CHAPTER 2
Overview

The energy industry plays a critical role in the Texas economy. The strength of the state's economy depends upon reliable and affordable energy supplies. As the state's population increases and its economy grows and evolves, it is vitally important to continue meeting this demand.

In basic terms, energy is used to perform work. Initially, this work was performed through our own labors, then by domesticated animals and now, increasingly, by machines. For any person, animal or machine, work requires an energy source or fuel. Bread consumed by laborers allowed them to move stones that became the great pyramids; grass eaten by oxen drove wagon trains across the West; and diesel fuel enables modern trucks to haul freight nationwide.

Today, Texans use energy for cooling and heating their homes and powering appliances; in industrial applications, such as petroleum refining and chemical production; and for a variety of commercial applications, from preparing crops for market to manufacturing goods. Energy also is consumed in the form of transportation fuel, both for personal transport and to move goods and provide services to consumers. And about 30 percent of all energy consumed in the state is used to generate electricity.[1]

Reliable and affordable energy is an important factor in economic development. In 2007, for example, two large manufacturing companies rejected possible expansion sites near Boise, Idaho because the area could not guarantee the necessary electric power, costing the area as many as 1,000 jobs.[2]

And disruptions to our energy supplies are costly. A massive electrical blackout on August 14, 2003, affected eight states and 50 million people in the northeastern U.S., costing the nation's economy between $4.5 billion and $12 billion in economic activity.[3] According to the Electric Power Research Institute, Texas loses between $7.3 billion and $11.5 billion annually to power outages, losses second only to California's.[4]

Energy Resource Trends

Mankind's energy use has shifted over the centuries. Coal powered the industrial revolution. A century ago, it provided most home heating and fueled steam locomotives. But new technologies allowed people to find cleaner and more convenient fuels; today, coal is used almost exclusively as a boiler fuel in large electric power plants, where economies of scale allow it to be used efficiently, with reasonably effective emissions controls. Coal is the most abundant and economic fossil fuel available to the nation, but wider use of it may be limited by concerns about air pollution and carbon emissions.

In the last century, petroleum came to dominate heating, industrial and transportation uses, due to its flexibility, including its ease of storage and transportation. Abundant, cheap oil changed Texas forever; it is almost certainly the most important industry in the state's history.

Today, oil continues to be the backbone of the state's industrial sector, and fuels virtually all of Texas' transportation systems, whether by air, land or water. The significant jump in oil prices during the past decade — from $12 per barrel in 1998 to more than $110 per barrel today — may spur some technological advances and fuel switching in the transportation sector.[5]

Over time, the U.S. has become more dependent on petroleum imports. In 2006, total liquids supply (including crude oil and refined products) from foreign sources accounted for 60 percent of U.S. supply.[6]

Natural gas initially was a nuisance byproduct of oil production that was commonly eliminated by "flaring" it at the wellhead. After pipelines allowed natural gas producers to connect with their customers, it began to play a significant role in meeting Texas' energy needs. In 1970, the price of natural gas was 62 cents per thousand cubic feet (in 2000 dollars). Today's prices are more than 10 times this amount; in 2005, they averaged $6.50

Oil continues to be the backbone of the state's industrial sector, and fuels virtually all of Texas' transportation systems, whether by air, land or water.

per thousand cubic feet. Despite higher prices, natural gas is still a highly valued, clean fuel that has become a Texas mainstay for industrial applications and electricity production.

Commercial nuclear power is an offshoot of the nation's enormous investment and expertise in nuclear technology for military purposes. Nuclear power can produce large amounts of heat that is best suited for use in very large power plants, and it has some very desirable features (such as low-cost fuel and extremely long run times between refueling) as well as significant drawbacks (very high front-end costs, long regulatory and construction lead times, and unique safety and security concerns).

Renewable energy represents a vast palette of natural energy resources, encompassing usable energy from the sun, wind, biomass (plant materials and animal waste), water and the earth itself (geothermal energy). These are fundamentally different from conventional fuel sources in that they are renewed by nature over short time cycles and hence are not depletable, as are fossil fuels. Renewable energy sources are virtually infinite, offering great promise for our long-term energy needs. Technology is the key to making use of these abundant but challenging resources, as they tend to be more dispersed and lower in energy density than fossil fuels.

Texas has a great assortment of energy options available to power its future.

Energy efficiency can help meet our energy needs by reducing our demand for energy. Better power plants, advanced auto technology and energy-saving lighting and appliances have proven that economic growth can be achieved with lower energy consumption. More efficient technology under the hood can stretch a tank of gas by many miles. Actions to reduce customer demand and consumption are the quickest and often the lowest-cost options for meeting short-term energy needs.

A growing economy and population will require more energy than can be saved with improved efficiency. But Texas has a great assortment of energy options available to power its future. As the supply of traditional fuels become less certain and more costly, advanced technology will play an increasingly important role.

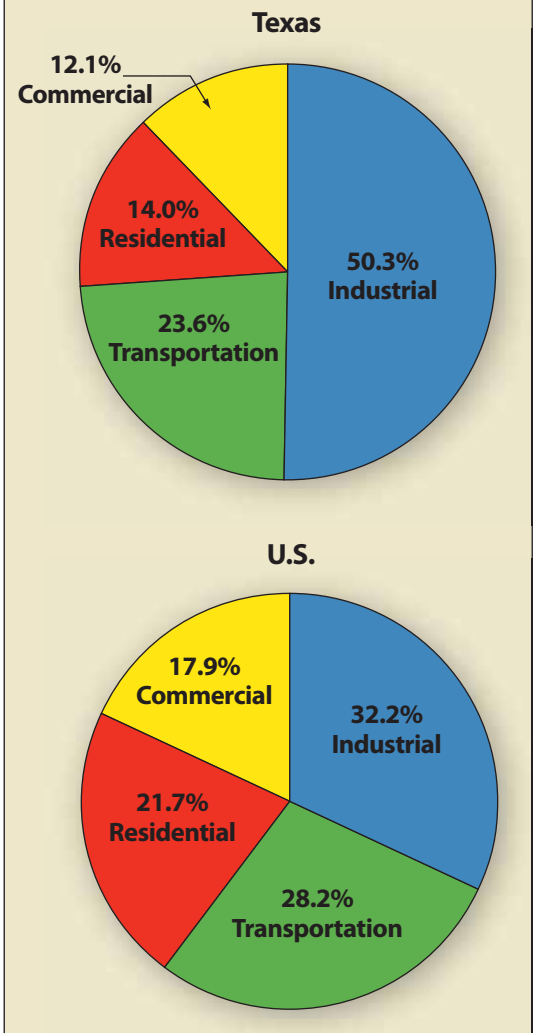
Note: The following sections include data through 2005, as this is the most recent data available across all fuel sources in a standard format. Subsequent chapters frequently rely on more recent data related to their topics.

Texas Energy Consumption

Texas' energy use is tied to its large population, hot climate and extensive industrial sector. Compared to the U.S., Texas has a high concentration of energy-intensive industries, such as aluminum and glass manufacturing, forest products, petroleum

Exhibit 2-1

Energy Consumption by Sector, Texas vs. U.S., 2005



Source: U.S. Energy Information Administration.

refining and petrochemical production.[7] Texas industries account for 50 percent of all energy used in Texas, while U.S. industrial energy use makes up 32 percent of total U.S. energy consumption (**Exhibit 2-1**). (Energy consumption commonly is divided between four end-use sectors — residential, commercial, industrial and transportation.) In other words, much of Texas' energy consumption fuels industries producing products used across the U.S. and around the world.

Texas thus leads the nation in energy consumption, accounting for 11.5 percent of all U.S. energy use and 18 percent of industrial use. Texas leads the states in the use of oil, natural gas, coal and electricity, consuming over 11.5 quadrillion British Thermal Units (Btu). California was second with more than 8 quadrillion Btu.[8]

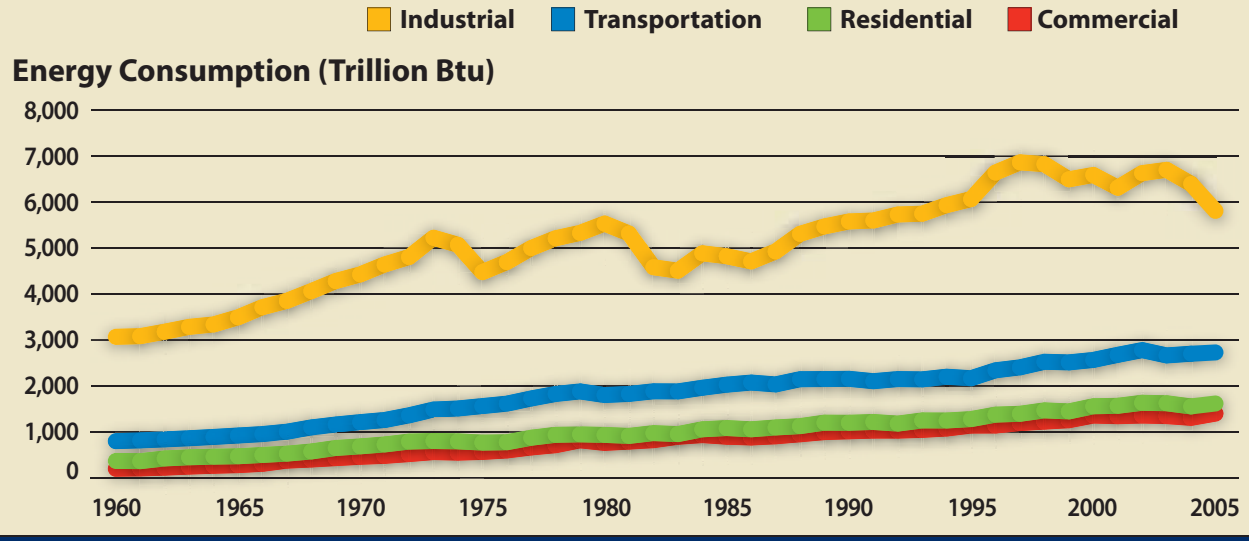
Total energy consumption has increased by an average of 2.2 percent annually since 1960. Residential and commercial consumption both increased gradually, while the demand for transportation fuel rose more rapidly, a trend reflecting a growing population and an expanding economy. Industrial consumption is much more variable than the other sectors, as it is more sensitive to higher energy prices and economic slowdowns. Industrial consumption fell by 13.3 percent from 2003 to 2005, due to higher energy prices and greater investments in efficiency. This paralleled efficiency gains prompted by higher energy prices in the early 1980s (**Exhibit 2-2**).

Heat value as measured in British Thermal Units or Btu, is one of the few ways to make apt comparisons among hydrocarbon fuels; such comparisons are used throughout this report. These fuels have varying energy qualities and are traded by different measures of weight or volume, but all are put to the same use — producing heat. Oil, for example, is traded by the barrel, which is equivalent to 42 U.S. gallons. Gasoline, diesel and heating oil are traded by the gallon. Natural gas is measured by volume — in thousand (Mcf), million (MMcf), billion (Bcf) or trillion (Tcf) cubic feet — or by heat value, usually dekatherms (1 million Btu). In the U.S., coal is measured by the short ton (2,000 pounds) or, in other parts of the world, by the metric "tonne," equivalent to about 2,200 pounds.

Energy use per person in Texas also has decreased in recent years and is at its lowest level since 1965 (**Exhibit 2-3**). Combined residential and commercial per capita consumption in Texas was slightly below the U.S. average in 2005, with 132 and 134

EXHIBIT 2-2

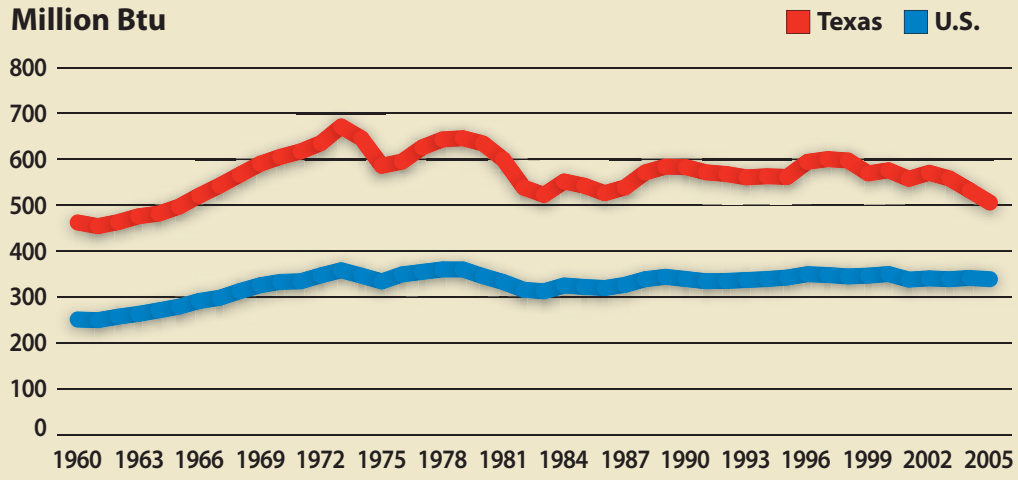
Texas Annual Consumption by Sector



Source: U.S. Energy Information Administration.

EXHIBIT 2-3

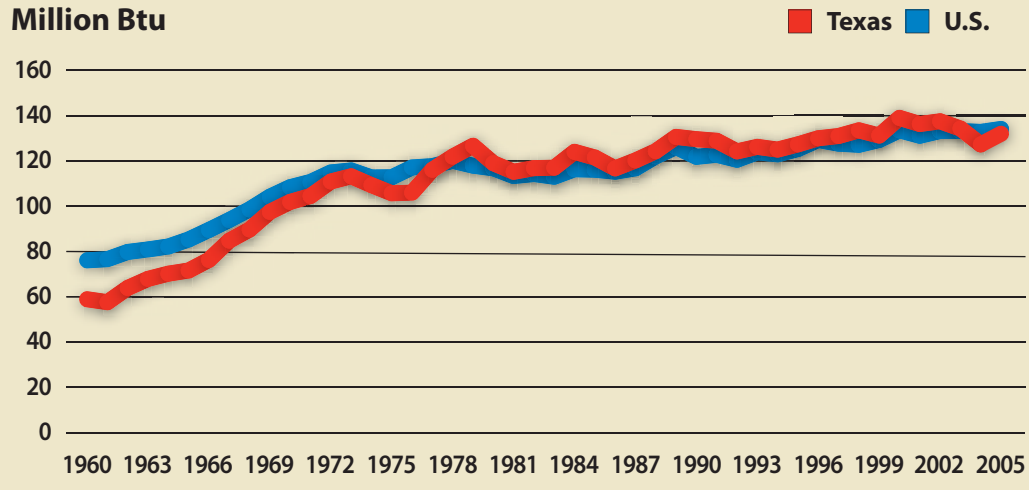
Total Per Capita Energy Consumption



Sources: U.S. Energy Information Administration and U.S. Census Bureau.

EXHIBIT 2-4

Residential and Commercial Per Capita Energy Consumption



Source: U.S. Energy Information Administration.

Decreasing energy intensity is an indication of greater energy efficiency and structural changes in the economy, such as growth in less energy-intensive industries like services.

million Btu, respectively (**Exhibit 2-4**). To no surprise, Texas per capita industrial consumption is well above the U.S. level, but Texas per capita industrial consumption has dropped steadily in recent years to its lowest level since 1960, the first year for which data are available (**Exhibit 2-5**). Per capita transportation use also has declined in recent years (**Exhibit 2-6**).

Furthermore, the energy "intensity" of the Texas economy — or its energy use per dollar of gross state product (GSP) — fell by nearly 68 percent between 1970 and 2005 (**Exhibit 2-7**).[9] Decreasing energy intensity is an indication of greater energy efficiency and structural changes in the economy, such as growth in less energy-intensive industries like services. Pricing also has an effect, as energy intensity declines more during periods of high energy prices.Texas and the U.S. have become increasingly more reliant on imported fuel, but as **Exhibit 2-7** demonstrates, our economy is less dependent on energy in general.[10]

Texas Primary Energy Sources

Primary energy resources are those used for direct-use applications (primarily heating and manufacturing); transportation fuels; and the production of secondary energy sources such as electricity (**Exhibit 2-8**).

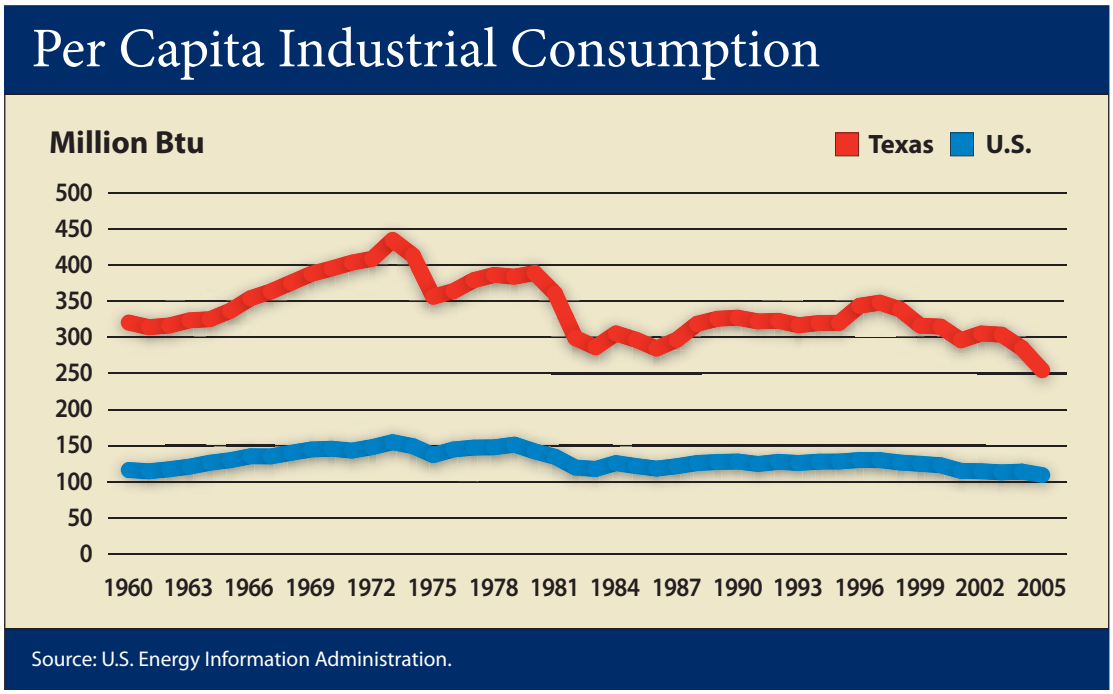
Direct uses include the burning of combustible materials to produce heat for homes and office buildings and to turn raw materials into finished products in industrial applications. Direct use accounted for 45.8 percent of all Texas energy consumption in 2005, for applications such as the manufacturing of chemicals, petroleum products, paper and metal (**Exhibit 2-9**). Energy for direct-use applications decreased by nearly nine percent in 2005, largely from declines in industrial energy consumption.

Texas energy consumption for transportation rose by an average 2.7 percent annually between 1965 and 2005, and accounted for 23.6 percent of all energy use in the latter year.

Among the markets for primary energy, electricity is Texas' fastest-growing type of energy consumption, rising by an annual average of 4.2 percent between 1965 and 2005. The production of electricity now accounts for over 30 percent of the state's energy use, up from 13 percent in 1965.[11]

Texas leads all states in the use of petroleum, as large quantities of petroleum are used in industrial

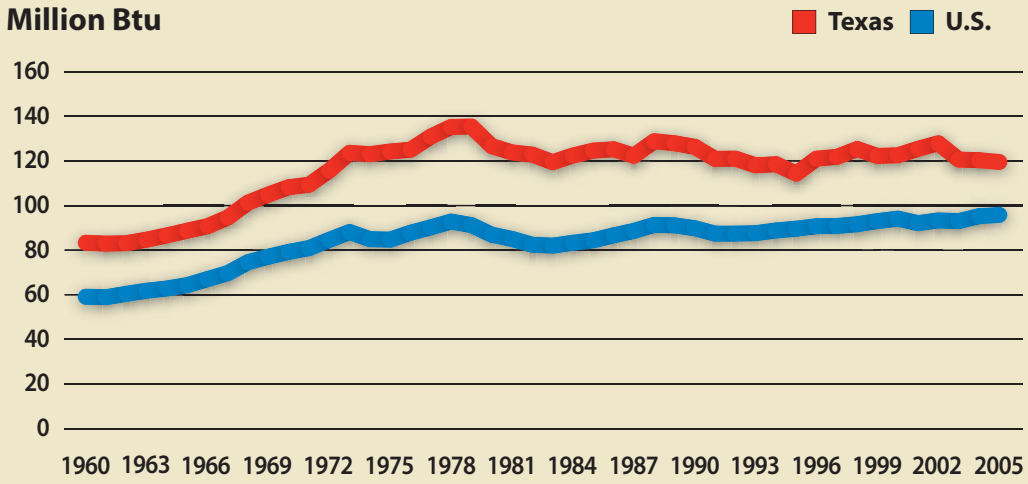
Exhibit 2-5



Source: U.S. Energy Information Administration.

EXHIBIT 2-6

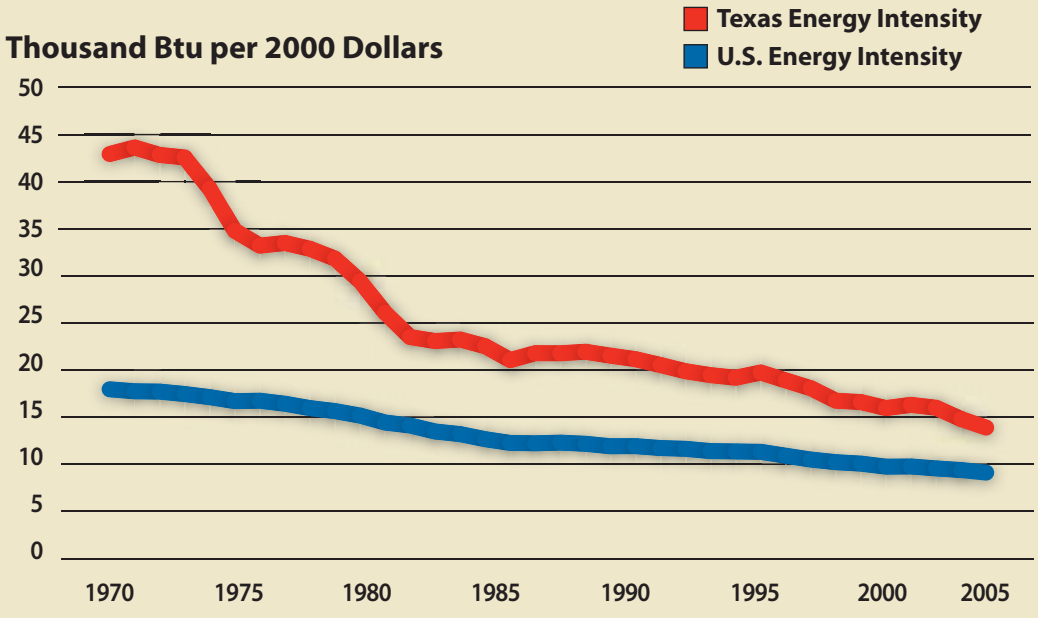
Per Capita Transportation Consumption



Source: U.S. Energy Information Administration.

EXHIBIT 2-7

Energy Use Per Real Dollar of Gross Domestic Product



Sources: U.S. Energy Information Administration and U.S. Bureau of Economic Analysis.

EXHIBIT 2-8

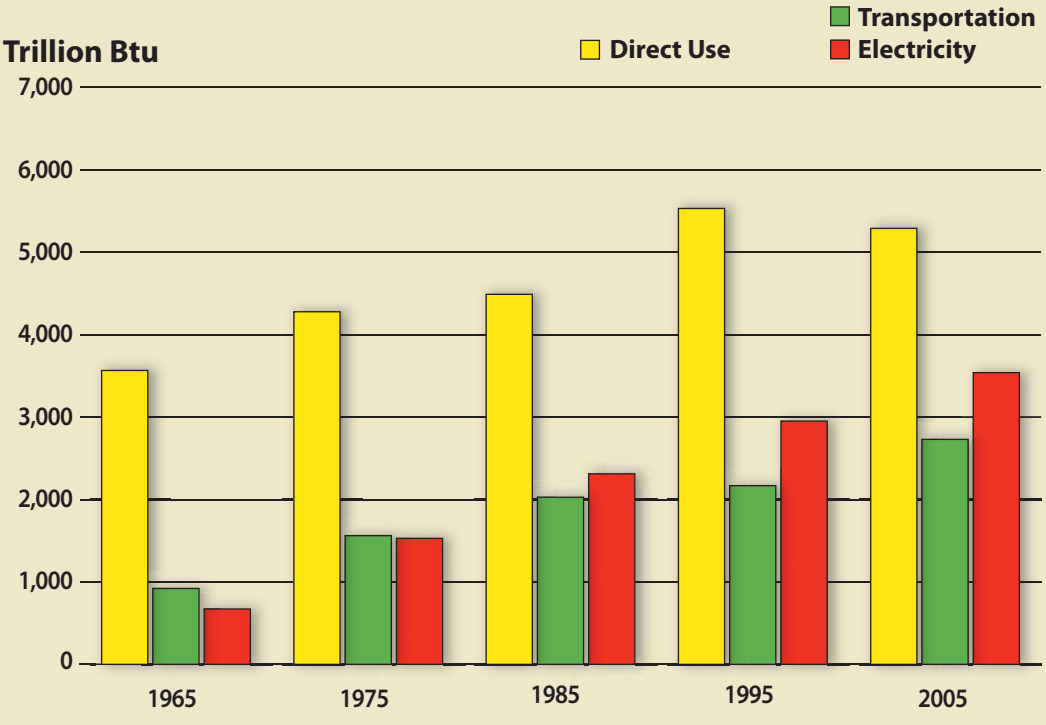
Primary Uses of Energy

Energy Source	Direct Use	Electricity	Transportation
Petroleum	x		x
Natural Gas	x	x	
Coal		x	
Uranium		x	
Solar	x	x	
Wind		x	
Biomass	x	x	x
Water		x	
Geothermal		x	

Source: Virtus Energy.

EXHIBIT 2-9

Texas Primary Energy Use



Source: U.S. Energy Information Administration.

applications relative to other states. In 2005, petroleum accounted for 50.8 percent of Texas industrial energy use, and Texas consumed 30.5 percent of the petroleum used for industrial purposes in the U.S. A major reason for the large share is Texas' use of liquid petroleum gas (LPG) for petrochemical production, as Texas used more LPG than all other states combined. For all sectors, Texas used 14 percent of U.S. petroleum.

Texas leads the U.S. in natural gas use, accounting for 16 percent of U.S. consumption. Texas' large share is mostly due to industrial consumption and electricity generation. For example, natural gas accounted for 49.4 percent of Texas electricity production in 2005, compared to 18.7 percent in the U.S. Texas' natural gas consumption fell by 20 percent from 2003-2005 to its lowest level since 1987, due to higher prices and a steep decline in industrial use.

Demand for coal and nuclear energy remained steady in 2005. While still accounting for a fraction of total energy use, renewable energy usage rose by 35 percent between 2000 and 2005, almost entirely due to wind-powered electric generation. In all, energy consumption in Texas fell by 3.4 percent in 2005 (**Exhibit 2-10**).[12]

Fossil fuels — crude oil, natural gas and coal — account for 94.5 percent of Texas energy consumption and 85.9 percent of U.S. consumption (**Exhibits 2-11** and **2-12**). As stated, natural gas plays a larger role in Texas due to the state's abundant supply and use for electric generation.

Energy by End Use Sector

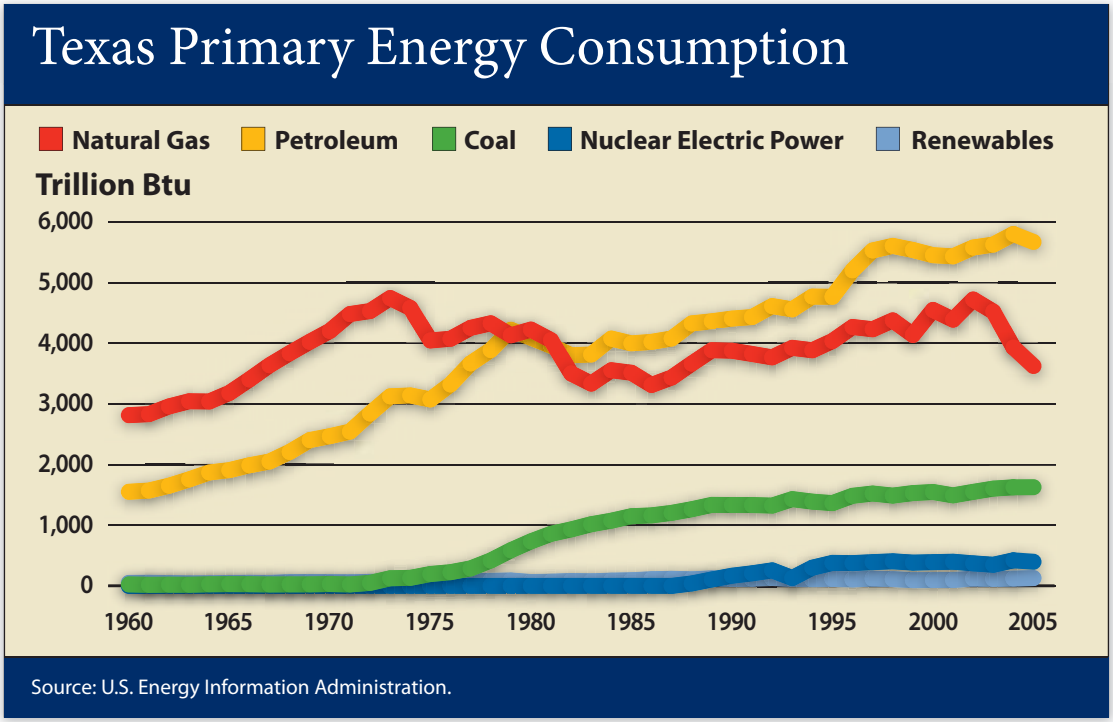
Texas per capita residential consumption of electricity is far greater than the national average. Other states rely more heavily, for example, on oil and gas for residential energy needs, and thus have lower average electricity consumption. The commercial sector in Texas also uses a large amount of electricity. The industrial sector depends principally on oil and gas but also uses a significant amount of electricity; the transportation sector is nearly 100 percent petroleum-dependent (**Exhibits 2-13**, **2-14** and **2-15**).

Electricity Generation

Natural-gas fired power plants supplied nearly half of Texas' electricity in 2005. This differs significantly from the national pattern. In the U.S. as a whole, nearly half of all electricity was generated by coal in 2005; only 20 percent came from natural gas. Over the past 10 years, electricity

For decades, Texas has led the states in energy production and remains the nation's largest producer and refiner of oil and gas.

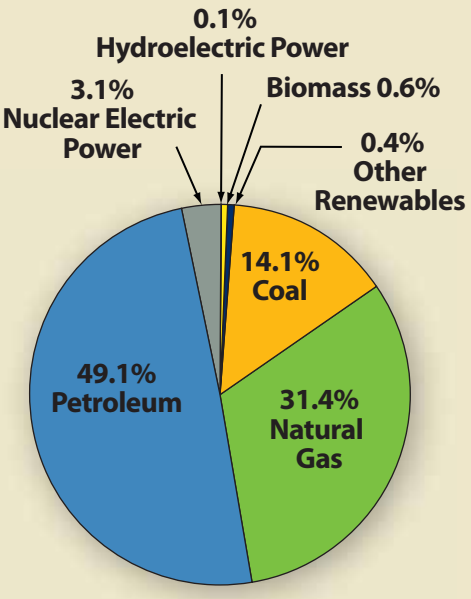
Exhibit 2-10



Source: U.S. Energy Information Administration.

EXHIBIT 2-11

Texas Primary Energy Use, 2005

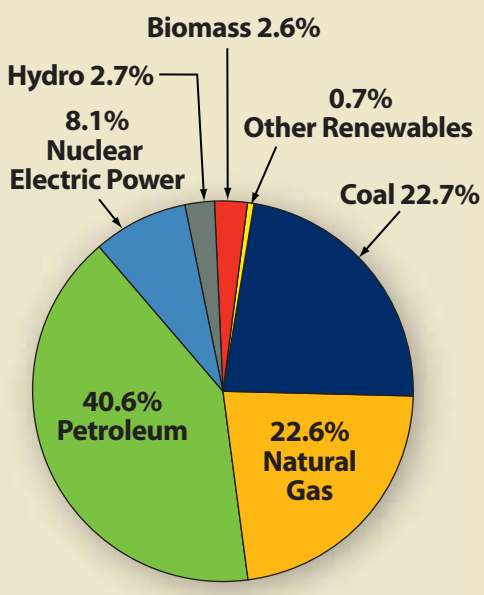


Note: Numbers may not total due to rounding and because net interstate electricity flows and losses are excluded.

Source: U.S. Energy Information Administration.

EXHIBIT 2-12

U.S. Primary Energy Use, 2005

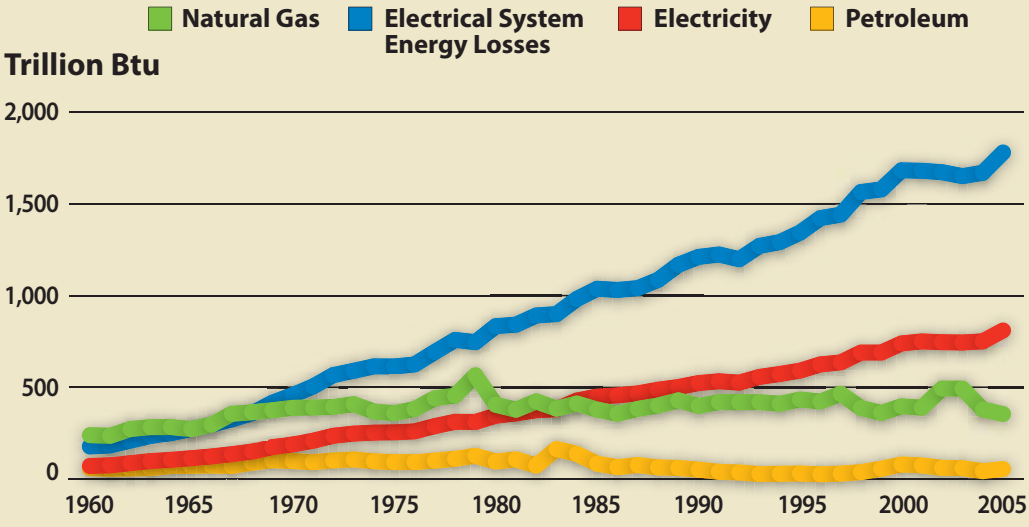


Note: Numbers may not total due to rounding and because net interstate electricity flows and losses are excluded.

Source: U.S. Energy Information Administration.

EXHIBIT 2-13

Texas Residential and Commercial Energy Consumption by Source



Source: U.S. Energy Information Administration.

production from nuclear power has remained relatively constant and in 2005 accounted for about 10 percent of Texas electricity generation. Due to increases in wind power, non-hydroelectric renewable energy accounted for 2 percent of Texas electricity generation (**Exhibit 2-16**).[13]

Texas Energy Production

For decades, Texas has led the states in energy production and remains the nation's largest producer and refiner of oil and gas. Texas has ample reserves of lignite coal, which can be used to generate

State Government Energy Spending

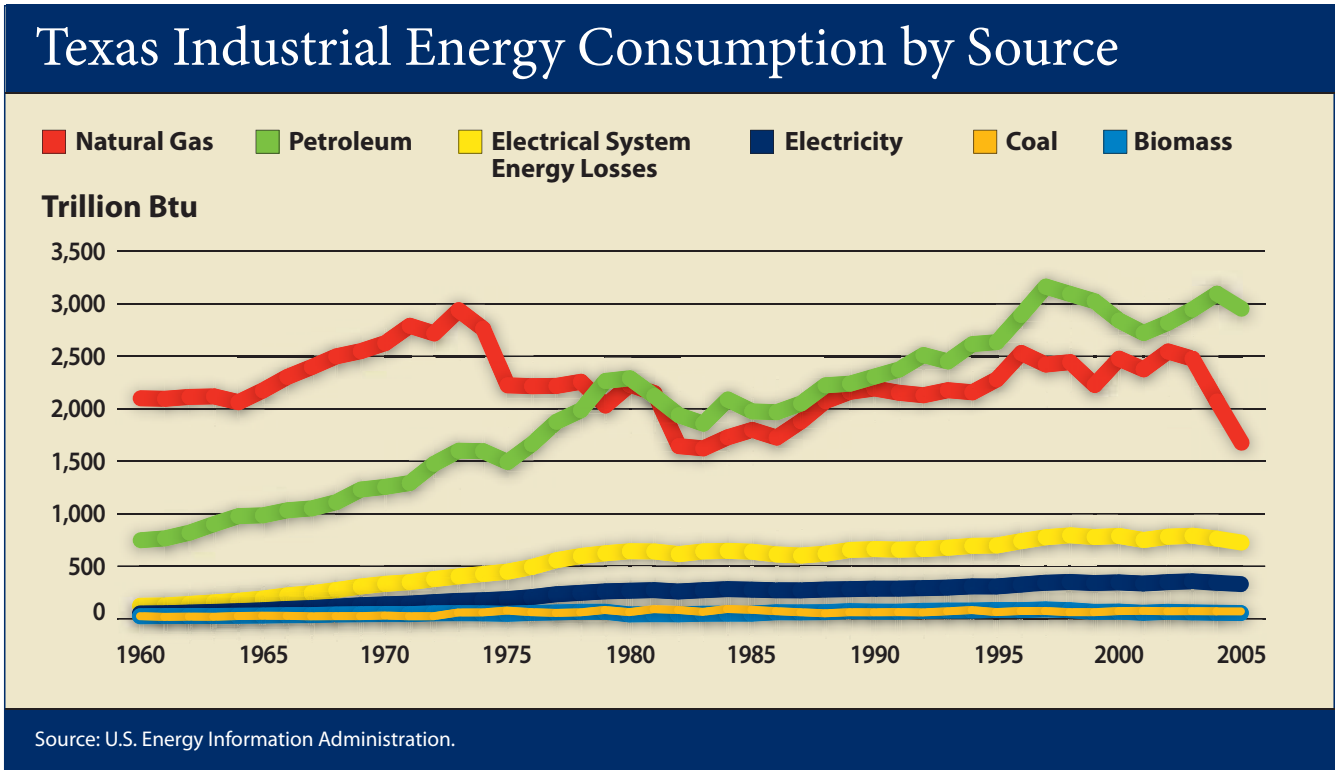
Texas state government consumes a great deal of electricity and transportation fuels. In fiscal 2007, state agencies spent $323 million on energy.

Texas State Government Energy Spending, Fiscal 2007

Description	Expenditures
Petroleum Products Used in State-Owned or Leased Vehicles and Other Equipment	$75,546,109.23
Petroleum Products Used in State-Owned or Leased Aircraft	1,134,052.50
Electrical Utilities	205,447,358.12
Natural and Liquefied Petroleum Gas Utilities	31,955,983.02
Thermal Energy (purchases of steam and hot and cold water)	9,094,583.95
Total	**$323,178,086.82**

Source: Texas Comptroller of Public Accounts.

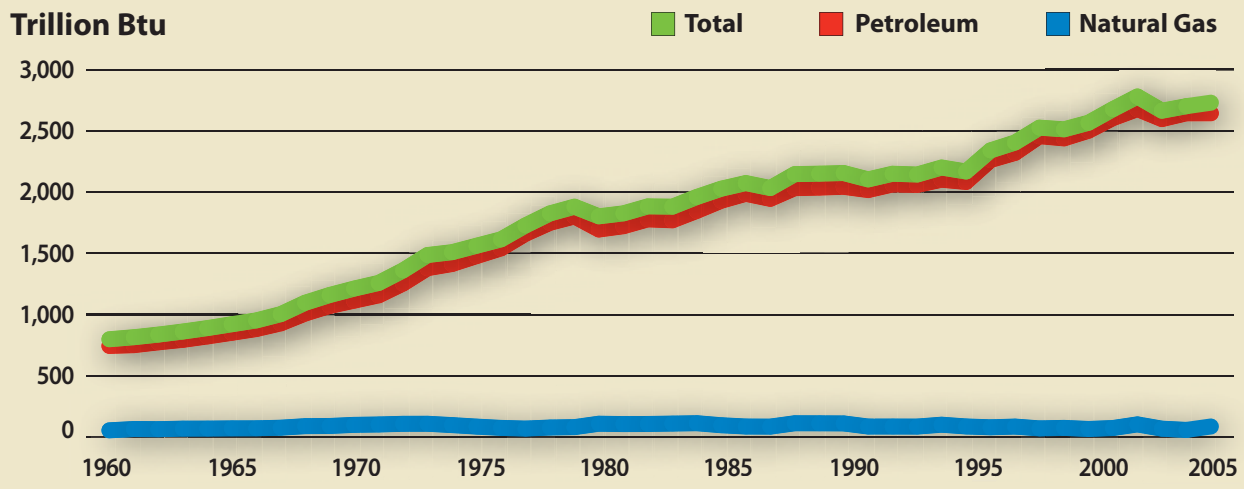
Exhibit 2-14



Source: U.S. Energy Information Administration.

EXHIBIT 2-15

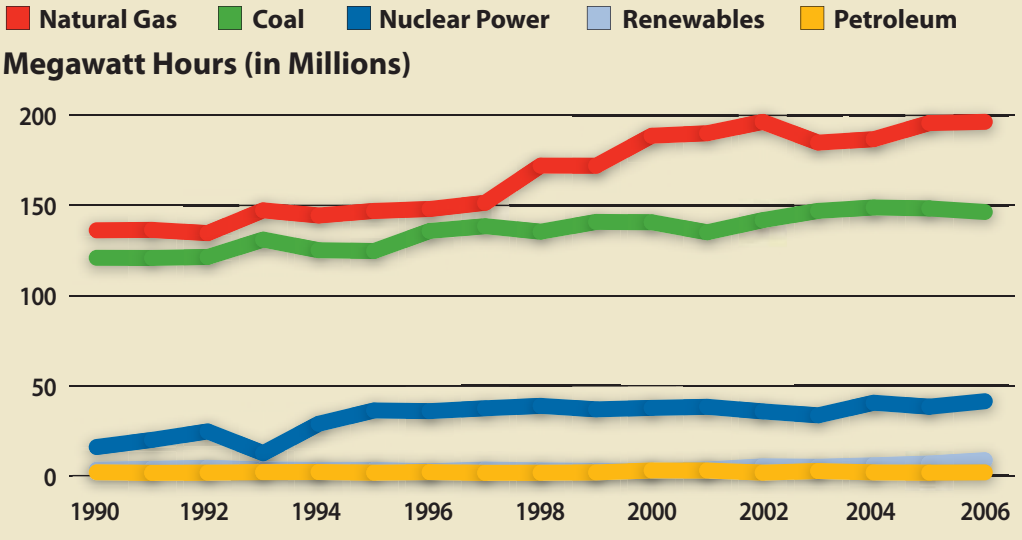
Texas Transportation Energy Consumption by Source



Source: U.S. Energy Information Administration.

EXHIBIT 2-16

Electric Power Industry Generation by Source



Source: U.S. Energy Information Administration.

electricity, as well as uranium deposits that can be used as fuel in generating nuclear power. Finally, Texas has an abundance of many types of renewable fuels and leads the nation in installed wind energy capacity.

Oil and Gas Production

Oil and gas production has been the cornerstone of the Texas energy industry since the Spindletop oilfield near Beaumont came in with a "gusher" on January 10, 1901. In the early 1900s, Texas produced just 1.3 percent of the nation's oil, and only 0.1 percent of its natural gas. This changed dramatically over the next half-century, however, and by 1952, Texas produced 45 percent of U.S. oil and 52 percent of its natural gas.[14] In 2006, Texas remained the nation's largest producer of oil and gas (excluding federal offshore areas), accounting for 21.3 percent and 27.8 percent of total U.S. production, respectively.[15]

Texas leads the states in fossil fuel reserves, with nearly a quarter of all U.S. oil reserves and nearly 30 percent of the country's natural gas.

Texas also leads the states in fossil fuel reserves, with nearly a quarter of all U.S. oil reserves and nearly 30 percent of the country's natural gas. (These statistics omit oil and natural gas production in federal offshore areas in the Gulf of Mexico and near California, which produce about a quarter of the nation's crude oil.)[16]

Texas also is the national leader in refining capacity. The state has 23 refineries capable of refining 4.6 million barrels of oil per day, more than a quarter (27 percent) of all U.S. refining capacity. The Houston area has the nation's largest concentration of refineries. It is home to the nation's largest refinery, in Baytown, and the originating point for the nation's largest refined product pipeline.[17]

Nevertheless, Texas oil and gas production has matured. U.S. and Texas crude oil production both have declined steadily since their peak in the early 1970s, leaving the nation increasingly reliant on imports of oil **(Exhibit 2-17**). Texas' natural gas production has remained relatively constant over the past two decades (**Exhibit 2-18**). Recent, dramatic increases in oil and gas prices have spurred exploration and drilling activity in Texas, particularly for natural gas. Natural gas production rose by 4.5 percent in 2006, yet U.S. crude oil production continues to decline.[18]

Coal and Nuclear Production

Texas has abundant deposits of lignite coal and some bituminous coal deposits. Lignite, the lowest grade of coal, is mined in Texas, but most of the state's coal-fired power plants burn higher-grade, lower-sulfur Powder River Basin coal, brought in by train from Wyoming, because it has higher energy content and lower emissions than lignite.

South Texas also is home to uranium mines and enriched uranium is used to fuel Texas' two nuclear power plants. The South Texas Project, jointly owned by NRG Energy, CPS Energy and Austin Energy, has two nuclear reactors with a combined rating of 2,500 megawatts; two new units will add an additional 2,700 megawatts when a planned expansion is complete.[19] Luminant's Comanche Peak facility has two reactors with a combined rating of 2,300 megawatts.[20] Luminant also plans to add two additional reactors at Comanche Peak.[21]

Renewable Energy Production

Texas leads the nation in renewable energy potential with a large amount of wind generation capacity and a high level of solar radiation capable of supporting a high level of solar power generation.[22] Texas now has the most wind generation capacity in the country, accounting for 27 percent of the national total.[23] Texas' current wind energy production is enough to power about 1 million homes in the state.[24] Unfortunately, the intermittent nature of wind energy means that it cannot be relied upon as a primary source of electricity and must be supplemented by more reliable sources, such as coal, natural gas or nuclear power plants.

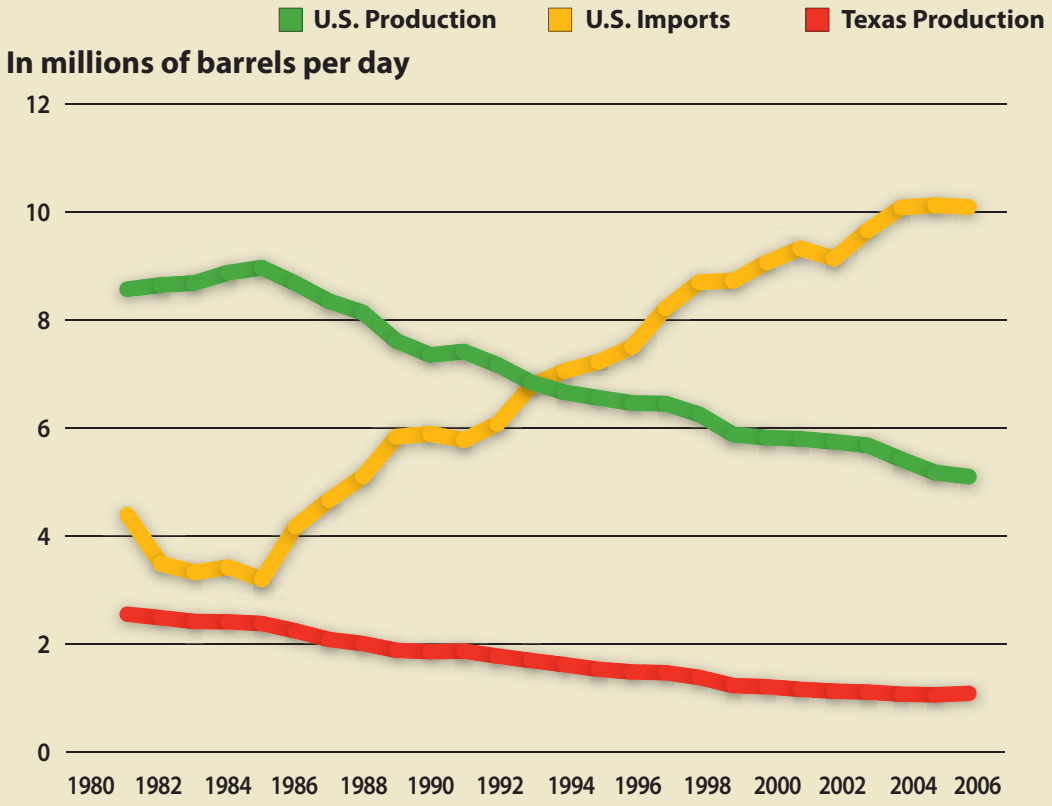
Texas is also the largest producer of biodiesel transportation fuel in the U.S., capable of producing more than 100 million gallons annually, with another 87 million gallons of capacity under construction. In 2007, Texas made 72.9 million gallons of biodiesel.[25]

Energy Spending

Given Texas' large population and many energy-intensive industries, it is no surprise that Texas businesses and consumers spend more money on energy than those in any other state. And with the cost of energy on the rise, total spending on energy has increased in recent years. Adjusted for inflation, Texas energy expenditures in 2005 were at an all-

EXHIBIT 2-17

U.S. and Texas Crude Oil Production and U.S. Imports



Source: U.S. Energy Information Administration.

time high. In 2005, Texans spent $114 billion on energy, accounting for nearly 11 percent of all U.S. energy expenditures. This measure nearly doubled the $61 billion (in 2005 dollars) spent in 1998, a period of much lower energy prices.[26]

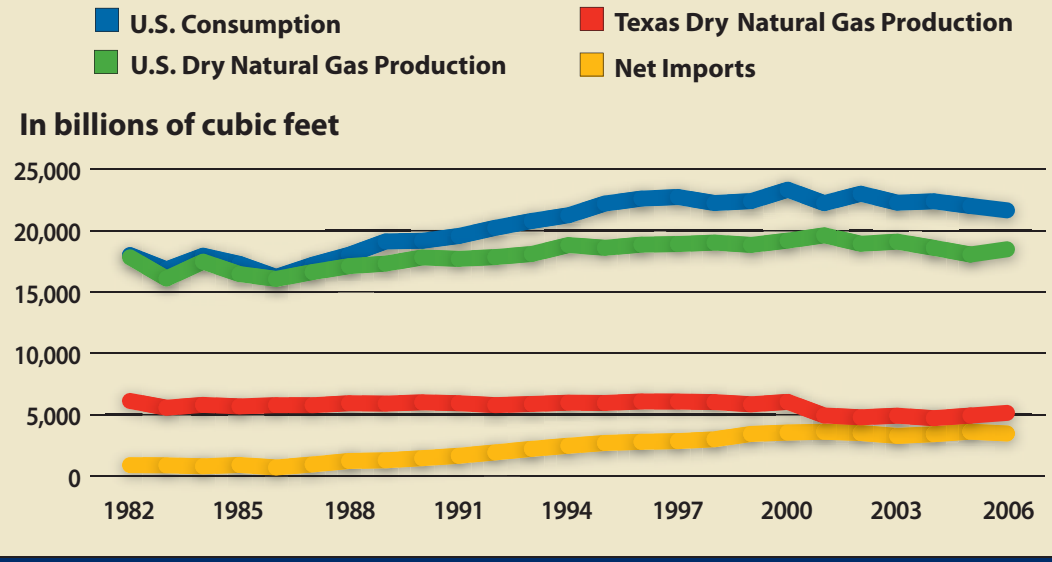
Per capita energy expenditures in Texas increased by 51 percent between 2002 and 2005, as energy prices rose. Energy expenditures in Texas roughly parallel the U.S., yet Texas per capita energy expenditures were 42 percent higher compared to the U.S in 2005 (**Exhibit 2-19**).

As a share of gross state product, Texas' energy expenditures have declined steadily over the past two decades, despite recent increases. In 2005, Texas' expenditures as a share of gross state product were 11.6 percent, down from its peak of 17.5 percent in 1981. The U.S. expenditure share was 8.4 percent in 2005 (**Exhibit 2-20**).

Though complete data are not yet available, it is clear that energy spending has continued to increase since 2005. Oil prices have set new records, exceeding $110 a barrel in April 2008. Prices for other fuels have been on the rise as well. This means it is likely that energy spending per capita and as a share of gross product have continued their recent climbs.

EXHIBIT 2-18

U.S. and Texas Natural Gas Production and U.S. Consumption and Imports



Source: U.S. Energy Information Administration.

ENVIRONMENTAL IMPACTS

Energy production and consumption obviously can have an effect on our environment, including air and water quality and land use. Government action to limit negative impacts can affect the cost of energy by making various fuels more expensive.

Major Federal Regulations

Congress approved two major public health and environmental protection laws in the 1970s. The Clean Air Act of 1970 authorized the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) that each state was required to adopt by 1975.[27] The Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act, authorized water quality programs, imposed federal effluent limits and state water quality standards and required permits for the discharge of pollutants into navigable waters.[28]

These two laws have had indirect but significant effects on energy production because the standards they impose affect discharges from power plants, refineries, mines, wells and other energy enterprises.

Clean Air Act

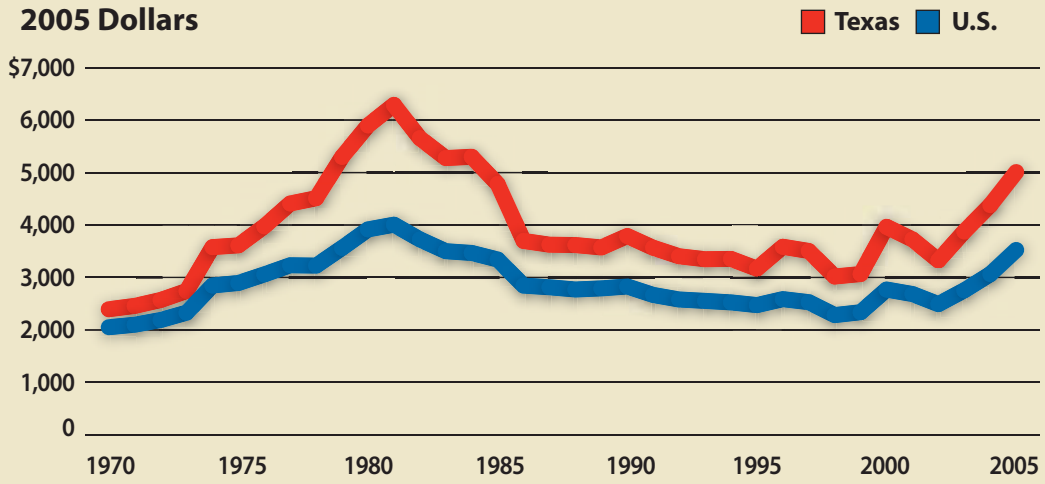
The NAAQS measure six outdoor air pollutants:

- ground-level ozone/smog (O_3)
- particulate matter (PM)
- lead (Pb)
- nitrogen dioxide (NO_2) and other nitrogen oxides (NO_X)
- carbon monoxide (CO)
- sulfur dioxide (SO_2) and other sulfuric oxides (SO_X)[29]

The Clean Air Act of 1970 created performance standards for new sources of emissions. All new

EXHIBIT 2-19

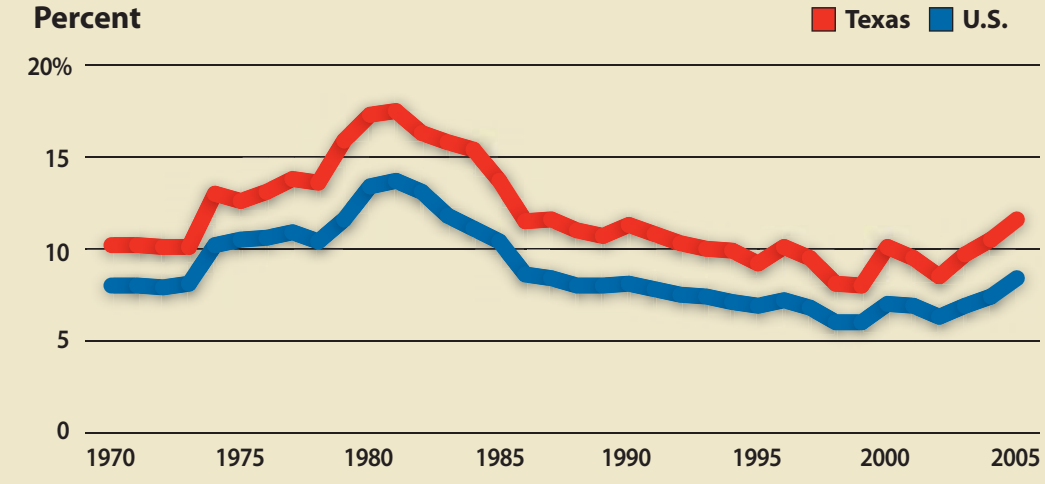
Real Per Capita Energy Expenditures



Source: U.S. Energy Information Administration.

EXHIBIT 2-20

Energy Expenditures as Share of Gross Product, U.S. and Texas



Sources: U.S. Energy Information Administration and U.S. Bureau of Economic Analysis.

plants and major additions to existing plants must meet higher emissions controls. Each state is required to submit a State Implementation Plan (SIP) to EPA to outline how it intends to meet federal air quality standards.

Areas that have cleaner air than EPA's standards are called "attainment areas;" areas that do not meet the standards are called "nonattainment areas."

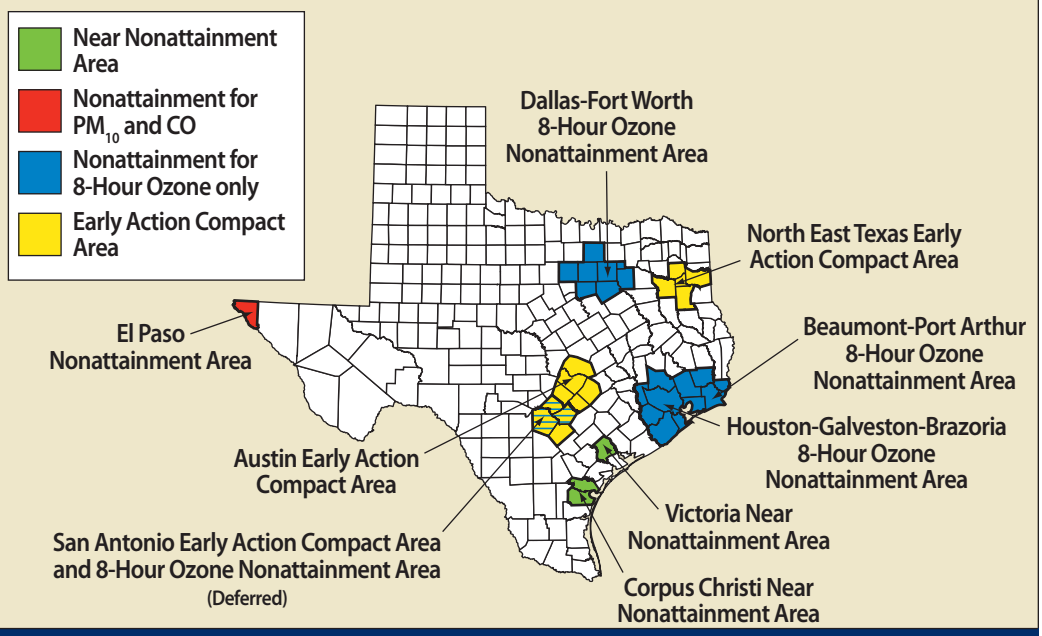
Texas has several geographical areas that violate EPA standards for ozone, particulate matter and carbon monoxide (**Exhibit 2-21**). EPA calculates ozone limits based on an eight-hour average of no more than 0.075 parts per million (ppm) of ozone.[30] Ground-level ozone — the primary component of smog — is created when volatile organic compounds (VOCs) and nitrous oxides react in the presence of sunlight and hot weather. Internal combustion engines, power plants and industrial plants emit these substances.

At this writing, Texas is not meeting federal clean air standards for carbon monoxide and particulate matter in El Paso or for ground-level ozone in Houston-Galveston-Brazoria, Dallas–Fort Worth, San Antonio and Beaumont–Port Arthur. Three Texas areas, Austin, San Antonio and Northeast Texas, have been designated as Early Action Compact Areas, which are voluntary eight-hour air quality plans for areas that are in danger of exceeding the eight-hour standard. If Texas fails to comply with Clean Air Act requirements, it could lose billions in federal highway funding.[31] The state recently asked EPA for an extension of time to meet federal standards.

Under 1990 amendments to the Clean Air Act, EPA must impose financial sanctions if states have not submitted or implemented adequate plans to meet the air quality standards. Note that it is not the failure to meet the air quality standards, but failing to plan to meet the standards that triggers the sanctions. The Clean Air Act leaves the states

EXHIBIT 2-21

Texas' Nonattainment and Near Nonattainment Areas



Source: Texas Commission on Environmental Quality.

responsible for determining what measures should be implemented to meet air quality standards.

In March 2008, as part of its mandatory five-year review of the Clean Air Act, EPA lowered the eight-hour ozone limit from 0.08 parts per million to 0.075 parts per million. Industry representatives and some state officials opposed any tightening of the ozone standard, citing the estimated $7.6 to $8.8 billion cost to affected industries to meet the new standard.[32]

The consequences of the lower ozone standard for Texas could be significant. The new standard is likely to substantially increase the number of nonattainment counties above the current 17, and regions that were already in nonattainment under the old standard could face additional restrictions under the lower standard. Other areas that were not yet in nonattainment or had recently achieved attainment could fall into nonattainment and face new restrictions.[33] Regions affected by the new rule likely will include Dallas-Fort Worth, Houston-Galveston-Brazoria, Beaumont-Port Arthur, El Paso, Northeast Texas, Austin, and San Antonio.

State and local officials point out that much of the pollution afflicting many Texas counties does not originate locally but instead blows in from the east from refineries, power plants and other industrial activity. Some of these critics argue that it is unfair for Texas cities and counties to be punished given Texas' unique characteristics such as its busy port in Houston, its extensive refinery operations, its border with Mexico and its international entry points filled with idling vehicles.[34] Other critics argue that these challenges should be addressed by state or federal government through more stringent restrictions on emissions from vehicles, power plants and other industrial activities that affect air quality in areas that are downwind.[35]

Whereas current federal regulations deal primarily with pollutants contributing to ozone and other public health threats, much of the current debate concerning energy and the environment is focused on greenhouse gas emissions, which most climate scientists believe contribute to global climate change. The emissions of some greenhouse gases, such as nitrous oxide, are restricted under the Clean Air Act, though not because of their greenhouse gas effects. And some greenhouse emissions, such as carbon dioxide, are not regulated at all.

In April 2007, the U.S. Supreme Court ruled that EPA has the authority to regulate greenhouse gas emissions.[36] Although the Court found that EPA was required to regulate greenhouse gases unless it provided a scientific reason not to do so, the agency has not yet taken action to regulate carbon emissions. In April 2008 a coalition of states, cities and environmental groups sued to require EPA to publish an agency analysis that found that greenhouse gas emissions endanger humans and contribute to climate change, an action that could lead to the adoption of rules regulating greenhouse gases. Federal legislation establishing a framework for regulating and reducing greenhouse gas emissions has also been filed in the U.S. House and Senate.[37]

Thus far, the most prominent legislation on greenhouse gas emissions (such as carbon emissions) introduced in the U.S. Congress is Senate Bill 2191, introduced by Senators Lieberman and Warner in October 2007. As filed, S. 2191 would establish an emissions "cap and trade" system intended to reduce U.S. carbon emissions to 2005 levels by 2012, 15 percent below 2005 levels by 2020, and 70 percent below 2005 levels by 2050. As of this writing, the bill had passed committee and was awaiting action by the full Senate.

Cap and trade systems typically limit emissions to a specific level, issue emissions allowances in some manner and allow the subsequent owners of those allowances to sell them on a market. Entities that acquire more allowances than they use can sell the surplus to entities that need more allowances.

Emissions allowances can be given to industries based, for example, on historical emissions, or they can be sold, typically via an auction. S. 2191 would give some allowances away and auction others, but over time would increase the share of total allowances that are auctioned.

As the nation's leading consumer of energy, due in part to its large industrial sector, Texas could face a significant economic impact from any policy that caps greenhouse gas emissions. The National Association of Manufacturers and the American Council for Capital Formation, for example, re-

If the federal government imposes limits on emissions of greenhouse gases such as carbon dioxide, it will inevitably shape the decisions made by Texas business, investors and policymakers as they develop the energy infrastructure.

leased an analysis of S. 2191 in March 2008. Their analysis concluded that Texas would see reductions in gross state product and household income, along with higher gasoline and electricity prices, if the bill were passed in its current form.

If the federal government imposes limits on emissions of greenhouse gases such as carbon dioxide, it will inevitably shape the decisions made by Texas business, investors and policymakers as they develop the energy infrastructure.

Clean Water Act

Water policy intersects with energy policy in numerous ways.

Under the federal Clean Water Act, states must establish standards describing the ways that water bodies can be used. The Texas Surface Water Quality Standards define four general categories of water use: aquatic life use, contact recreation, public water supply and fish consumption.

States generally have focused on controlling "point sources" of pollution, or pollution that can be traced to a specific location. Point-source pollution is the most serious cause of water pollution, and can be controlled by treating wastewater before discharging it into lakes or rivers. According to TCEQ, about 59 percent of the water bodies in Texas were "impaired" — not meeting the state's quality standards — in 2006.[38]

Water and Energy

Water policy intersects with energy policy in numerous ways. Water is used directly to generate electricity through hydroelectric power, and to cool thermoelectric power plants, enhance oil recovery, refine oil and biofuels, irrigate corn and other sources of biofuel and aid in the extraction of coal and other natural resources.

A distinction should be made, however, between water *withdrawals* and water *consumption*. Power plants with "open-loop" cooling systems require very large water withdrawals, but almost all of this water is returned to its source. Most power plants constructed since the 1970s use "closed-loop" cooling systems. These plants require much less water, although most of what they use is lost through evaporation.[39]

Water is required to produce electricity, and electricity is required to pump and transport water. Improved water conservation and efficiency will lead to lower energy demand, just as improved energy conservation and efficiency will lead to lessened demand for water resources.

Another important issue is the impact that energy production has on *water quality*. Without proper controls, energy production has the potential to affect water quality. Waste streams flowing from mining runoff can affect water supplies; air pollution from power plants can lead to acid rain; aquifers can be contaminated by oil and gas exploration and production; and the irrigation of biofuel crops can lead to pesticide runoff. State and federal environmental regulations exist to protect water quality, and proper mitigation activities by utilities, mining companies, agricultural producers, and other interests can minimize many of these harmful effects.

Finally, evaporation due to surface water storage in reservoirs is an important consideration in evaluating hydroelectric power projects. The U.S. Department of Energy estimates that evaporative losses associated with hydropower are approximately 3.8 billion gallons per day.[40]

Government and the Energy Industry

As should be clear from the above discussion of environmental regulations, government action can influence the development of energy resources. Federal, state and local governments can affect the development of any industry, directing private investors away from resources in which they might otherwise invest. Similarly, government action can drive investment *toward* resources that might otherwise be ignored. In other words, government action can distort markets.

Such government action can take a variety of forms: regulation, such as the Clean Air Act discussed earlier in this chapter; taxation, which makes the cost of a product or service more expensive; or subsidies, which can encourage investment in and development of resources, products or services.

Regulation and taxation can be used to limit negative spillover effects — "negative externalities" — that result from a given activity. Negative externalities impose costs on society that are not borne by the producers or consumers of a product or service. Pollution is a classic example of a negative externality

whose costs often are borne by society at large instead of by the producers of that pollution. The Clean Air Act, in turn, is an example of regulation intended to limit the impact of pollution by forcing polluters to pay for equipment to reduce emissions.

Regulation and taxation are government actions that typically discourage a given activity. Subsidies, on the other hand, can encourage the private sector to engage in some activity by using tax dollars to make such investments more attractive. Recent examples of energy industry growth strongly influenced by government subsidies include the production of corn-based ethanol and wind-generated electricity. Chapter 28 of this report details the value of federal, state and local financial subsidies to the energy industry.

Energy, then, is an industry in which the government has traditionally exerted influence through regulation, taxes and subsidies. In Texas, for example, the oil and gas industry has benefited from subsidies, is subject to a mature set of regulations and has contributed a significant portion of state revenues through the taxes it pays. And a recent surge in renewable energy resources in Texas, particularly wind, has benefited from subsidies such as property tax value limitations as well as regulations requiring power companies to use renewable energy sources for a certain amount of their total electricity generation.

Furthermore, the mere *prospect* of government action can influence private investment decisions. A comparison between recent developments in the coal and wind industries is instructive in this regard. The wind industry, as noted above, has grown rapidly in Texas in recent years. In addition to federal, state and local subsidies that encourage investment in the industry and the improving cost-competitiveness of wind-generated electricity, investor anticipation of new federal regulations to limit carbon emissions has encouraged private investment in emissions-free wind farms.

Conversely, many investors may be hesitant to invest in new coal plants, as any regulations limiting carbon emissions are likely to raise the cost of coal-generated electricity. To cite just one example, three major investment banks — Citigroup, J.P. Morgan Chase and Morgan Stanley — recently announced that they believe Congress will enact carbon restrictions within a few years, and that the banks will begin requiring new power plants seeking financing to show that they will be able to generate profits with such emissions caps in place.[41]

Government policy also can have unintended consequences — impacts beyond what the policy was intended to achieve. A recent, oft-cited example of this is government policy to encourage corn-based ethanol production. Ethanol production, as discussed in Chapter 13 of this report, has boomed in recent years, indicating that government policy has achieved its goal. As Chapter 13 also notes, however, the policies intended to encourage the use of ethanol have had dramatic impacts in other areas. Rising corn prices resulting from strong ethanol demand have raised prices in other markets, indirectly increasing prices for other agricultural products, including crops whose supply has decreased as farmers replace them with higher-priced corn. It also raised feed costs for cattle ranchers as well as poultry and pork producers, thereby raising meat prices.

Texas-based Pilgrim's Pride, Inc. eliminated 1,100 jobs after closing a chicken processing plant in Silver City, North Carolina and 6 of its 13 distribution centers. The company cited record high prices for corn and soybean meal, as well as an oversupply of chicken, as reasons for the job cuts.[42]

These are only a few examples illustrating how policy plays a key role in the energy industry. This report draws no conclusions about the policies lawmakers should pursue. Instead, it is intended to provide them with the factual information they need to make informed decisions as they carefully weigh the costs and benefits of policies to achieve the state's energy goals.

Outlook for Texas

Energy fuels economic development, and Texas' demand for energy will continue growing for the foreseeable future. Meeting this demand will require a diverse array of existing and new resources and technologies, combined with improved energy efficiency.

In the following chapters, we will explore the availability, costs and benefits of various fuel sources to meet our growing demands. We also discuss

Energy fuels economic development, and Texas' demand for energy will continue growing for the foreseeable future.

the major uses of energy in Texas and the current mix of fuels employed for those uses, along with a discussion of efficiency. Finally, we take a groundbreaking look at the extent of current government involvement in the energy sector through a detailed analysis of subsidies across energy sources.

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