Chapter 3
Overview: Non-Renewable Fuels

Introduction

Oil, natural gas, coal and uranium — the most common fuels in the world — are considered to be non-renewable, due to the eons it took to create them and mankind's inability to synthesize similar fuels readily. All but uranium are called "fossil fuels" because of their genesis in decaying plant and animal matter. Together, oil, natural gas and coal account for about 85 percent of the world's energy supply, a share that has changed little over recent decades. Nuclear power now provides 6.3 percent, a six-fold increase from 1973 levels.[1]

In 2005, petroleum products (including oils, gasoline and other liquid fuels, but not natural gas) provided 40.6 percent of the 100.3 quadrillion British Thermal Units (Btu), or "quads," consumed in the U.S. Coal and natural gas each provided more than 22 percent of the Btu consumed nationwide; nuclear energy provided 8 percent; and hydropower and biomass provided less than 3 percent each.[2]

The Texas oil and gas industry has bolstered the state economy for a century. Oil and gas deposits are widely distributed throughout the state and offshore. Deposits of coal and uranium (which, when processed, produces nuclear power) are found in Texas, but not in quantities comparable to those of oil and gas. Combined, these fuels produce all but a small fraction of the state's electricity; gasoline and diesel refined from oil likewise account for all but a small fraction of the state's transportation fuels.

Hydrocarbons

Oil, natural gas, coal and liquefied petroleum gases (LPGs) are called "hydrocarbons" because of their chemical structure, which is based on hydrogen and carbon atoms. Under heat and pressure, these elements bond and create chains of molecules in almost infinite combinations, each with unique properties. For example, the long "carbon chain" molecules that create crude oil can be heated and "cracked" in the refining process. (The longer the chain, the broader the variety of refined products it can produce.) The result is a variety of shorter molecule chains that give us waxes, liquids and gases such as paraffin, diesel, gasoline, kerosene, propane, butane and methane (natural gas), among others.

Petroleum deposits, for the most part, formed at the bottom of ancient seabeds to become semi-solid, liquid and gaseous compounds. These deposits are now found as deep as tens of thousands of feet below the earth's surface. As such, petroleum deposits generally can be extracted economically only by drilling. The exception is tar or oil sands, found in Canada and elsewhere in the world, which are near the surface and can be mined.[3]

Today, petroleum products and their derivatives supply almost all of the world's transportation fuels, chemicals and plastics.

Coal

Coal is a combustible rock of varying hardness, moisture and mineral content. Coal deposits, called "seams," must be excavated; commercial deposits generally are found either just below the surface or underground at depths up to 1,000 feet, although mine depths of more than 2,000 feet are not uncommon.[4]

Coal was widely used first as jewelry, then as fuel, by the Chinese six millennia ago and by the Romans in Britain four millennia later.[5] Today, coal is the world's most common heating fuel. China, with the third-largest proven reserves in the world, is unique among developing countries in that coal is its preferred fuel for both heating and home cooking.[6]

Oil, gas, coal and uranium combined produce all but a small fraction of the state's electricity.

Uranium

Uranium is a mineral found throughout the world. Commercial concentrations of uranium ore are fairly widespread, including several in South Texas.

In its natural state, uranium is an ore that must be extracted via underground mining, open-pit mining or in-situ leach (ISL) mining. Open-pit and underground mining mechanically remove the uranium ore from on or below ground, break it up and send it to a mill where the uranium is removed.

ISL mining, also called solution mining, pumps a leach solution (commonly sulfuric acid or a weak alkaline solution, depending on the type of rock) through the ground to separate uranium from the source rock, and then extracts the uranium-bearing fluid from the formation. ISL causes little surface disturbance or waste rock. The source rock must be permeable to the leach solution, however, and should be located in a geologic formation that prevents groundwater contamination.

Domestic supplies of coal, natural gas, crude oil and natural gas plant liquids accounted for about 78 percent of all 2006 U.S. domestic energy production

From Source to Consumption

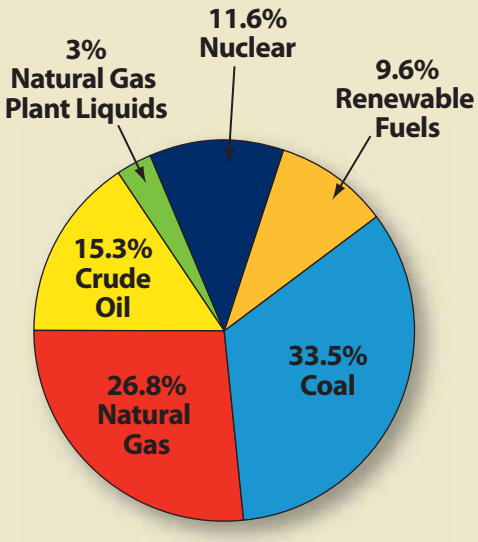
Domestic supplies of coal, natural gas, crude oil and natural gas plant liquids (hydrocarbons and water that precipitate out of natural gas) contributed 56 quadrillion Btu (quads), accounting for about 78 percent of all 2006 U.S. domestic energy production (**Exhibit 3-1**). (Throughout this report, Btus will be used to compare the heat value in fuels that are otherwise measured by different units of volume. Once a fuel is burned to generate electricity, that electricity will be measured by watts.)

Imported petroleum and nuclear sources added a combined 37 quads or 36 percent to the total supply. Fossil fuel and nuclear sources combined represented 93 percent of the total U.S. energy supply of 104.8 quads in 2006 (**Exhibit 3-2**).

Of the total 99.9 quads the U.S. consumed in 2006, residential customers used 21 percent, commercial customers 18 percent and industrial customers 32 percent. The remaining 28 percent was used for transportation.[7]

Exhibit 3-1

Domestic Energy Production, 2006 (in Quadrillion Btu)

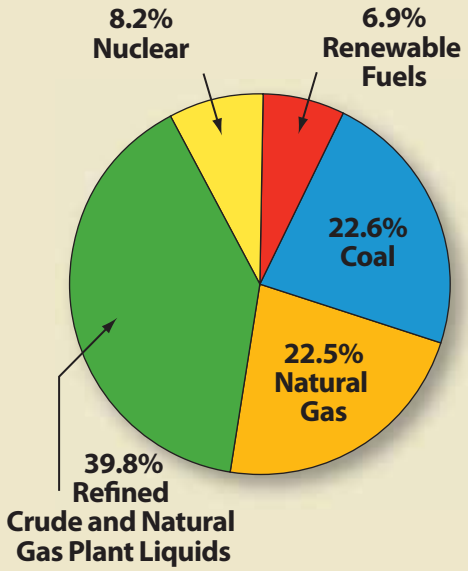


Note: Numbers may not total due to rounding.

Source: U.S. Energy Information Administration.

Exhibit 3-2

Domestic and Imported Energy Sources, 2006



Note: Numbers may not total due to rounding.

Source: U.S. Energy Information Administration.

Electricity Production: U.S. vs. Texas

In both the U.S. and Texas, fossil fuels are by far the largest source of energy used to generate electricity, followed at some distance by nuclear power. But Texas and the rest of the U.S. differ greatly on their reliance on specific fossil fuels.

For example, coal-fired generators produced roughly half of the nation's electricity from 1995 to 2006 (**Exhibit 3-3**).

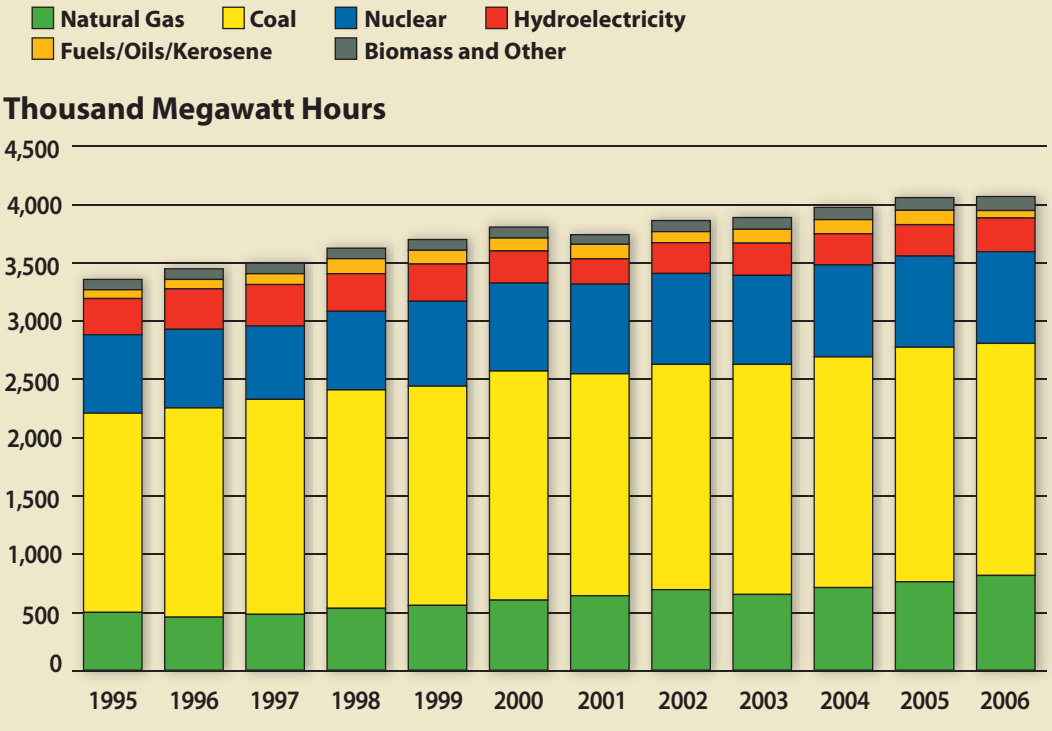
Although the nation's total electricity generation (as measured in megawatt-hours, or MWhs) increased by 21 percent from 1995 to 2006, coal's share of that production declined by about 2 percent, from 51 to 49 percent of the total. Nuclear remained steady at about 20 percent. The share attributable to natural gas rose by about 5 percent over the period, from 14.8 percent in 1995 to 20 percent in 2006. Fuel oils and liquefied petroleum gases, or LPG, remained at a relatively steady 3 percent share until 2006, when they dropped to 1.6 percent.[8]

The story in Texas, however, is quite different (**Exhibit 3-4**). Due to the state's population growth, Texas electricity generation rose by about 26 percent from 1995 to 2006, 5 percent more than the national increase. Natural gas was the state's most common electricity-producing fuel from 1995 to 2006, and its share rose over the period, from a low of 45 percent in 1996 and 1997 to a high of 51 percent in 2001. In 2006, natural gas accounted for 49 percent of all Texas electricity generation.

Coal was second but, following the national trend, saw its share of electricity generation decline by about 3 percent, from 39.3 percent in 1995 to 36.5 percent in 2006. Nuclear power's share remained

EXHIBIT 3-3

U.S. Net Electricity Production by Fuel Source

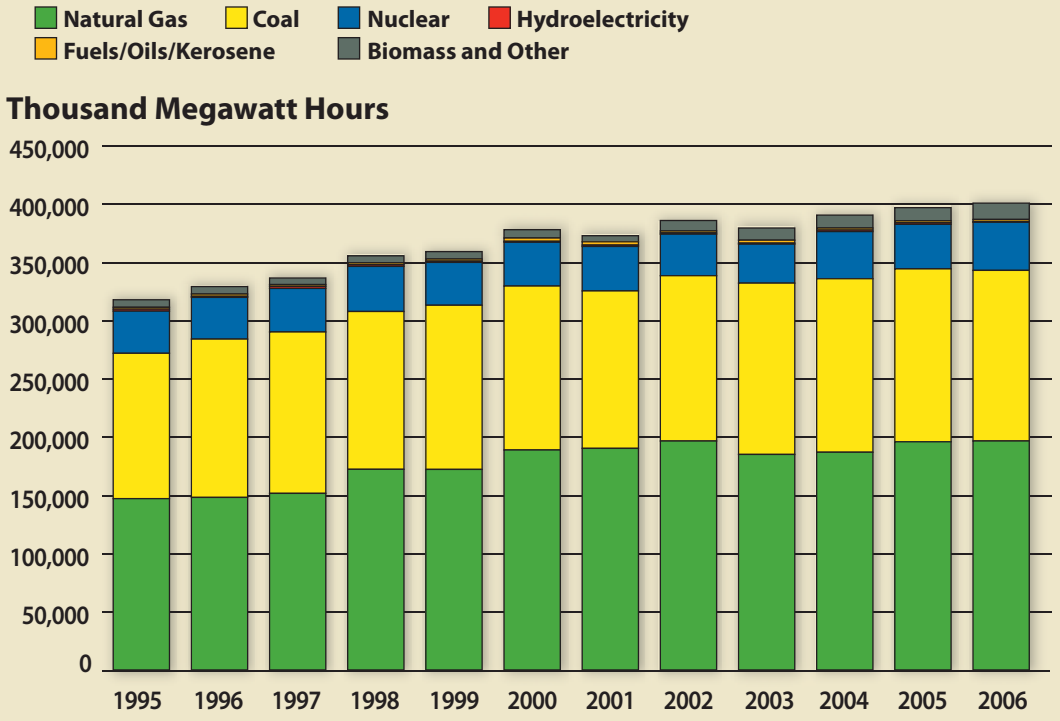


Source: U.S. Energy Information Administration.

Natural gas is the state's most common electricity-producing fuel.

EXHIBIT 3-4

Texas Net Electricity Production by Fuel Source



Source: U.S. Energy Information Administration.

relatively steady at about 10 percent, as did the fuel oils/LPG share, at about 0.5 percent.[9]

For more information on electricity, see Chapter 27.

DIRECT USE

Fossil fuels also are used in homes and businesses to provide heat. In 2004, Texans used about 641.2 trillion Btu of direct-use energy to heat homes and another 558.4 trillion Btu to heat commercial buildings.

In the same year, according to EIA, 49 percent of Texas' 8 million-plus homes were heated by natural gas or LPG (primarily propane); 49 percent were heated by electricity; and the remaining 2 percent of homes were heated by other sources such as wood and solar and geothermal energy.[10]

For more information on direct use, see Chapter 25.

TRANSPORTATION

In 2005 (most recent data available for both the U.S. and Texas), Americans used 28.3 quadrillion Btu of fuel to transport people or goods from one place to another (**Exhibit 3-5**).[11]

For more information on transportation fuels, see Chapter 26.

FUEL CONSUMPTION

Many factors affect fuel consumption. For example, the wide difference between the share of electricity produced by natural gas nationwide (18 percent) and in Texas (almost 50 percent) is largely a matter of climate, supply and infrastructure. Northern areas of the country import vast

EXHIBIT 3-5
U.S. and Texas Transportation Fuel Sources, 2005 (Trillions of Btu)

Fuel Source	U.S. Amount of Fuel Used	Percent	Texas Amount of Fuel Used	Percent
Petroleum Products	27,301.6	96.5%	2,640.9	96.8%
Natural Gas*	626.3	2.2	85.4	3.1
Ethanol**	342.0	1.2	2.4	0.1***
Electricity	25.7	0.1	0.3	
Total	**28,295.6**	**100.0%**	**2,729**	**100.0%**

* Natural gas used in the transportation sector is consumed in the operation of pipelines, primarily in compressors, and gas consumed as vehicle fuel.
** On the original EIA document, ethanol is listed twice: once as blended into motor gasoline and also separately, to display the use of renewable energy by the transportation sector.
*** Ethanol and electricity used for transportation in Texas together account for 0.1 percent of all transportation fuel used in the state.
Source: U.S. Energy Information Administration.

Northern areas of the country import vast quantities of natural gas from the Gulf Coast and Canada, but more commonly use it for home heating rather than electricity generation.

quantities of natural gas from the Gulf Coast and Canada, but more commonly use it for home heating rather than electricity generation. Texas, with a warmer climate, prolific supplies and an extensive pipeline infrastructure, uses natural gas to heat homes, generate electricity and run the massive petrochemical complex on the Texas Gulf Coast. The remainder is shipped by pipeline to the rest of the country.

Coal use is also affected by many factors. In northern areas, coal is the centuries-old traditional fossil fuel, while natural gas is a relative latecomer. Because high transportation costs naturally encourage an area to consume local coal, northern areas burn high-grade, cleaner-burning coal supplies from Appalachia and Wyoming, while Texas uses a combination of Wyoming coal and local, lower-grade supplies with lower heat value and higher emissions.

TEXAS ECONOMIC IMPACT

Non-renewable fuels, particularly oil and gas, have been the mainstays of the Texas economy throughout the 20th century and are still important today. The two fuels are so intertwined from production through consumption that federal and state governments combine their data on the two, which is why this chapter discusses oil and gas as a single entity.

The oil and gas industry remains a significant part of the Texas economy, but its relative importance has declined over the past 30 years. Texas crude oil and natural gas production peaked in 1972. In that year, the oil and gas industry represented more than 14 percent of Texas' gross state product (GSP). Its share of GSP continued to rise, largely due to increasing oil prices, to a peak of more than 26 percent of GSP in 1981. In 2006, the industry's share of GSP was 15.7 percent, up from its lowest point of 7.4 percent in 1999.[12]

Employment and Wages

During the 1970s and early 1980s, the health of the Texas economy largely depended on the price of oil. By 1981, oil prices reached $38 per barrel (the equivalent of nearly $87 in 2007). In that year, Texas employment in oil and gas extraction and oilfield machinery manufacturing totaled 366,200 jobs, or 6 percent of all nonfarm employment in the state. By July 1986, however, oil prices dropped to less than $12 per barrel ($21 in 2007 dollars), sending Texas into a 17-month recession. By 1987, Texas had lost 175,000 jobs in oil and gas extraction and oilfield machinery manufacturing.

In the past two decades, Texas' reliance on the oil and gas industry has decreased as the state has transitioned to a more service-oriented economy. Industries such as manufacturing, trade and services, transportation, communications, finance, insurance and real estate all have increased their share of the state's output. The overall result is a state economy that increasingly mirrors the national economy and is less dependent on energy prices.[13]

In 2006, the oil and gas industry employed more than 312,000 Texans, or 3.1 percent of the state's nonfarm jobs. That was slightly higher than 2000 levels, when oil and gas employment accounted for less than 3 percent, but considerably lower than its 4.3 percent share in 1990.[14]

Wages in the state oil and gas industry totaled $30.6 billion in 2006, accounting for 6.9 percent of all nonfarm wages.

The industry's contribution to the Texas GSP has risen every year since 2003, when it was $85.6 billion or 10.3 percent of the total. In 2004, the oil and gas share of GSP rose to $118.4 billion (13.1 percent of the total); in 2005, it was $142.2 billion (14.4 percent); in 2006, $159.3 billion and 14.9 percent, respectively.[15] (See Chapters 4 and 5 for more information.)

Coal production contributed 2,241 mining jobs to the Texas economy in 2006.[16] Other coal-related jobs may exist in other sectors, such as electricity generation, that are not included in these data. Wages totaled an estimated $167.6 million. (See Chapter 7 for more information.)

The state's two nuclear reactors — Luminant's Comanche Peak near Glen Rose and the South Texas Project (STP) in Matagorda County — employ a combined 2,150 persons, not including contractors. Total payroll for the two plants is approximately $196 million annually. (See Chapter 8 for more information.)

State Taxes and Revenues

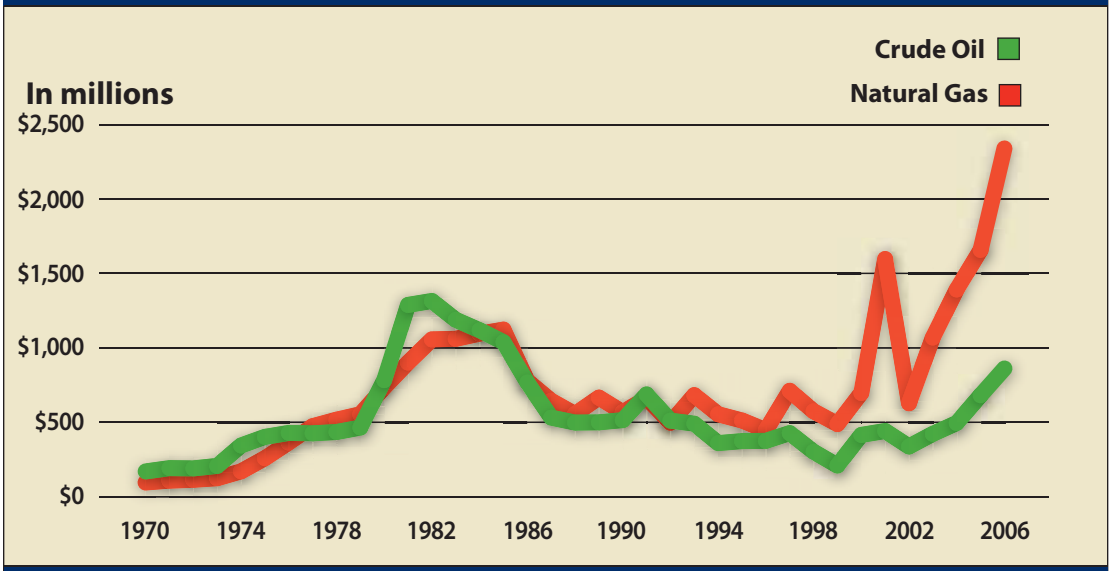
Texas has several sources of tax revenue related to oil and gas, including severance taxes and motor fuels taxes.

Severance taxes include the oil production tax and the natural gas tax, both paid by producers based on the market price of each commodity. Until recently, revenue from both taxes had been declining steadily since the early 1980s (**Exhibit 3-6**). Due to higher oil and gas prices and an increase in production, however, severance tax collections jumped by 37 percent in 2006, to $3.2 billion. In 2006, severance taxes accounted for 9.1 percent of total state revenue, up from just 3 percent in 1999. Oil accounted for almost 2.5 percent and natural gas accounted for 6.6 percent (**Exhibit 3-7**).

The oil and gas industry remains a significant part of the Texas economy.

Exhibit 3-6

Oil and Gas Severance Tax Revenue



Source: Texas Comptroller of Public Accounts.

Motor fuels taxes include consumption levies on gasoline, diesel fuel and liquefied petroleum gas. Both the diesel and gasoline taxes have been levied at a rate of 20 cents per gallon since 1991. In 2006, motor fuels taxes totaled nearly $3 billion in revenue, or nearly 9 percent of all state tax revenue (**Exhibit 3-8**).

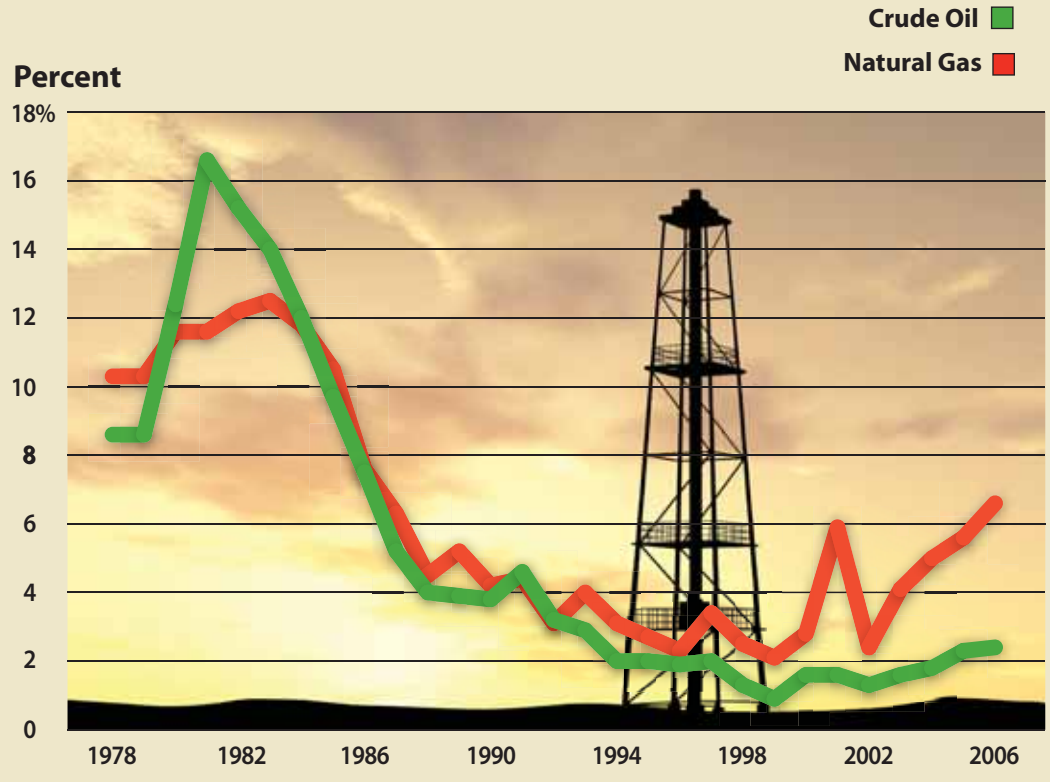
Coal and uranium production and use contribute to federal, state and local tax revenues through income taxes, state franchise taxes, property taxes and indirectly through taxes paid by coal and nuclear power plant owners. No data are available, however, to identify or quantify revenues attributable to these energy sources.

Outlook for Texas

Texas leads the U.S. in the production and consumption of non-renewable fuels and the electricity generated from them. The U.S., in turn, leads the world. Our reliance on these fuels presents both challenges and choices for the future. The challenges will come in trying to provide a growing state with more energy; the choices will come in deciding how to accomplish that task. Because these fuels are so important to our lives and our economy, we must choose carefully for ourselves and for the generations to come.

Exhibit 3-7

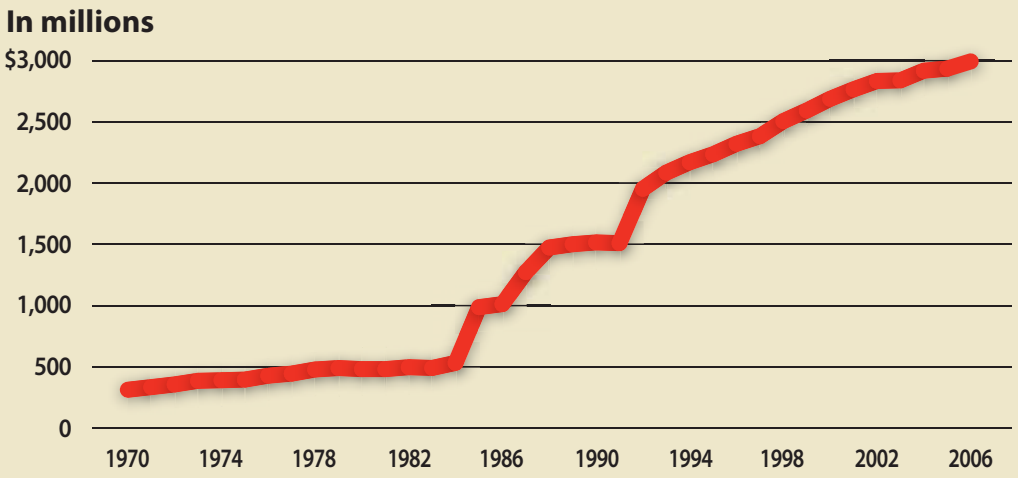
Oil and Gas Industry Tax Revenue as a Percentage of Texas Total Tax Revenue



Source: Texas Comptroller of Public Accounts.

EXHIBIT 3-8

Texas Motor Fuel Tax Revenue



Source: Texas Comptroller of Public Accounts.

ENDNOTES

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5 Freese, Barbara, *Coal: A Human History* (New York: Penguin Books, 2003), pp. 15-16 (Britain) and pp. 204-205 (China).

6 International Energy Agency, *World Energy Outlook 2006, Chapter on Energy for Cooking in Developing Countries*, p. 435, http://www.worldenergyoutlook.org/2006.asp. (Last visited April 21, 2008.)

7 An excellent chart detailing the sources and uses of energy may be found at U.S. Energy Information Administration, *Annual Energy Review*, "Energy Flow, 2006" http://www.eia.doe.gov/emeu/aer/diagram1.html. (Last visited April 21, 2008.)

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14 Texas Comptroller calculation based on data obtained from Texas Workforce Commission.

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