.

Matagorda County has secluded, extensive forests, wetlands, prairie, and coastal regions. The Gulf Coast floodplain has several conditions conducive to a variety of ecosystems and recreational activities evident by the highest count of migrating birds in the United States. Fishing (on- and offshore), hunting, and scuba diving are large parts of the recreation industry due to the Colorado River, the forests and Matagorda Bay.