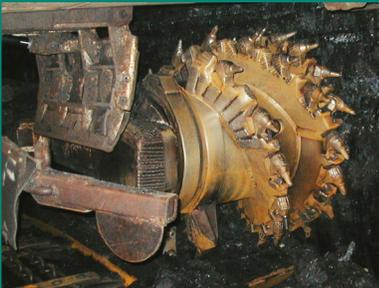
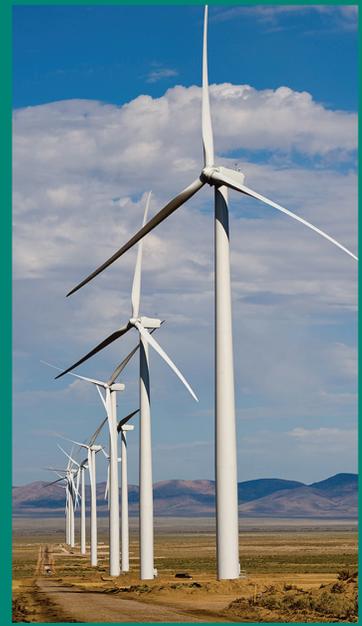


# UTAH'S ENERGY LANDSCAPE

by Michael D. Vanden Berg



CIRCULAR 113  
UTAH GEOLOGICAL SURVEY  
*a division of*  
DEPARTMENT OF NATURAL RESOURCES

2011

GEOLOGICAL SURVEY

# UTAH'S ENERGY LANDSCAPE

by Michael D. Vanden Berg

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### Cover photo captions

1. Office of Energy Development staff constructing a 50-meter anemometer tower.
2. Drill rig at the Covenant oil field.
3. Utah oil shale sample.
4. PacifiCorp's Blundell geothermal power plant.
5. Milford wind farm. (photo courtesy of First Wind)
6. Longwall mining machine at the Deer Creek coal mine.
7. Coal loadout at the SUFCO mine.
8. PacifiCorp's Hunter coal-burning power plant.
9. Solar panels at Goblin Valley State Park.
10. Crude oil pump jack from the Aneth oil field.

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Background photo: Spanish Fork Wind Farm

## MESSAGE FROM THE GOVERNOR

Welcome to *Utah's Energy Landscape*, a publication by the Department of Natural Resources' Utah Geological Survey. This booklet is designed to assist you in becoming more familiar with Utah's diverse energy portfolio. *Utah's Energy Landscape* provides balanced facts on Utah's past, present, and possible future energy sources, including all conventional, unconventional, and renewable resources.

Energy is one of Utah's four cornerstones for success, and the development of clean, secure, low-cost energy is one of my top priorities as Governor. Energy use and development is at the forefront of many citizens' minds, especially during these times of economic uncertainty, rapid population growth, and major swings in the energy market.

The State of Utah is fortunate to have the abundant resources necessary to provide affordable and secure energy now and in the future. Since 1980, Utah has produced on average 28% more energy than it has consumed, making the state a net energy exporter. The majority of this excess energy is in the form of exported coal and natural gas, along with significant amounts of electricity.

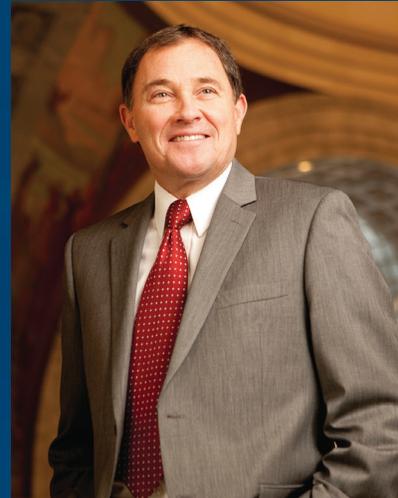
Utah's energy resources are such that the state will continue to be a net exporter for the foreseeable future, enhancing our economy and providing numerous jobs. In addition, Utahns enjoy some of the lowest prices in the nation for natural gas and electricity, making Utah very attractive for business development.

While rich in energy resources, Utah is also known for its unrivaled natural beauty. Our national parks, state parks, and outdoor recreation venues contribute to our high quality of life and to our economy. Both energy development and environmental preservation are necessities for our state, and they are not mutually exclusive propositions. We have proven this in the past, and will continue to do so in the future as we move forward to secure our energy future.

Sincerely,



Gary R. Herbert  
Governor



## INTRODUCTION

The state of Utah is fortunate to have abundant and diverse energy resources including large reserves of conventional fossil fuels, several areas suitable for renewable resource development, and vast quantities of untapped, unconventional fossil fuel energy sources. This publication, *Utah's Energy Landscape*, was created to offer a complete, visual-based description of Utah's entire energy portfolio.

The graphs found within this document were created using data compiled by the Utah Geological Survey (UGS) from several sources, including the U.S. Department of Energy's Energy Information Administration (EIA) and the Utah Division of Oil, Gas, and Mining (DOG M), as well as in-house surveys and conversations with individuals and companies.

Utah Energy and Mineral Statistics (UEMS) is a web-based data repository located on the UGS website (see screen shot below) and contains all the energy data used to create the graphs contained in this report. Each graph includes a reference table number, indicating where the data can be found and downloaded either as a Microsoft Excel® file or an Adobe® PDF file.

Utah Energy and Mineral Statistics website: <http://geology.utah.gov/emp/energydata>

The screenshot shows the Utah Geological Survey website. At the top, there is a navigation bar with "UTAH.GOV SERVICES" and "AGENCIES" links, and a search box. Below this is the "UTAH GEOLOGICAL SURVEY" header. The main content area is titled "Utah Energy and Mineral Statistics" and includes a description of the repository, contact information for Michael Vanden Berg, and a table of contents listing chapters and their last update dates. A sidebar on the left contains a search box and a list of navigation links.

UTAH GEOLOGICAL SURVEY

ugs / utah geology / energy resources / energy & mineral data

### Utah Energy and Mineral Statistics

Utah Energy and Mineral Statistics is a web-based repository for energy and mineral data for the State of Utah. It contains over 130 tables and 50 figures (in both Excel and PDF formats) in nine different chapters and is continuously updated as new data becomes available.

If you have any questions, comments, or suggestions for improvement, please contact Michael Vanden Berg at 801.538.5419 or by email at [michaelvandenber@utah.gov](mailto:michaelvandenber@utah.gov).

	last updated
Chapter 1: Overview of U.S. and Utah Energy Trends	08/11/2011
Chapter 2: Coal	08/02/2011
Chapter 3: Crude Oil and Petroleum Products	08/02/2011
Chapter 4: Natural Gas	08/02/2011
Chapter 5: Electricity	08/08/2011
Chapter 6: Renewable Resources	08/03/2011
Chapter 7: Heating/Cooling Degree Days	11/03/2010
Chapter 8: Greenhouse Gas Emissions	11/03/2010
Chapter 9: Industrial Minerals and Metals	08/11/2011
Appendix: Thermal Conversion Factors	11/18/2009
Glossary (pdf)	

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## UTAH ENERGY HIGHLIGHTS

- In 2010, the majority of energy (in Btu) produced in Utah was from natural gas, surpassing coal for the first time in history (page 6).
- One-third of all coal produced in Utah is shipped to other states or countries (page 14).
- The number of oil and gas well completions in Utah averaged 879 per year over the past 7 years, a major increase over the 274 wells averaged throughout the 1990s (page 16).
- Utah refineries received record amounts of crude oil in 2006, with 20% coming from Canada. Refinery receipts have declined over the past four years with Canadian imports falling to 8% of total (coinciding with a rise in Utah crude oil production) (page 19).
- The value of Utah's natural gas reached a record high in 2008, even when adjusted for inflation, at about \$2.7 billion (the value in 2010 dropped to \$1.7 billion) (page 27).
- Utah's average price of residential natural gas in 2010 was \$8.21 per thousand cubic feet, the third lowest in the nation (page 27).
- Utah is one of five states to produce electricity from geothermal sources (page 33).
- The newly constructed Milford wind farm has added 306 megawatts (MW) of renewable energy capacity to Utah's energy portfolio, doubling Utah's percentage of total electric capacity from renewable sources from 4.4% in 2008 to 8.6% in 2010 (page 40).
- In 2010, 81% of the electricity generated in Utah was from coal-burning power plants. Electricity generation from natural-gas power plants more than doubled between 2006 and 2007, increasing its total share to 15% (page 41).
- Sales of electricity in Utah increase an average of 4.3% each year (page 42).
- Utah enjoys the second lowest industrial electricity rate in the nation, 4.9 cents per kilowatthour (kWh) in 2010 (the U.S. average industrial electricity rate equals 6.8 cents per kWh) (page 44).
- Utah's average price of residential electricity in 2010 was 8.7 cents per kWh, the fifth lowest in the nation (page 44).

# UTAH ENERGY CONTACTS

## Office of Energy Development

195 North 1950 West, 2nd floor  
Salt Lake City, UT 84116  
[www.energy.utah.gov](http://www.energy.utah.gov)  
801-536-4235

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1594 West North Temple, Suite 3110  
Salt Lake City, UT 84116  
[geology.utah.gov](http://geology.utah.gov)  
801-537-3300

## Utah Division of Oil, Gas, and Mining

1594 West North Temple, Suite 1210  
Salt Lake City, UT 84116  
[ogm.utah.gov](http://ogm.utah.gov)  
801-538-5283

## Utah Department of Environmental Quality

195 North 1950 West  
Salt Lake City, UT 84114  
[www.deq.utah.gov](http://www.deq.utah.gov)  
801-536-4400

## Governor's Office of Economic Development

324 South State Street, Suite 500  
Salt Lake City, UT 84111  
[business.utah.gov](http://business.utah.gov)  
801-538-8700

## Utah Division of Public Utilities

160 East 300 South  
Salt Lake City, UT 84111  
[publicutilities.utah.gov](http://publicutilities.utah.gov)  
801-530-7622

## Utah Public Service Commission

160 East 300 South  
Salt Lake City, UT 84111  
[psc.utah.gov](http://psc.utah.gov)  
801-530-6716

## Governor's Public Lands Policy

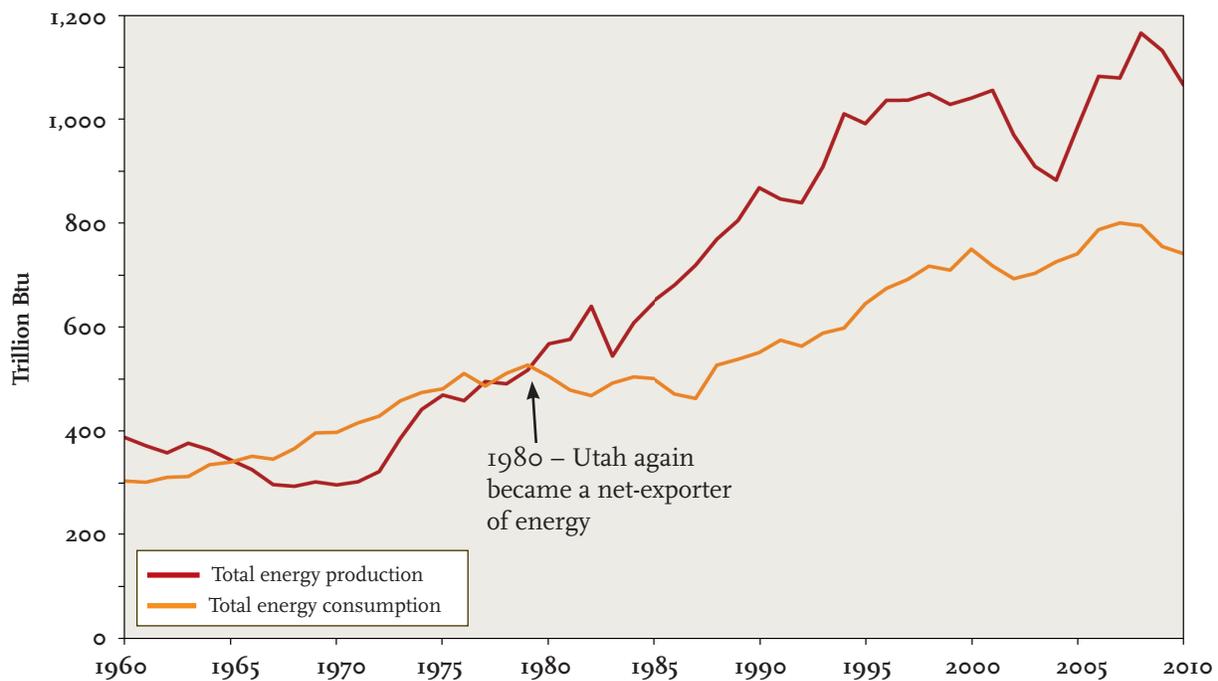
**Coordination Office**  
5110 State Office Building  
Salt Lake City, UT 84111  
[www.governor.utah.gov/publiclands](http://www.governor.utah.gov/publiclands)  
801-537-9801



Background photo: Wind turbine at Camp Williams

# OVERVIEW

## UTAH ENERGY BALANCE: PRODUCTION AND CONSUMPTION, 1960–2010



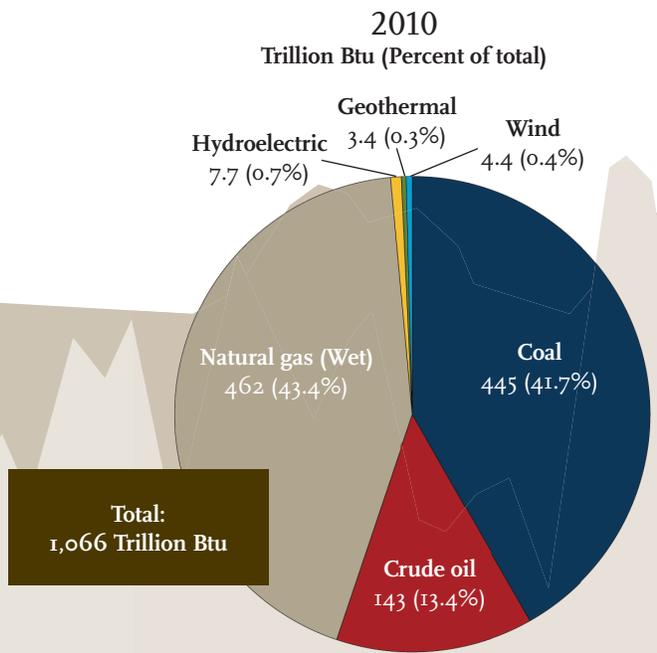
UEMS website table: Table 1.4

Source: EIA, UGS

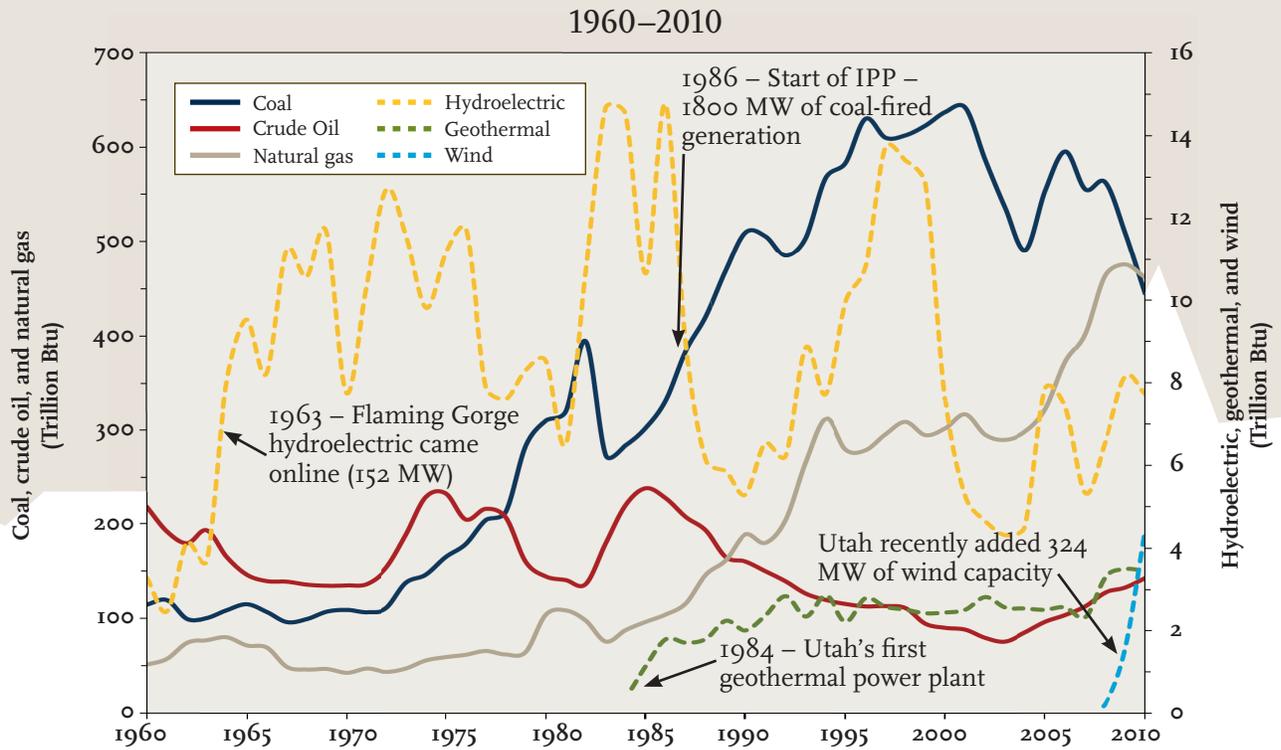
Note: 2010 data is estimated.

Utah produced 31% more energy than it consumed in 2010, making the state a net-energy exporter. The majority of this excess energy was in the form of exported coal and natural gas. Utah also exports significant amounts of electricity, produced from both fossil fuels and renewable sources.

# ENERGY PRODUCTION IN UTAH BY SOURCE



Fossil fuels made up 98.5% of Utah's total energy production in 2010, while renewable sources accounted for only 1.5% of Utah's production portfolio. 2010 marks the first year that more energy from natural gas was produced in Utah than coal.

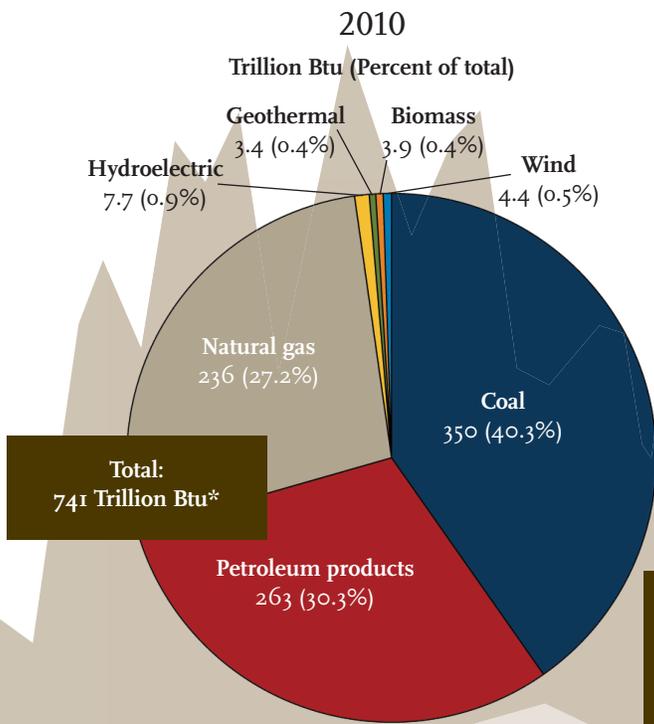


UEMS website table: Table 1.8

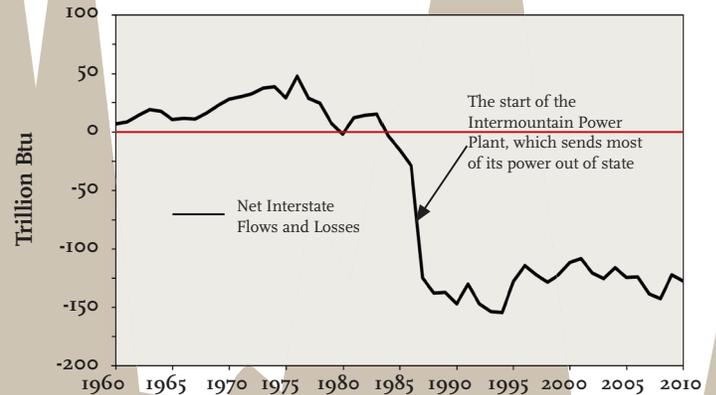
Source: EIA, UGS

Notes: 2010 data are estimated; EIA states that Utah does not produce energy from biomass and production from solar is negligible; IPP = Intermountain Power Plant.

# ENERGY CONSUMPTION IN UTAH BY SOURCE

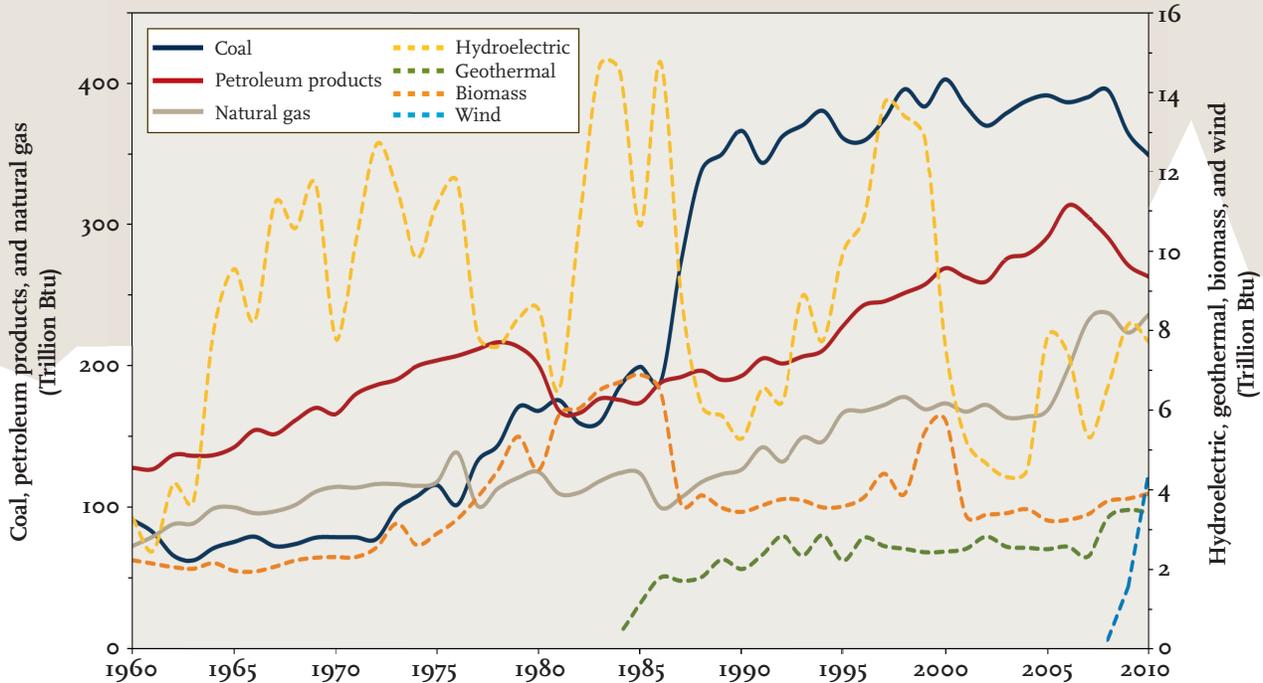


NET INTERSTATE FLOWS AND LOSSES IN UTAH, 1960–2010



Fossil fuels made up 97.7% of Utah's total energy consumption in 2010, while renewable sources only accounted for 2.3% of Utah's consumption portfolio. These graphs do not include net interstate flows and losses (see inset graph); Utah exported 127.7 trillion Btu of electricity (including losses) in 2010, thus reducing total consumption to 741 trillion Btu.

1960–2010



UEMS website table: Table I.14

Source: EIA, UGS

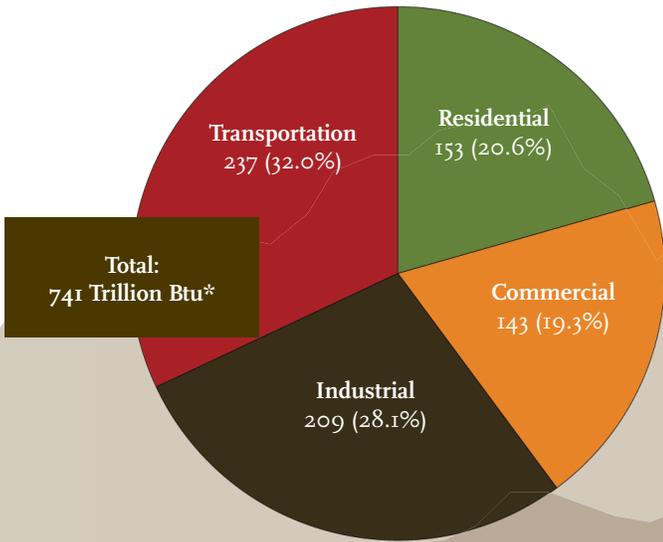
Notes: 2010 data are estimated; consumption from solar is negligible.

\*Total includes net interstate flows and losses. Net interstate flow of electricity is the difference between the amount of energy in the electricity sold within a state (including associated losses) and the energy input at the electric utilities within the state. A positive number indicates that more electricity (including associated losses) came into the state than went out of the state during the year; conversely, a negative number indicates that more electricity (including associated losses) went out of the state than came into the state.

# ENERGY CONSUMPTION IN UTAH BY SECTOR

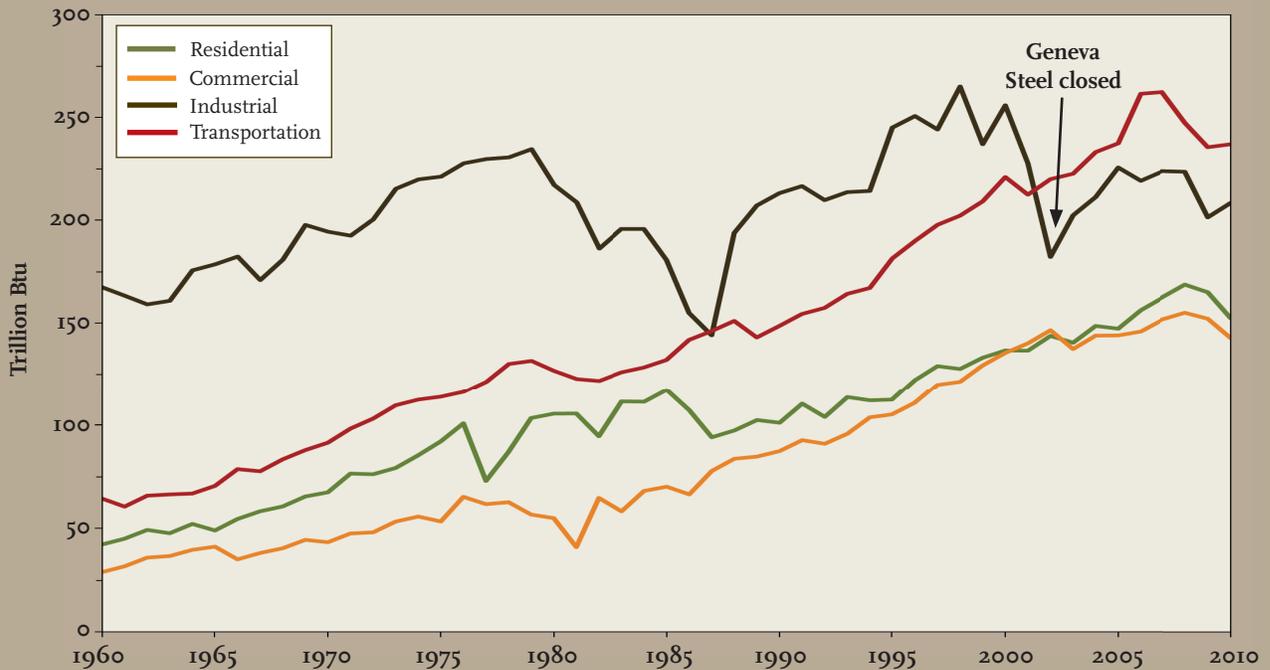
2010

Trillion Btu (Percent of total)



The transportation sector, mostly gasoline and diesel for vehicles, was the largest consumer of energy in Utah in 2010 (32.0%). The residential, commercial, and transportation sectors have all gradually increased over time, consistent with increasing population and increasing energy consumption per capita, while the industrial sector follows a pattern more closely tied to the national economy (e.g., an economy-related dip in the mid-1980s).

1960–2010



UEMS website table: Table 1.16

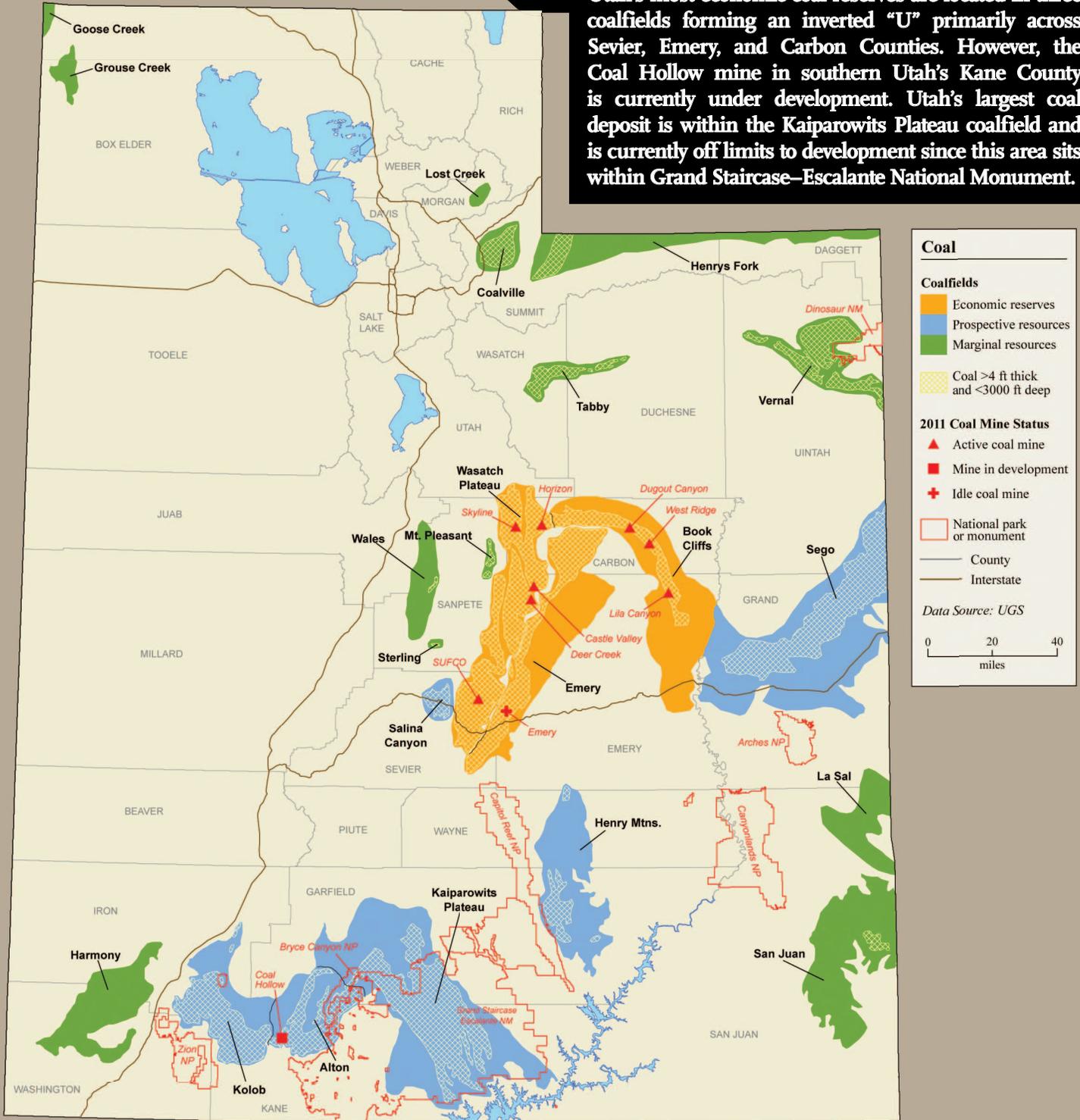
Source: EIA

Note: 2010 data are estimated.

\*Includes net interstate flows and losses

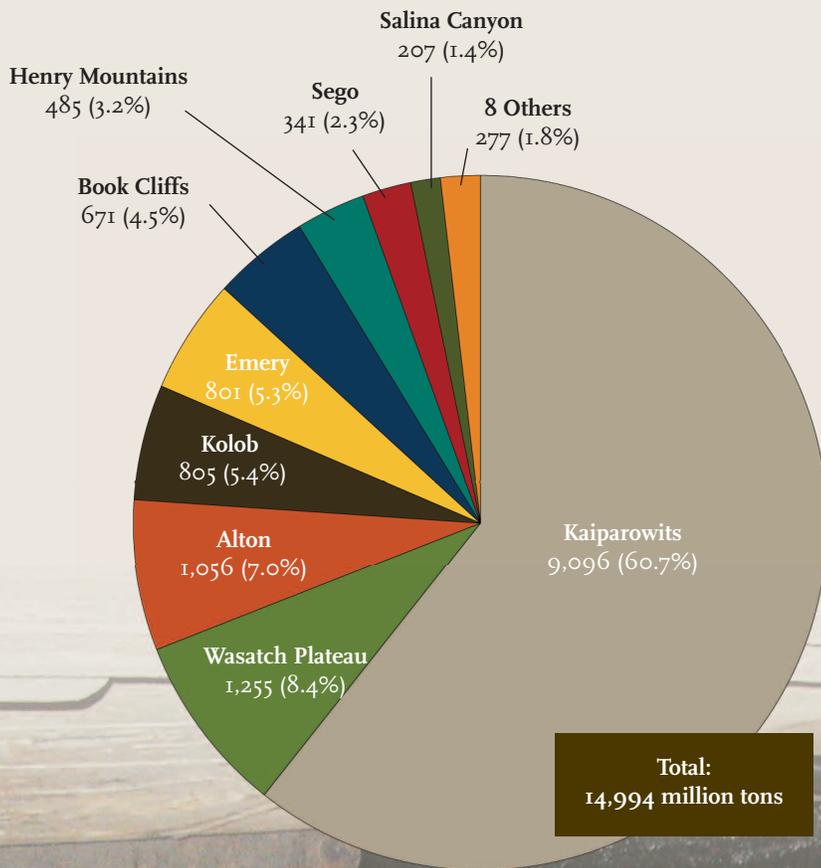
# COAL

Utah's most economic coal reserves are located in three coalfields forming an inverted "U" primarily across Sevier, Emery, and Carbon Counties. However, the Coal Hollow mine in southern Utah's Kane County is currently under development. Utah's largest coal deposit is within the Kaiparowits Plateau coalfield and is currently off limits to development since this area sits within Grand Staircase-Escalante National Monument.



# UTAH'S RECOVERABLE COAL RESOURCES BY COALFIELD, 2010

Million tons (Percent of total)



The majority of Utah's recoverable coal resources are located in the Grand Staircase–Escalante National Monument within the Kaiparowits coalfield (60.7% of Utah's estimated recoverable coal, as of 2010). Only the Wasatch Plateau, Emery, Book Cliffs, and Alton fields currently contain economically recoverable reserves and active mines.

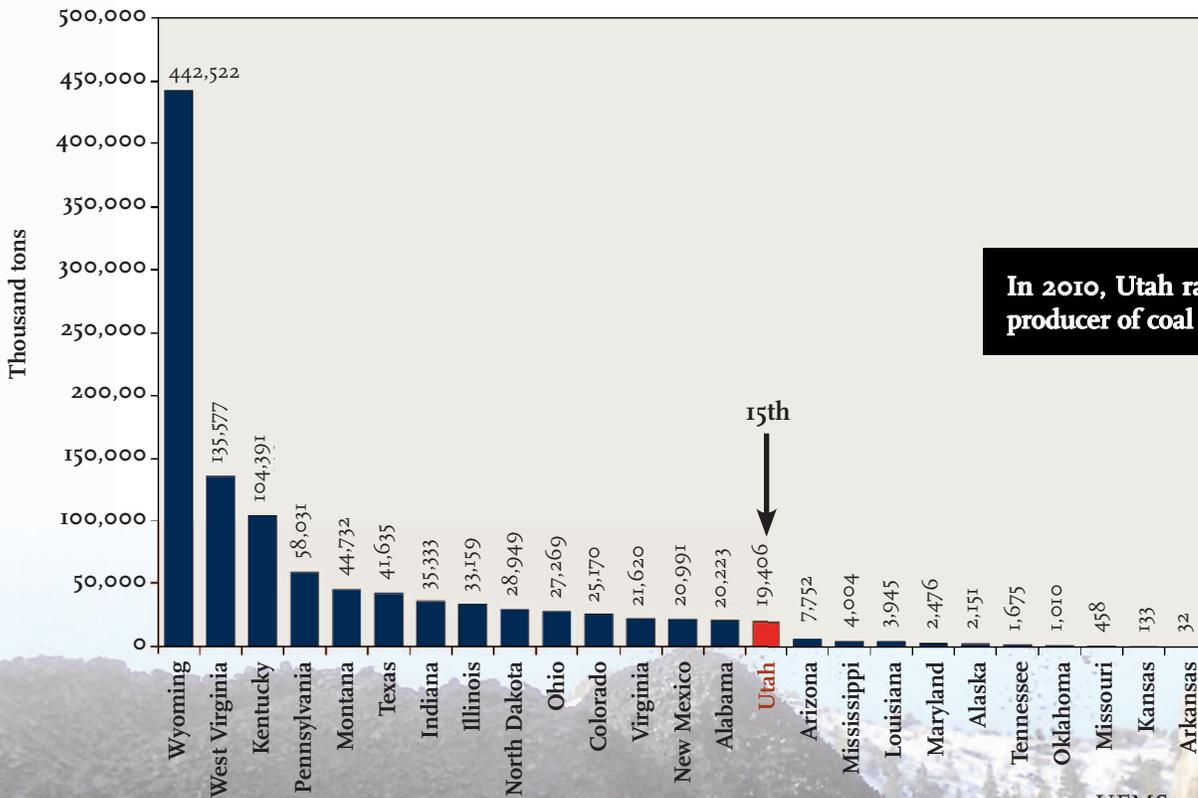
UEMS website table: Table 2.3

Source: UGS

Note: For Wasatch Plateau, Alton, Emery, Book Cliffs, and Henry Mountains, resources were constrained by a seam height minimum of four feet, with no more than 3000 feet of cover. For the remaining fields, resources were constrained by an estimated resource factor ranging from 30% to 40% of principal (unconstrained) resources. These resources do not take into account economic or land use constraints.



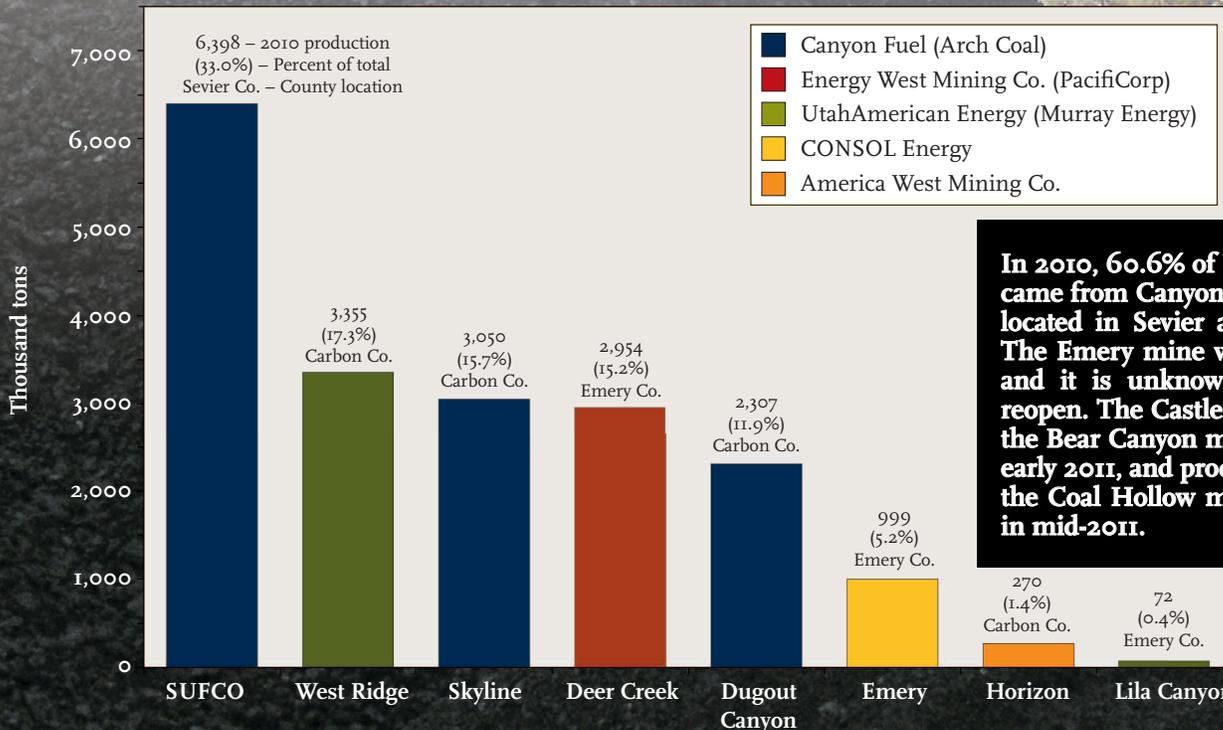
## U.S. COAL PRODUCTION BY STATE, 2010



In 2010, Utah ranked as the 15th largest producer of coal in the United States.

UEMS website table: Table 2.7  
Source: EIA, UGS

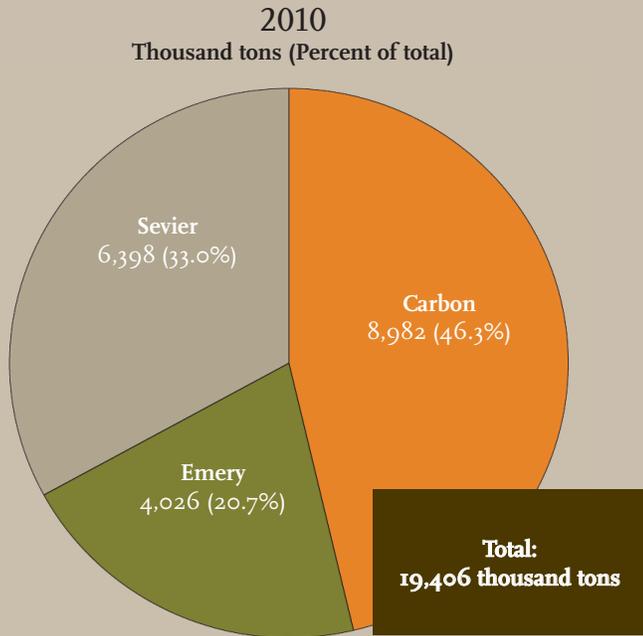
## UTAH COAL PRODUCTION BY MINE, 2010



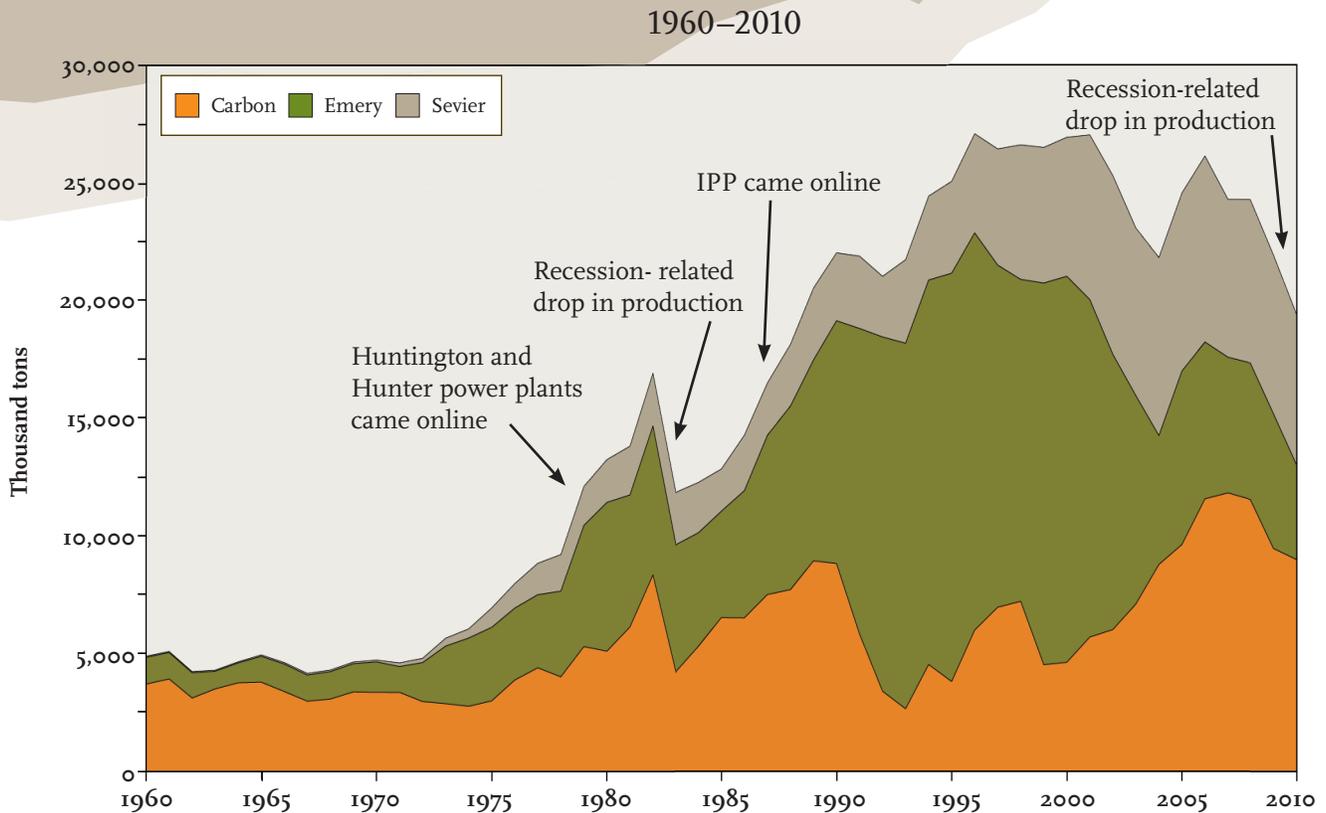
In 2010, 60.6% of Utah's coal production came from Canyon Fuel Company mines located in Sevier and Carbon Counties. The Emery mine was idled in late 2010, and it is unknown when or if it will reopen. The Castle Valley mine (formally the Bear Canyon mine) was re-opened in early 2011, and production commenced at the Coal Hollow mine in the Alton field in mid-2011.

UEMS website table: Table 2.8  
Source: UGS

# UTAH COAL PRODUCTION BY COUNTY



In recent years, coal production has declined in all Utah counties, mostly due to the recent economic recession. Carbon County mines, namely Dugout, West Ridge, and Skyline, account for almost half of Utah's total production. Only one large mine, Deer Creek, remains in Emery County, while the only coal produced in Sevier County is from the SUFCO mine. In the next few years, the percentage of coal mined from Emery County will increase as the new Lila Canyon mine ramps up to full production and mines in Carbon County deplete their reserves. In addition, the development of the Coal Hollow mine in the Alton coal field of southern Utah's Kane County could result in the first significant coal production outside Carbon, Emery, and Sevier Counties in over 50 years.



UEMS website table: Table 2.10

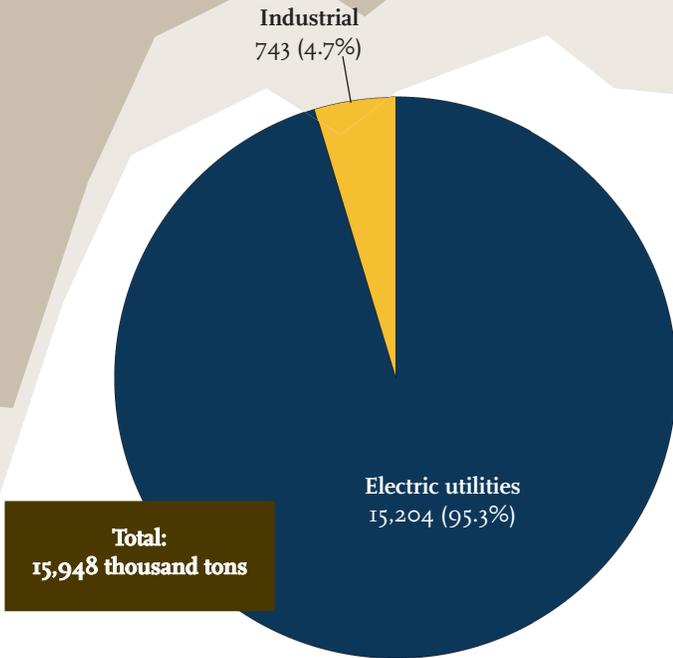
Source: UGS

Note: Production too small to be seen on graph was reported from Summit, Iron, and Kane Counties, mostly between 1960 and 1972.

# UTAH COAL CONSUMPTION BY SECTOR

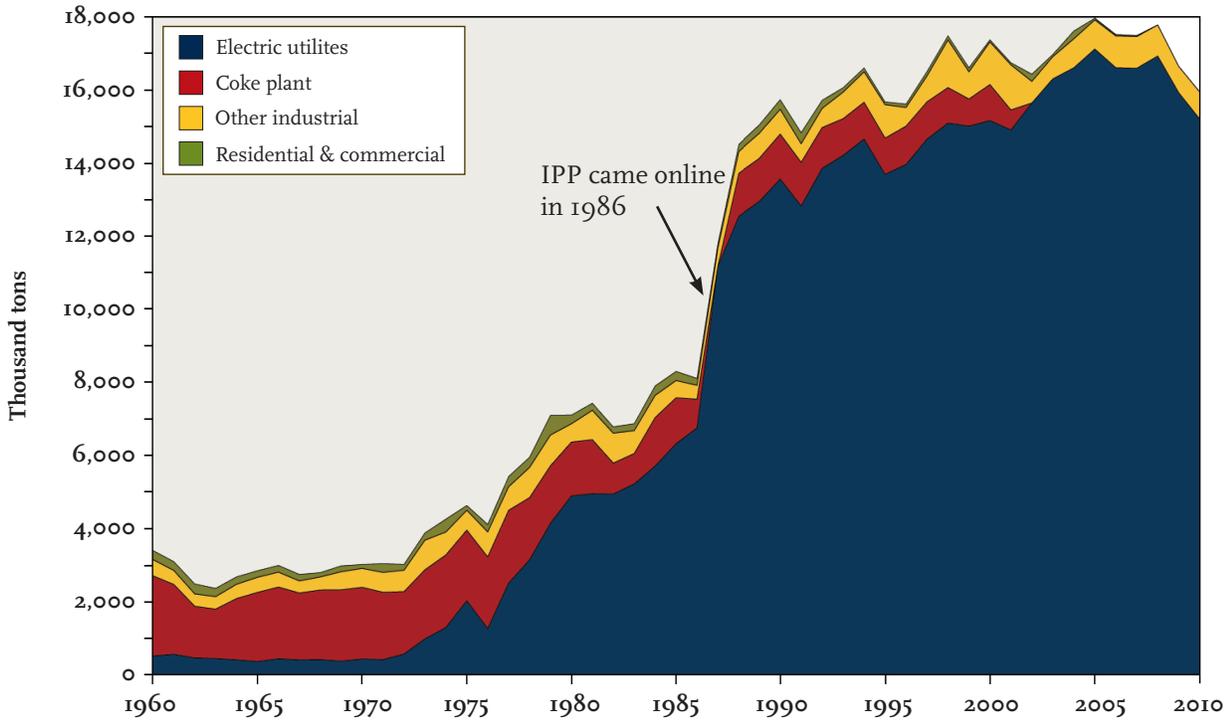
2010

Thousand tons (Percent of total)



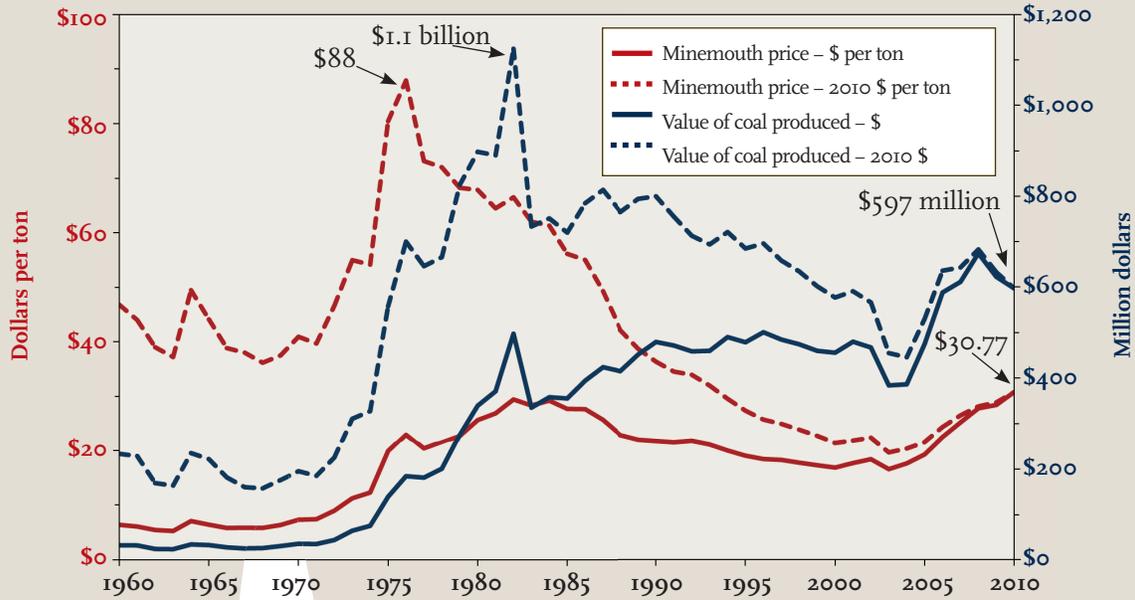
The vast majority of coal in Utah (95.3%) is consumed at electric power plants. The remaining coal (4.7%) is consumed by the industrial sector at cement/lime plants and Kennecott Utah Copper's power plant (182 megawatt capacity) which provides electricity for copper smelting. Coke consumption ceased in 2001 when Geneva Steel went out of business, and consumption in the residential and commercial sectors has become negligible in recent years.

1960–2010



UEMS website table: Table 2.21  
Source: EIA, UGS

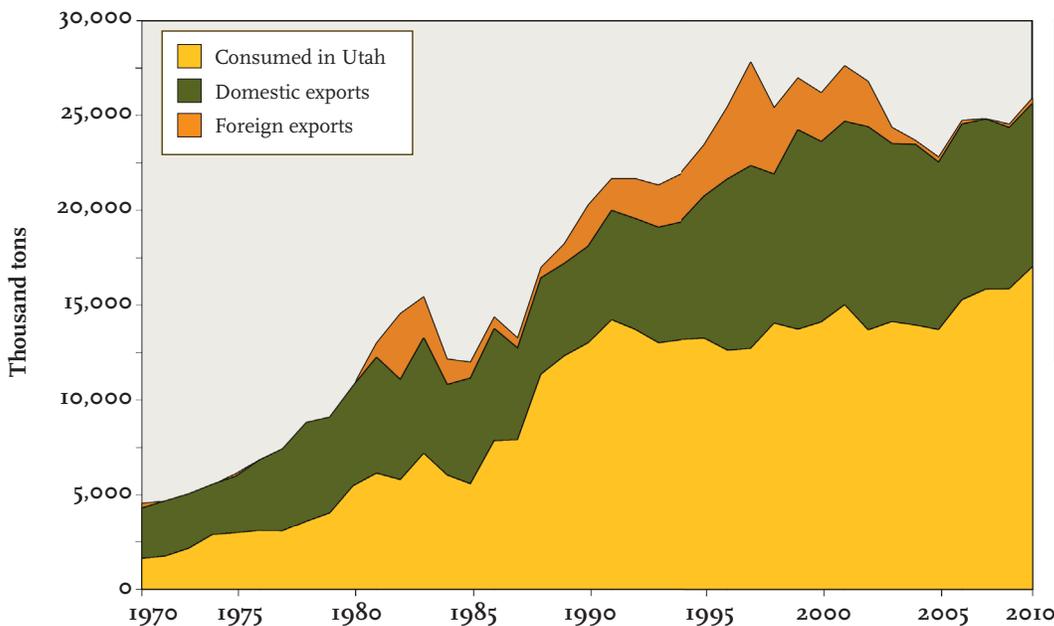
## AVERAGE MINEMOUTH PRICE AND VALUE OF UTAH COAL, 1960–2010



Utah's minemouth price (the price at the mine) of \$30.77 per ton in 2010 was the highest nominal price in history, but was well below the real (inflation-adjusted) high of \$88 reached in 1976. The 2010 value of produced Utah coal equaled \$597 million, the 4th highest in nominal dollars, but much less than the inflation-adjusted value of \$1.1 billion recorded in 1982.

UEMS website table: Table 2.22  
Source: UGS

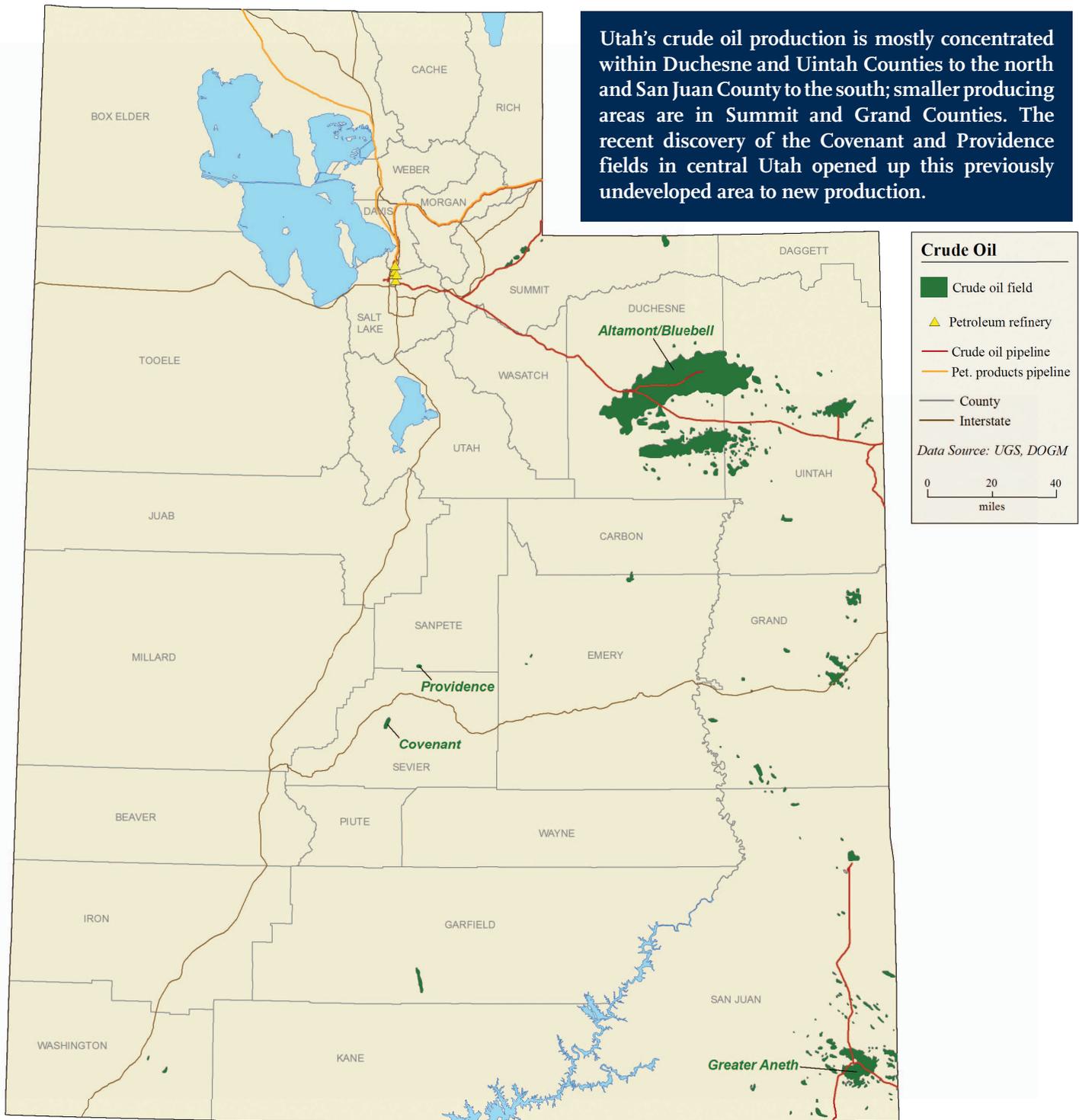
## DISTRIBUTION OF UTAH COAL, 1970–2010



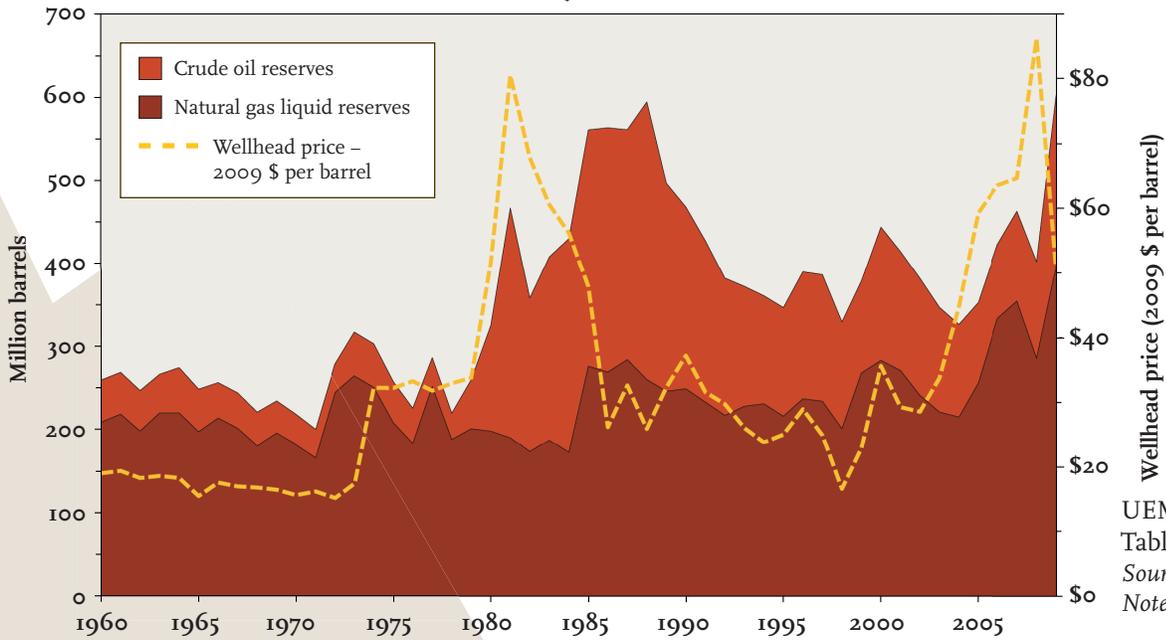
The majority of Utah coal, 66.9% in 2010, was used in state, while 29.8% was shipped out of state, and 3.3% was shipped to other countries. Foreign exports, mostly to Asia, peaked in 1996 when 5.5 million tons or 19.7% of Utah coal was shipped to foreign markets.

UEMS website table: Table 2.19  
Source: UGS

# CRUDE OIL AND PETROLEUM PRODUCTS



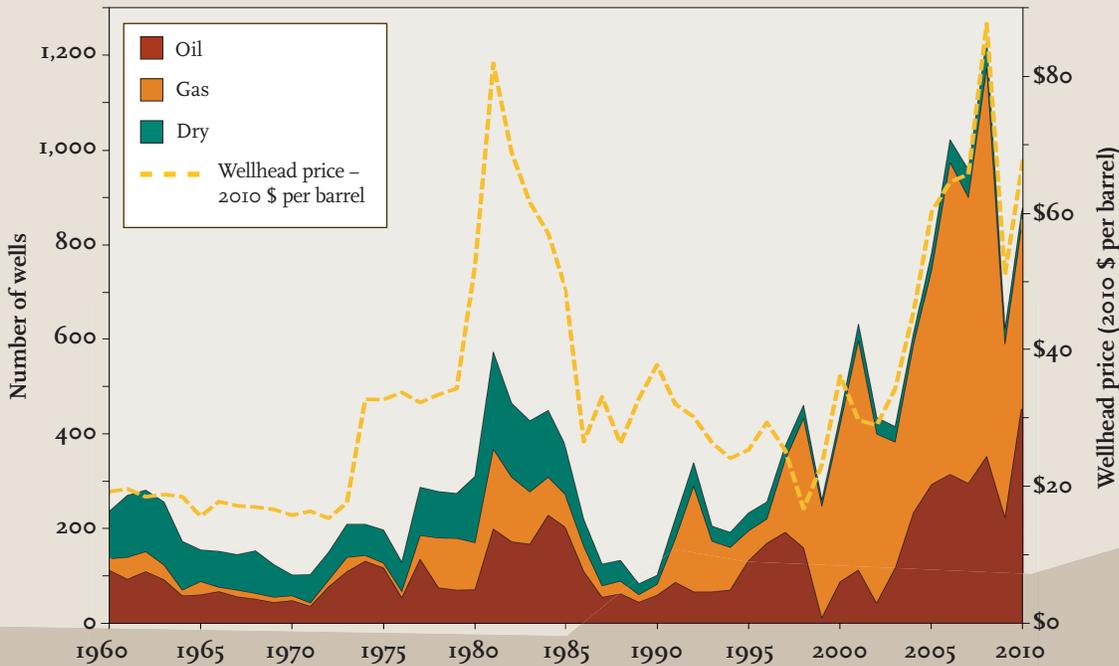
### CRUDE OIL AND NATURAL GAS LIQUID RESERVES IN UTAH, 1960–2009



UEMS website tables:  
Table 3.2 and Table 3.19  
Source: EIA  
Notes: 2010 reserve data are not yet available.

Natural gas liquids reserves increased in 1979, coinciding with a spike in oil prices, and peaked in the late 1980s. The recent increase in crude oil reserves was the result of record high prices in mid-2008, and is expected to remain high as the 2010 crude oil price has rebounded from the 2009 recession related drop.

### OIL AND GAS WELL COMPLETIONS IN UTAH, 1960–2010

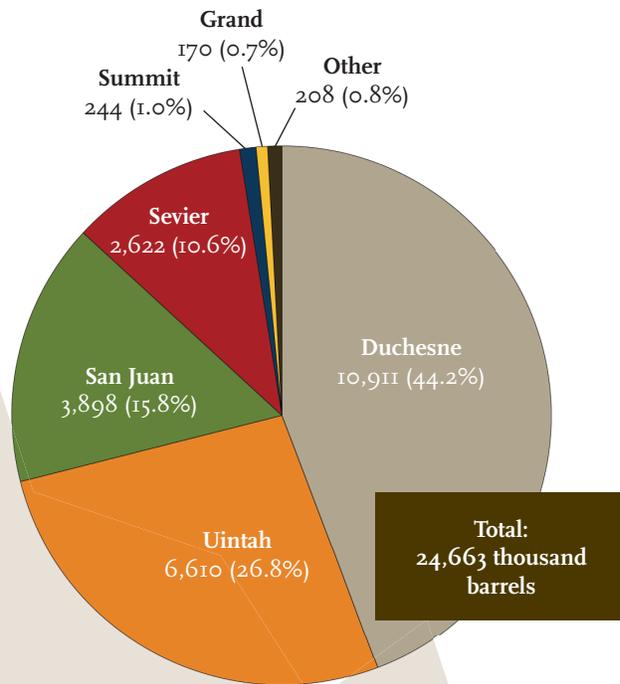


UEMS website tables:  
Table 3.4 and Table 3.19  
Source: DOGM, EIA

The number of well completions (both oil and gas) has tracked closely with wellhead price, both peaking in the early 1980s and again in recent years. Drilling in 2010 has recovered from the recession related drop in 2009. Also of note is the decrease in the number of dry wells through the years as drilling and exploration techniques have improved and high-risk wildcat drilling has decreased.

## UTAH CRUDE OIL PRODUCTION BY COUNTY, 2010

Thousand barrels (Percent of total)



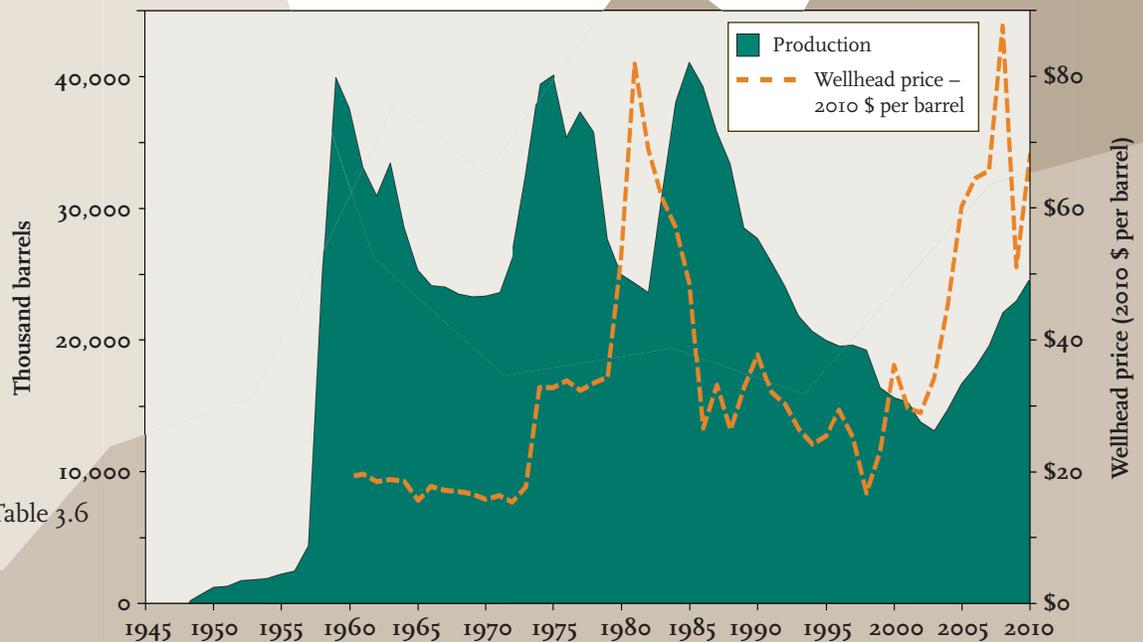
Crude oil production in Utah is mostly concentrated in Duchesne, Uintah, and San Juan Counties. Recently, production has started in Sevier County with the discovery of the Covenant field in central Utah.

UEMS website table: Table 3.7

Source: DOGM

Note: "Other" includes Garfield, Carbon, Emery, Sanpete, and Daggett Counties.

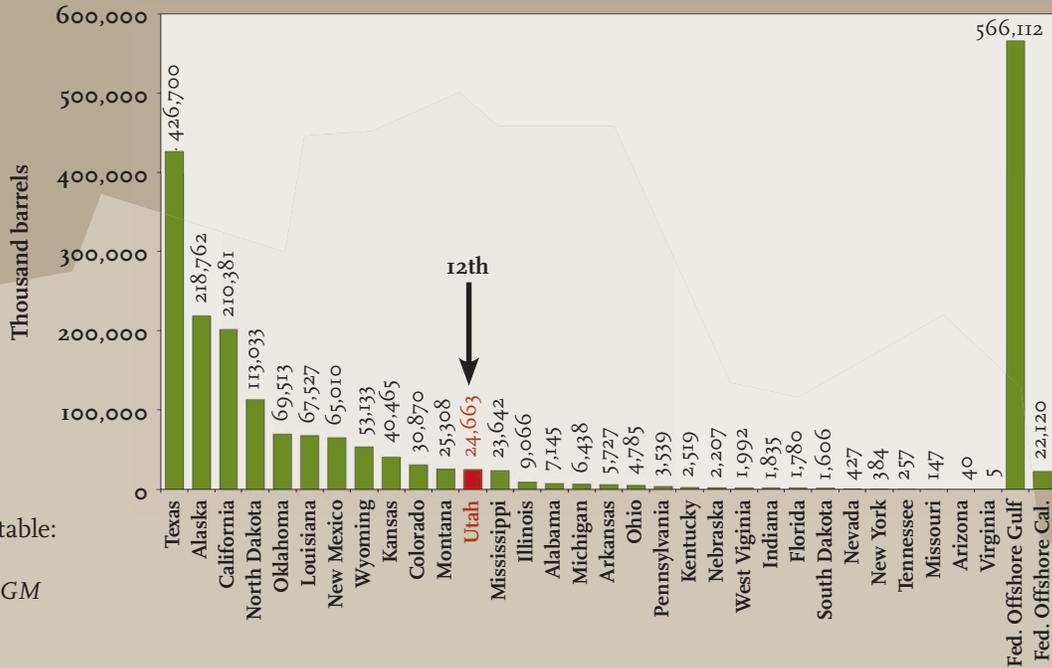
## UTAH CRUDE OIL PRODUCTION, 1945–2010



UEMS website tables: Table 3.6 and Table 3.19  
Source: DOGM, EIA

Utah has experienced three oil booms in the past 60 years and is currently defining a fourth. The first spike in crude oil production followed the discovery of the very large Bluebell and Greater Aneth fields in 1955 and 1956, respectively. The second spike coincided with a 1971 increase in wellhead price as well as the discovery of the Altamont field. The third peak in production resulted from the price spike of the early 1980s and followed the 1980 discovery of the Anschutz Ranch East natural gas field, which also produced large amounts of crude oil. The current rise in crude oil production is related to higher prices resulting in higher production from existing fields, especially in the Uinta Basin, as well as the discovery of the Covenant field in central Utah.

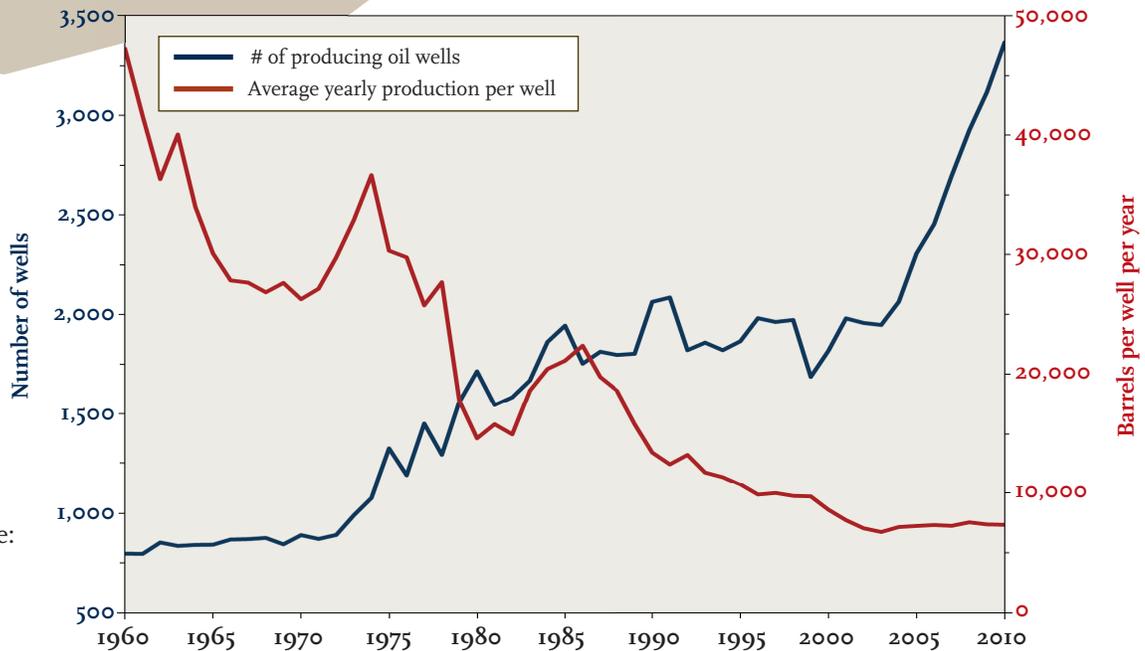
## U.S. CRUDE OIL PRODUCTION BY STATE, 2010



UEMS website table:  
Table 3.5  
Source: EIA, DOGM

In 2010, Utah ranked as the 12th largest producer of crude oil in the United States (not including federal offshore areas).

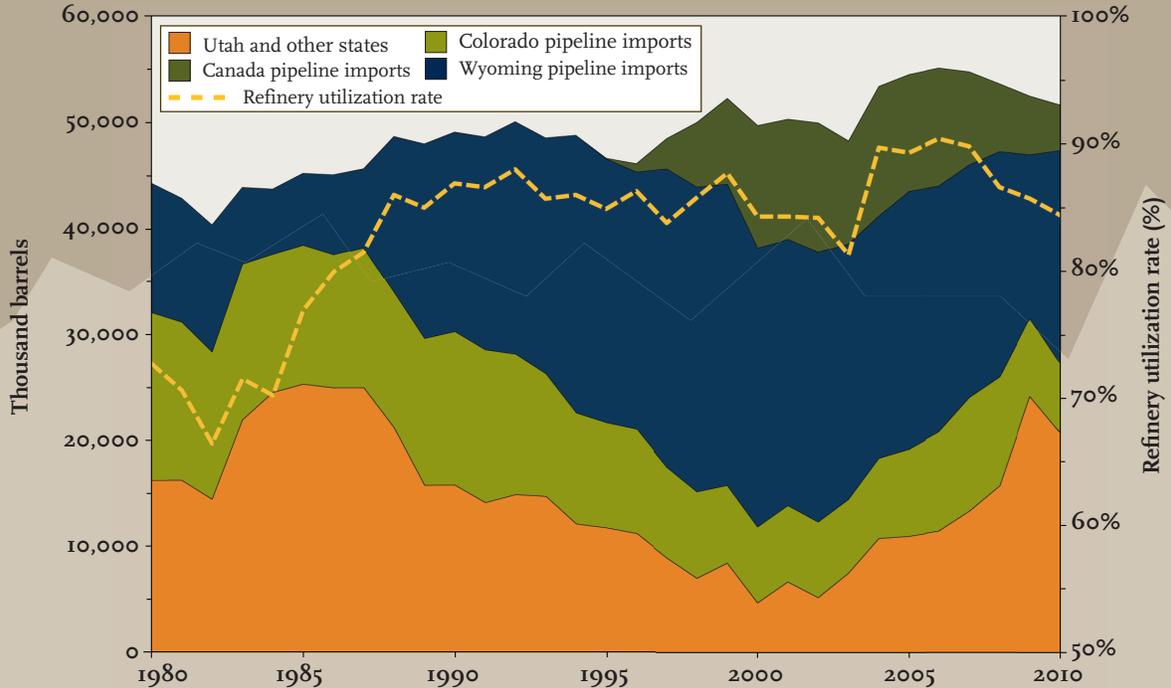
## NUMBER OF PRODUCING CRUDE OIL WELLS IN UTAH VERSUS AVERAGE YEARLY PRODUCTION PER WELL, 1960–2010



UEMS website table:  
Table 3.6  
Source: DOGM

As the total number of producing oil wells has increased over the years, the average yearly production per well has decreased. This graph illustrates how it now requires more wells to produce the same amount of crude oil.

## CRUDE OIL SHIPPED TO UTAH REFINERIES BY STATE OR COUNTRY OF ORIGIN, 1980–2010

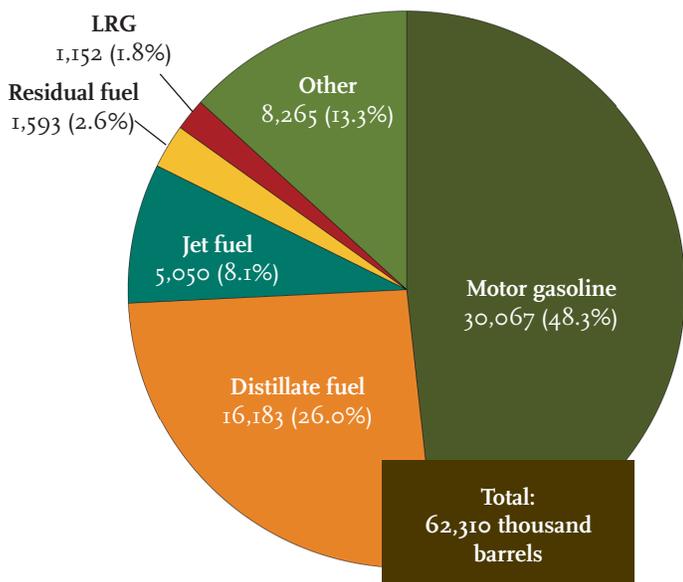


Utah refineries receive crude oil from four main sources: Utah, Colorado, Wyoming, and, as of 1995, Canada. Utah's refinery utilization rate, the average ratio of crude oil inputs to total refinery capacity, has averaged 83% over the past 20 years. In 2006, the average rate was greater than 90% for the first time since 1973, but has since dropped to 84% in 2010 as the high price of gasoline and economic recession helped decrease demand.

UEMS website tables: Table 3.14 and Table 3.16  
 Source: EIA, UGS  
 Note: Pipeline imports are known, however, deliveries via truck are difficult to track.

### UTAH REFINERY PRODUCTION BY PRODUCT, 2010

Thousand barrels (Percent of total)



Utah refineries produced over 30 million barrels of motor gasoline in 2010, of which roughly 14 million barrels was shipped to surrounding states.

UEMS website table: Table 3.15  
 Source: EIA  
 Note: LRG = Liquefied refinery gases

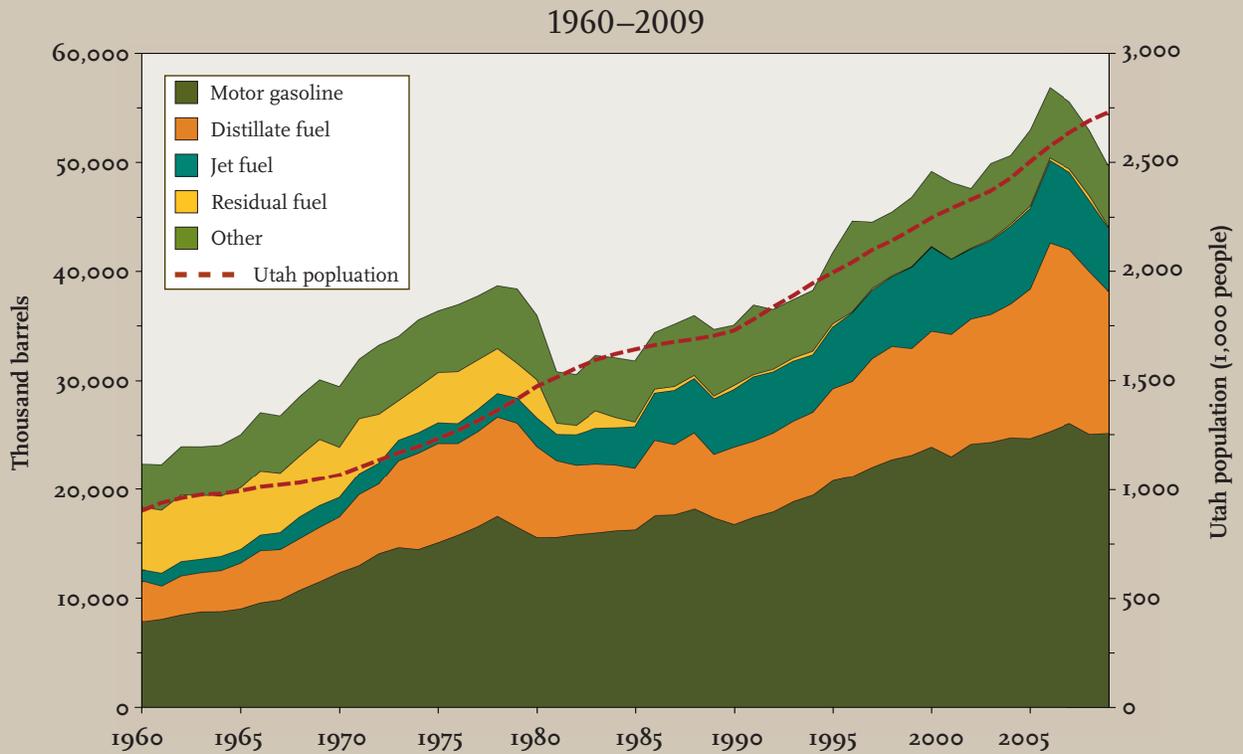
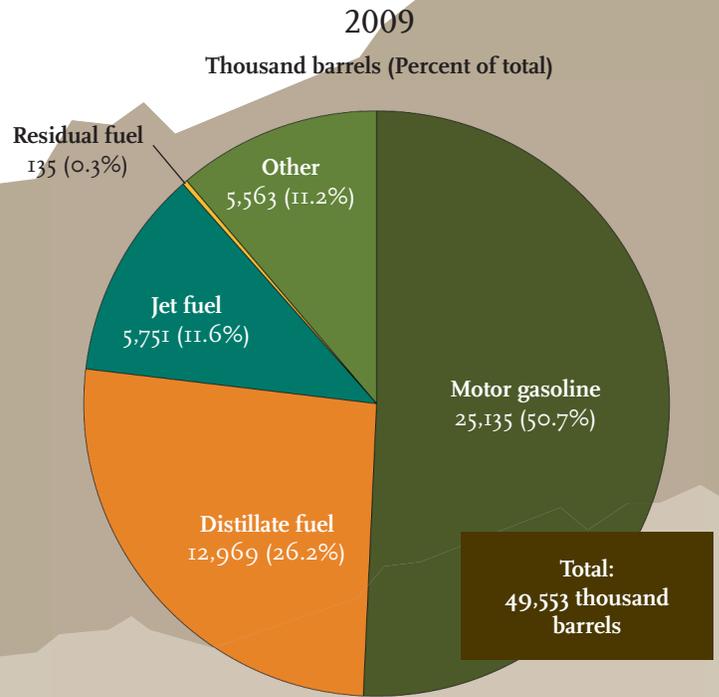
# CONSUMPTION OF PETROLEUM PRODUCTS IN UTAH

Motor gasoline was the most used petroleum product in 2009, accounting for 50.7% of all consumption. Distillate fuel ranked second at 26.2%, followed by jet fuel at 11.6%. Residual fuel use has declined greatly since the mid-1980s since it is no longer used as a fuel in power plants. Petroleum product consumption peaked in 2006 and has declined the past three years due to higher prices and the economic downturn. Overall petroleum product consumption tracks well with Utah's population growth.

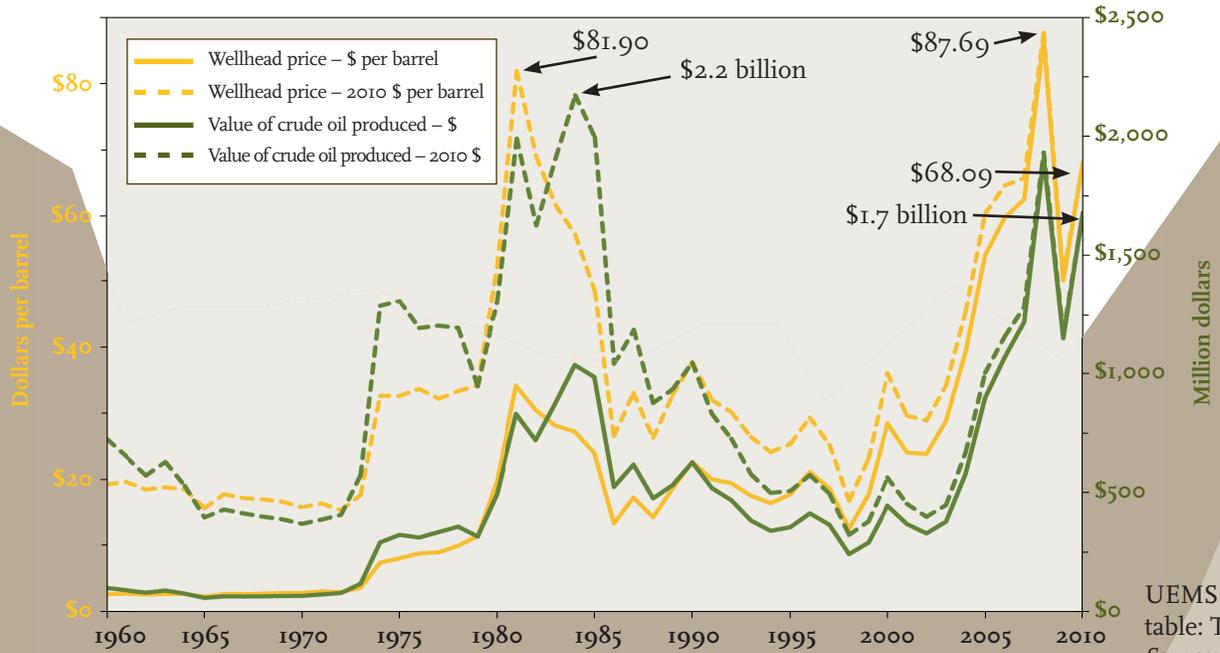
UEMS website table: Table 3.17

Source: EIA

Notes: 2010 data are not yet available; "Other" includes asphalt and road oil, aviation gasoline, kerosene, liquefied petroleum gases, lubricants, among others.

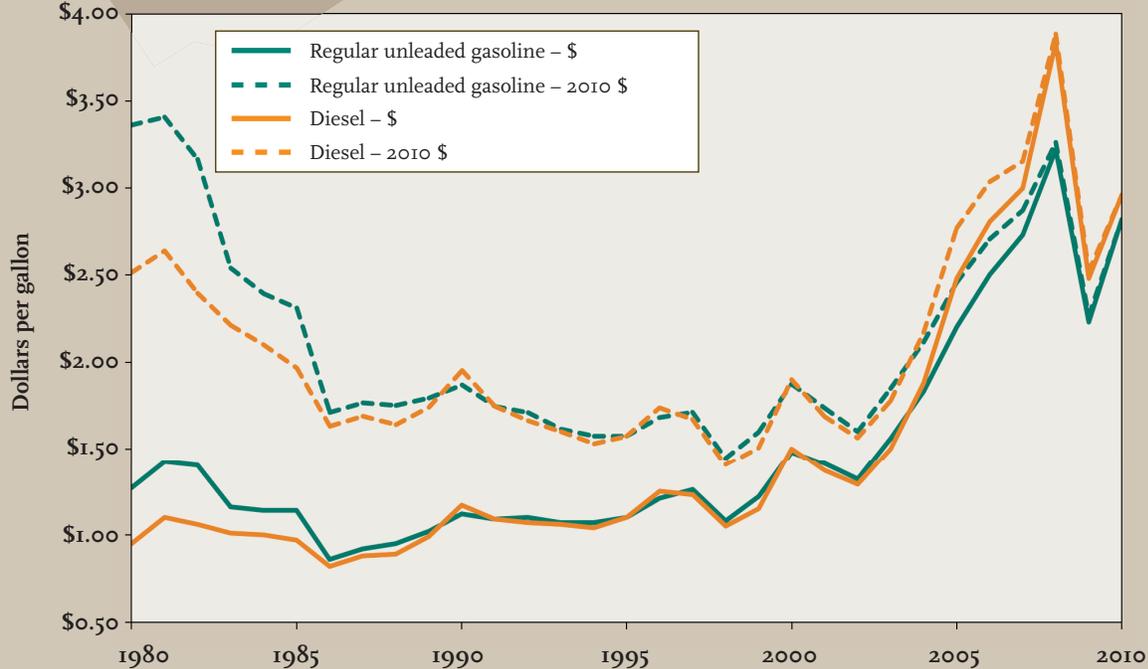


## AVERAGE WELLHEAD PRICE AND VALUE OF CRUDE OIL IN UTAH, 1960–2010



Utah's crude oil wellhead price hit an all-time high of \$87.69 per barrel in 2008, even when adjusted for inflation. Crude oil prices dropped substantially to \$51.04 per barrel in 2009, but rebounded in 2010 to \$68.09. The value of Utah's crude oil reached \$1.7 billion in 2010 in nominal dollars, the fifth-highest value in inflation-adjusted dollars.

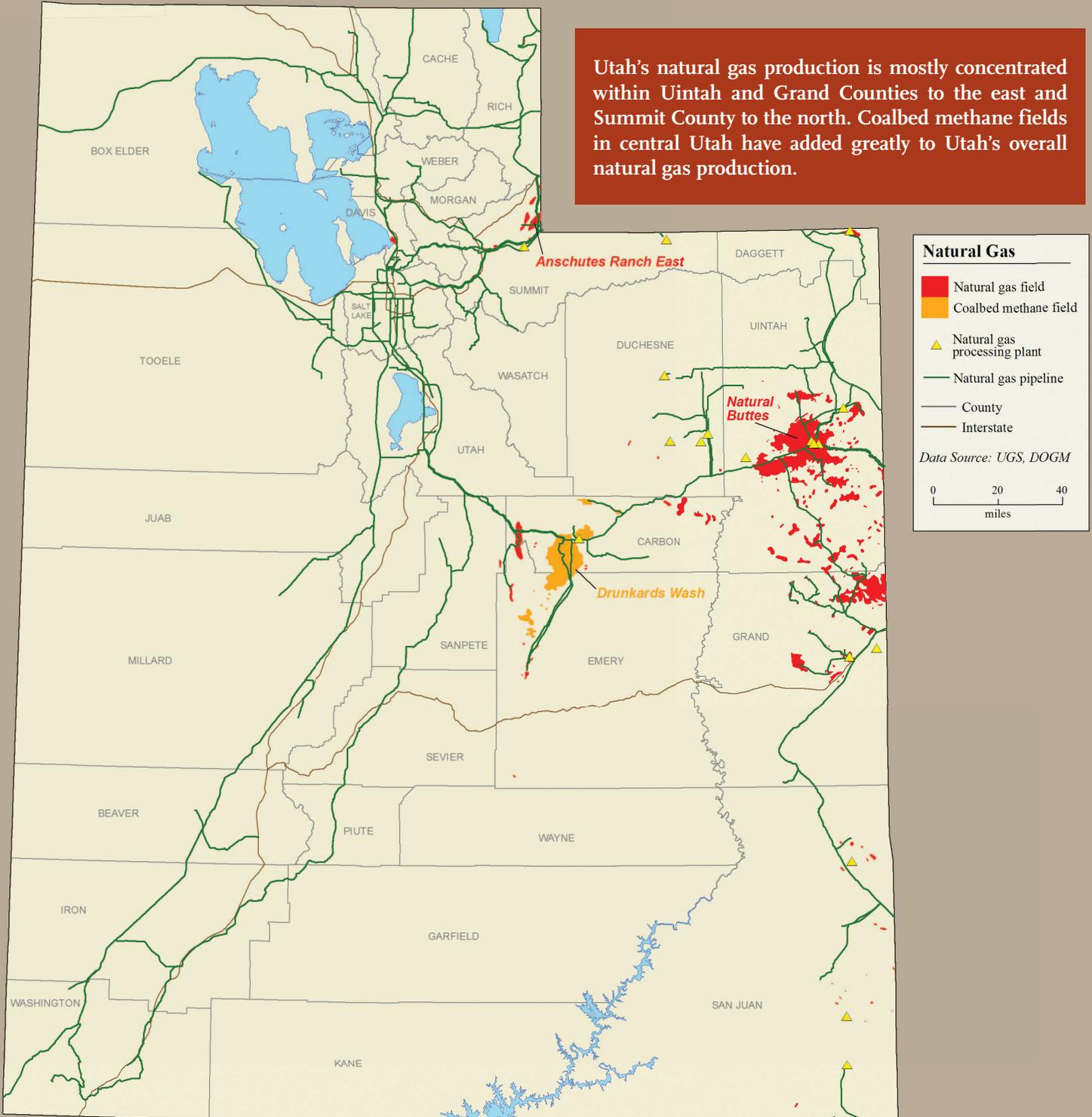
## UTAH PRICE OF MOTOR GASOLINE AND DIESEL, 1980–2010



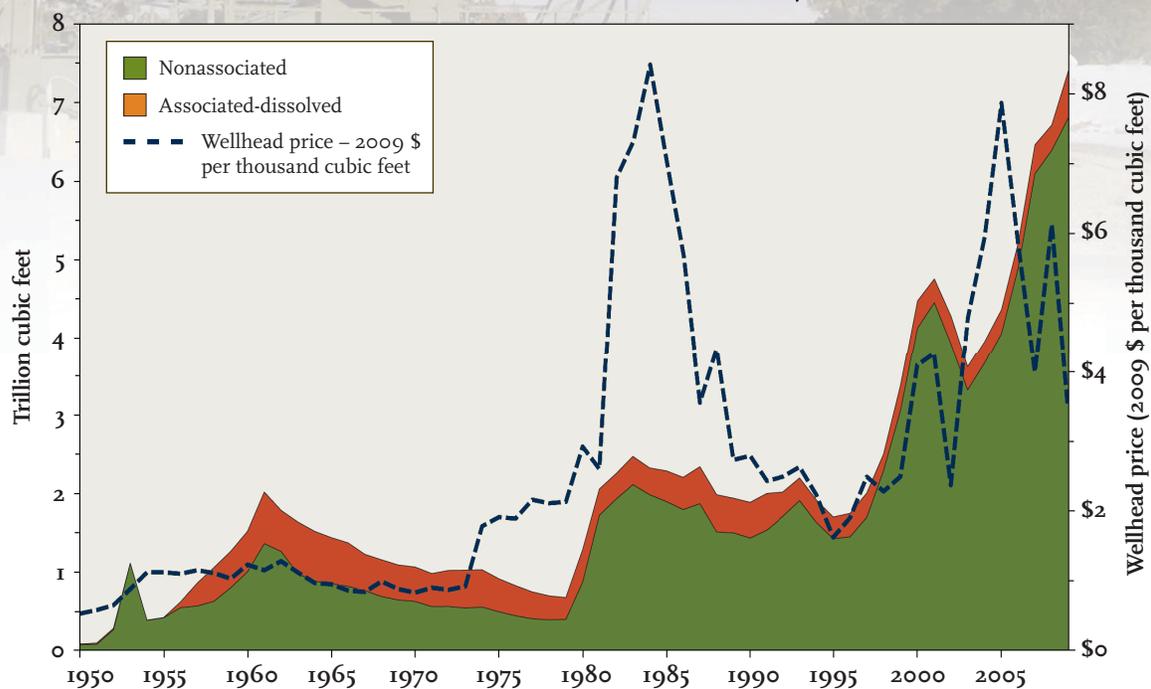
Regular unleaded gasoline and diesel prices rebounded to an average of \$2.82 and \$2.96 per gallon, respectively, in 2010 after a dramatic recession-related drop in 2009.

# NATURAL GAS

Utah's natural gas production is mostly concentrated within Uintah and Grand Counties to the east and Summit County to the north. Coalbed methane fields in central Utah have added greatly to Utah's overall natural gas production.



## NATURAL GAS RESERVES IN UTAH, 1950–2009



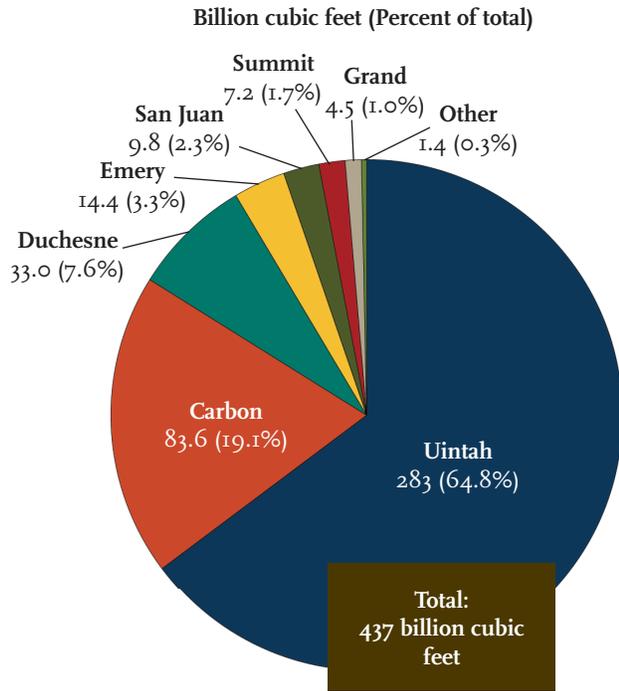
Natural gas reserves surged in 1980 and 1981, coinciding with an increase in wellhead prices, and a second surge occurred in the late-1990s, coinciding with new development of coalbed methane. The current increase in reserves is the direct result of the recent increase in average wellhead price.

UEMS website tables: Table 4.2 and Table 4.15

Source: EIA

Note: 2010 reserve data are not yet available; nonassociated natural gas is not in contact with significant quantities of crude oil in the reservoir; associated-dissolved natural gas occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved gas).

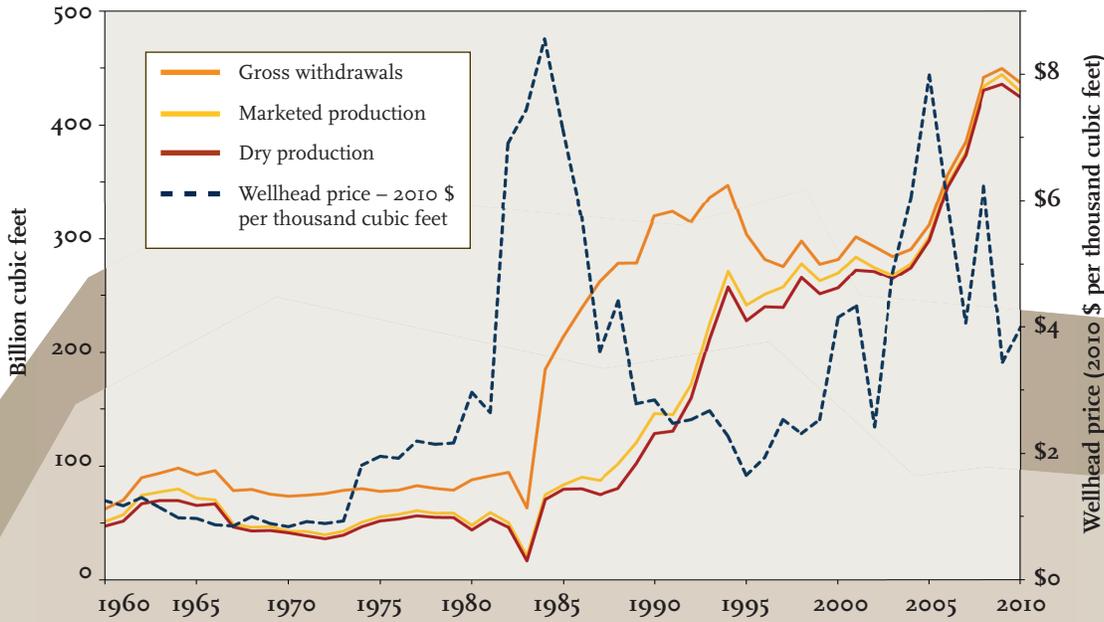
# UTAH NATURAL GAS PRODUCTION (GROSS) BY COUNTY, 2010



Gross natural gas production is on the rise in Uintah County, which contains Utah's largest natural gas field, Natural Buttes, and in Duchesne County, where gas is produced along with increasing amounts of crude oil. Production is on the decline in all other counties, including Carbon and Emery Counties where the production is mainly from coalbed methane resources.

UEMS website table: Table 4.5  
 Source: DOGM  
 Note: "Other" includes Daggett, Sanpete, and Garfield Counties.

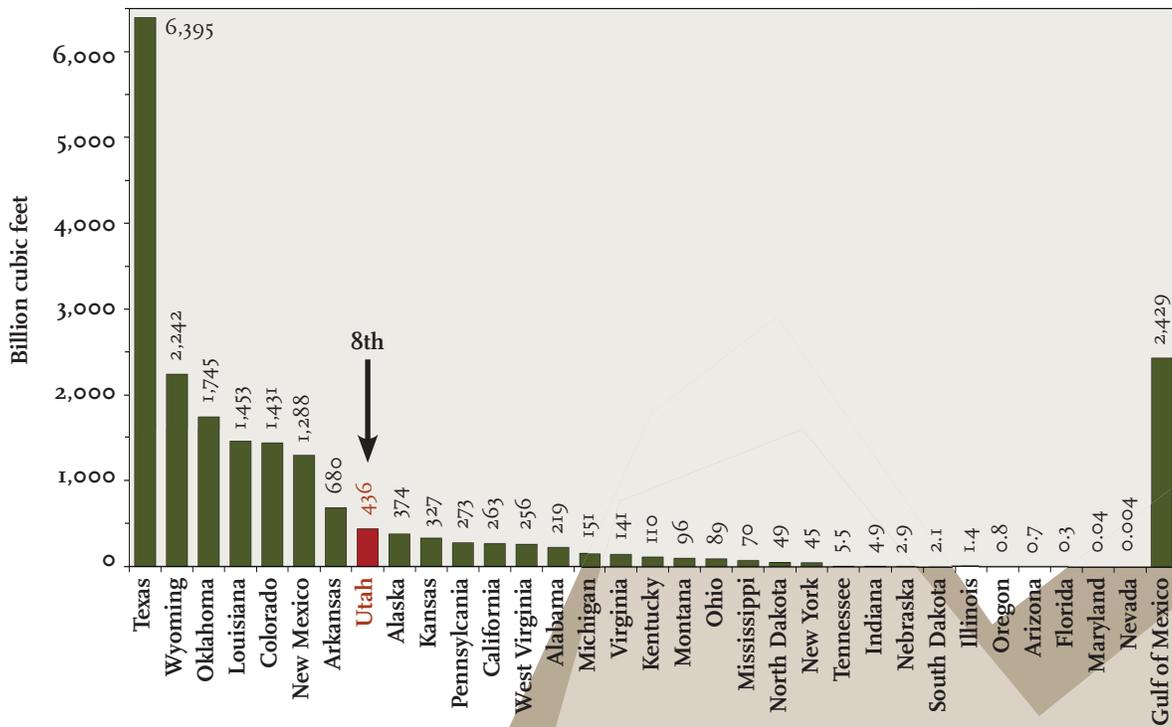
## UTAH NATURAL GAS PRODUCTION, 1960–2010



The first major increase in natural gas production occurred in the mid-1980s, coinciding with a large spike in prices and the discovery of coalbed methane in central Utah. The mid-2000s surge in production was also price related, but with a decrease in average wellhead price to around \$4 per thousand cubic feet, production has begun to level off.

UEMS website tables:  
 Table 4.4 and 4.15  
 Source: DOGM, EIA  
 Note: 2010 marketed production, dry production, and wellhead prices are estimated.

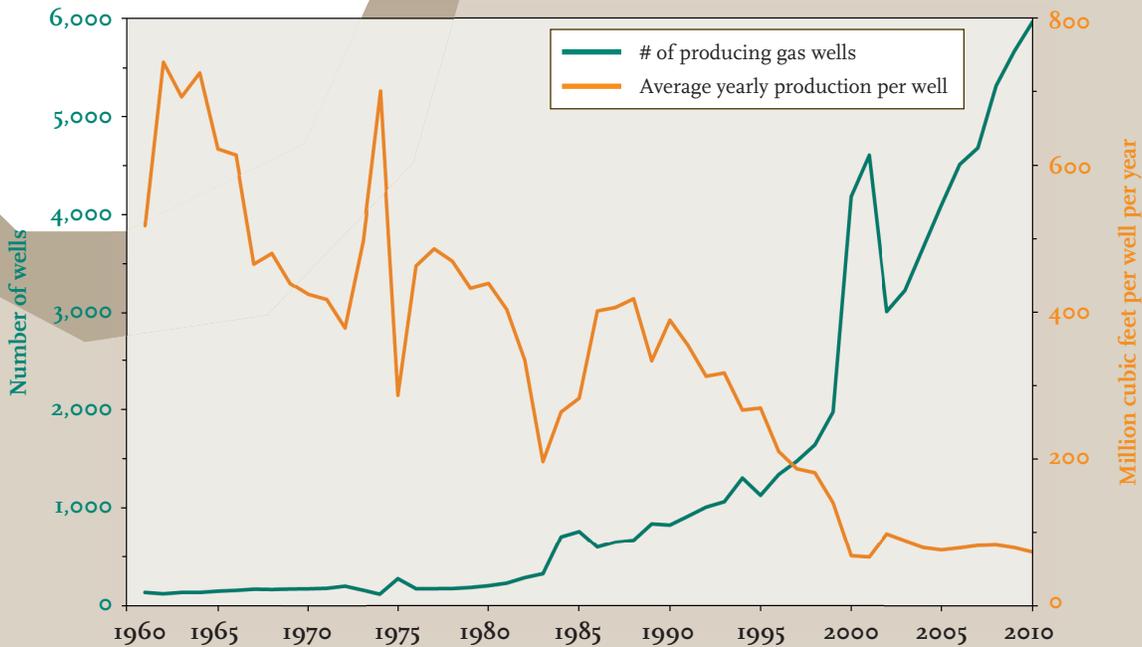
## U.S. NATURAL GAS PRODUCTION (DRY) BY STATE, 2009



UEMS website table:  
Table 4.3  
Source: EIA, DOGM  
Note: 2010 data are not yet available.

In 2009, Utah ranked as the 8th largest producer of natural gas in the United States (not including production in the Gulf of Mexico).

## NUMBER OF PRODUCING NATURAL GAS WELLS IN UTAH VERSUS AVERAGE YEARLY PRODUCTION PER WELL, 1961–2010

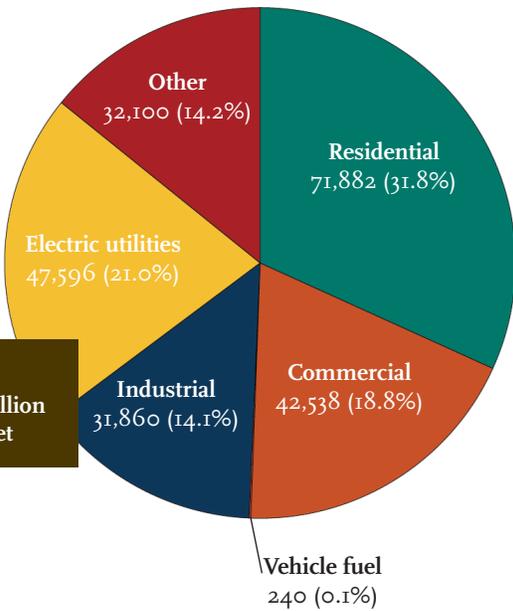


UEMS website table:  
Table 4.4  
Source: DOGM

Similar to crude oil, as the total number of producing gas wells has increased over the years, the average yearly production per well has decreased.

# CONSUMPTION OF NATURAL GAS IN UTAH

2010  
Million cubic feet (Percent of total)



**Total:**  
226,216 million  
cubic feet

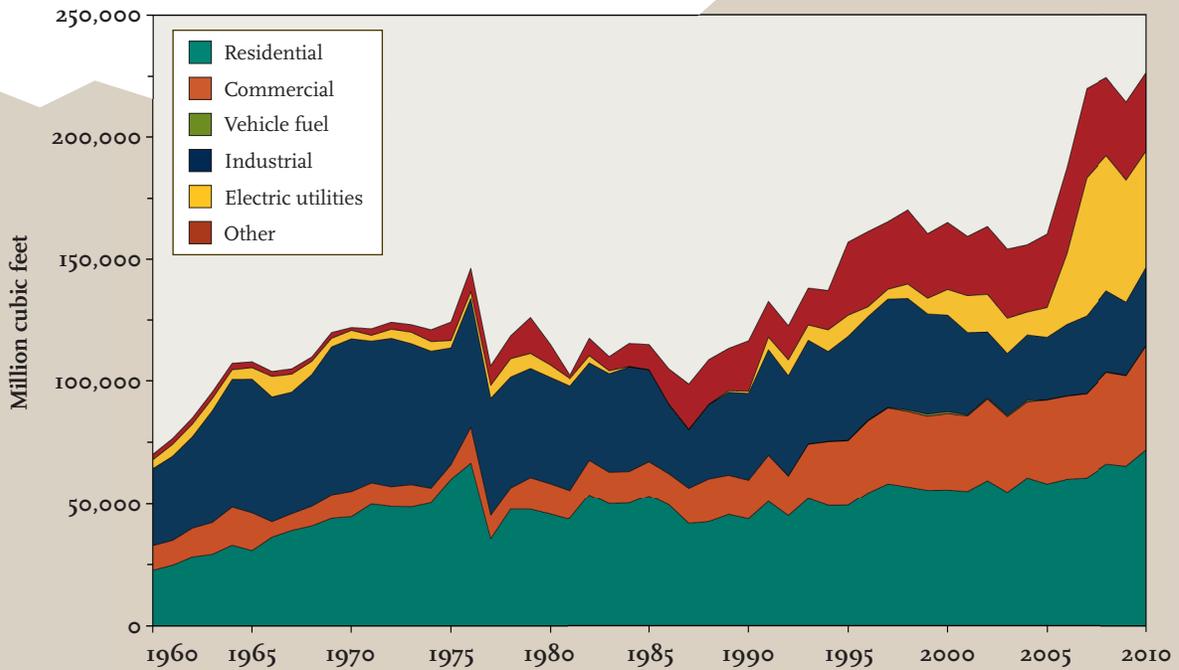
Consumption of natural gas in 2010 rebounded to a new record high after experiencing a recession-related dip in 2009. Natural gas is mostly used for home heating (residential, 31.8%), but starting in mid-2004, 1300 MW of new natural-gas-fired electric capacity have come online, greatly increasing the amount used by the electric utility sector (from 7.6% in 2005 to 21.0% in 2010).

UEMS website table: Table 4.14

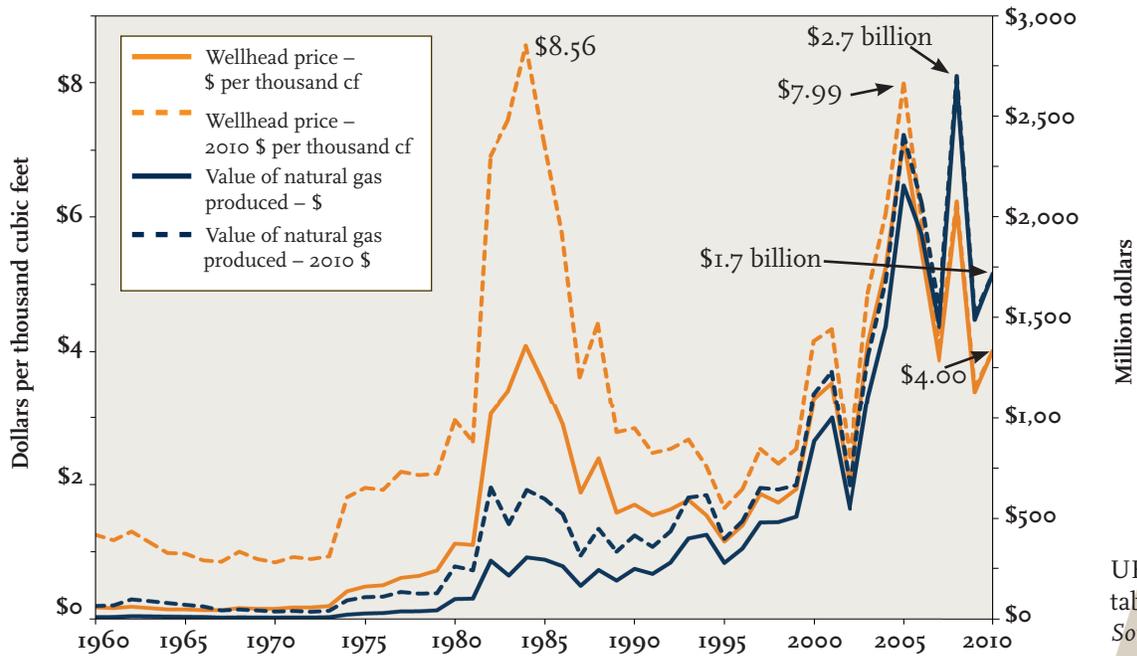
Source: EIA

Notes: 2010 data are estimated; "Other" includes lease use, plant use, and pipeline fuel.

1960–2010



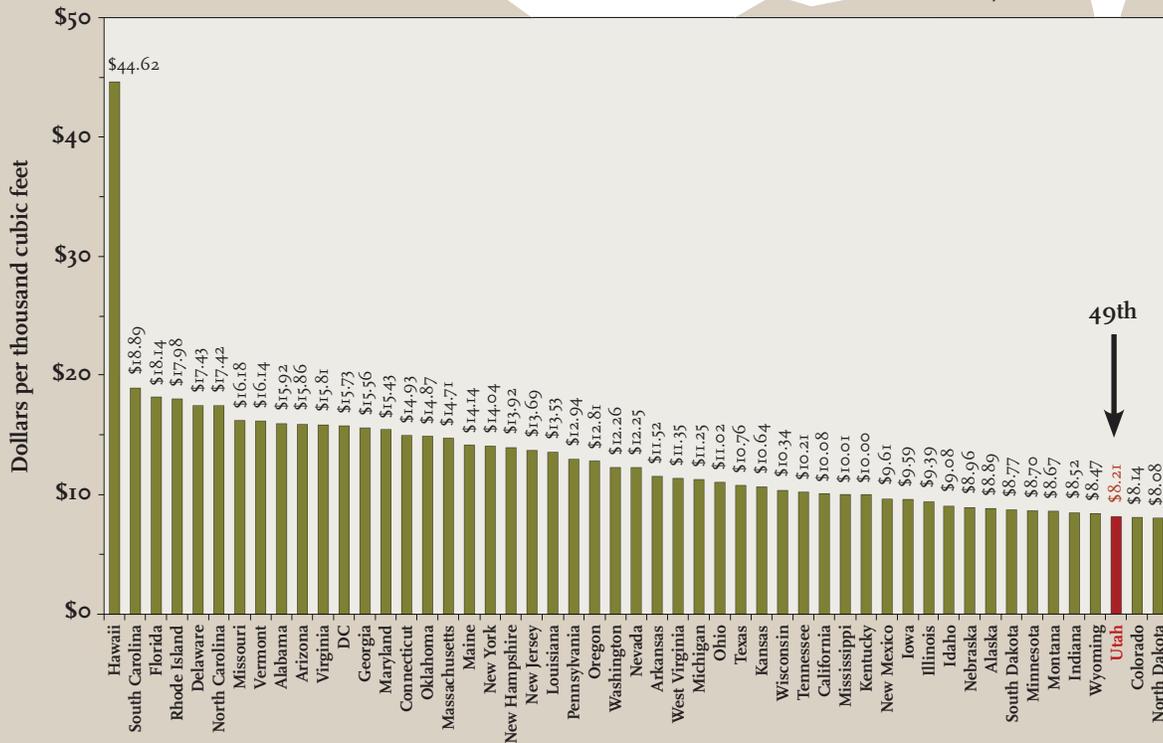
## AVERAGE WELLHEAD PRICE AND VALUE OF NATURAL GAS IN UTAH, 1960–2010



UEMS website table: Table 4.15  
Source: EIA

The price and value of natural gas produced in Utah in the past few years has fluctuated dramatically, peaking in 2005 (due to high prices related to Hurricane Katrina) and again in 2008, before settling down to \$4.00 per thousand cubic feet in 2010 translating to a value of \$1.7 billion.

## AVERAGE PRICE OF RESIDENTIAL NATURAL GAS BY STATE, 2010



UEMS website table: Table 4.17  
Source: EIA

Notes: 2010 data are preliminary; includes the District of Columbia.

In 2010, Utah had the third-lowest price for residential natural gas in the country, behind only Colorado and North Dakota.



# RENEWABLE RESOURCES

## UTAH RENEWABLE ENERGY ZONES TASK FORCE: PHASE I AND PHASE II STUDIES

The state of Utah is fortunate to have its own indigenous energy resources for the production of electrical energy. In 2008, 97.7 percent of electricity produced in Utah was from traditional coal, natural gas, and petroleum resources. Renewable resources such as hydroelectric and geothermal contributed only 1.8 percent of electricity in Utah. To promote the development of carbon-free energy resources, the 2008 Utah State Legislature passed *The Energy Resource and Carbon Emission Reduction Initiative* (Utah Code 54-17-602). Utah Code 54-17-602 set a target for Utah's municipal, investor-owned, and cooperative utilities to provide 20 percent of their adjusted retail sales from qualifying non-carbon based energy resources by 2025 if cost-effective. Utilities are not required to purchase power from Utah based projects. Power may be purchased from projects within the Western Electricity Coordinating Council (WECC) region. The WECC region is made up of the following states and provinces: Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Oregon, Utah, Washington, Wyoming, Alberta, British Columbia, and Baja California.

In order to promote and identify Utah's utility-scale electrical renewable energy resources and to assess transmission needed to bring those resources to load centers in Utah, the Utah Renewable Energy Zones (UREZ) Task Force was commissioned to (1) identify geographical areas in Utah where utility-scale renewable energy development could occur; (2) assess the electrical generation potential of wind, solar, and geothermal technologies (see maps); and (3) identify new and existing transmission needed to bring renewable energy generation sources to market.

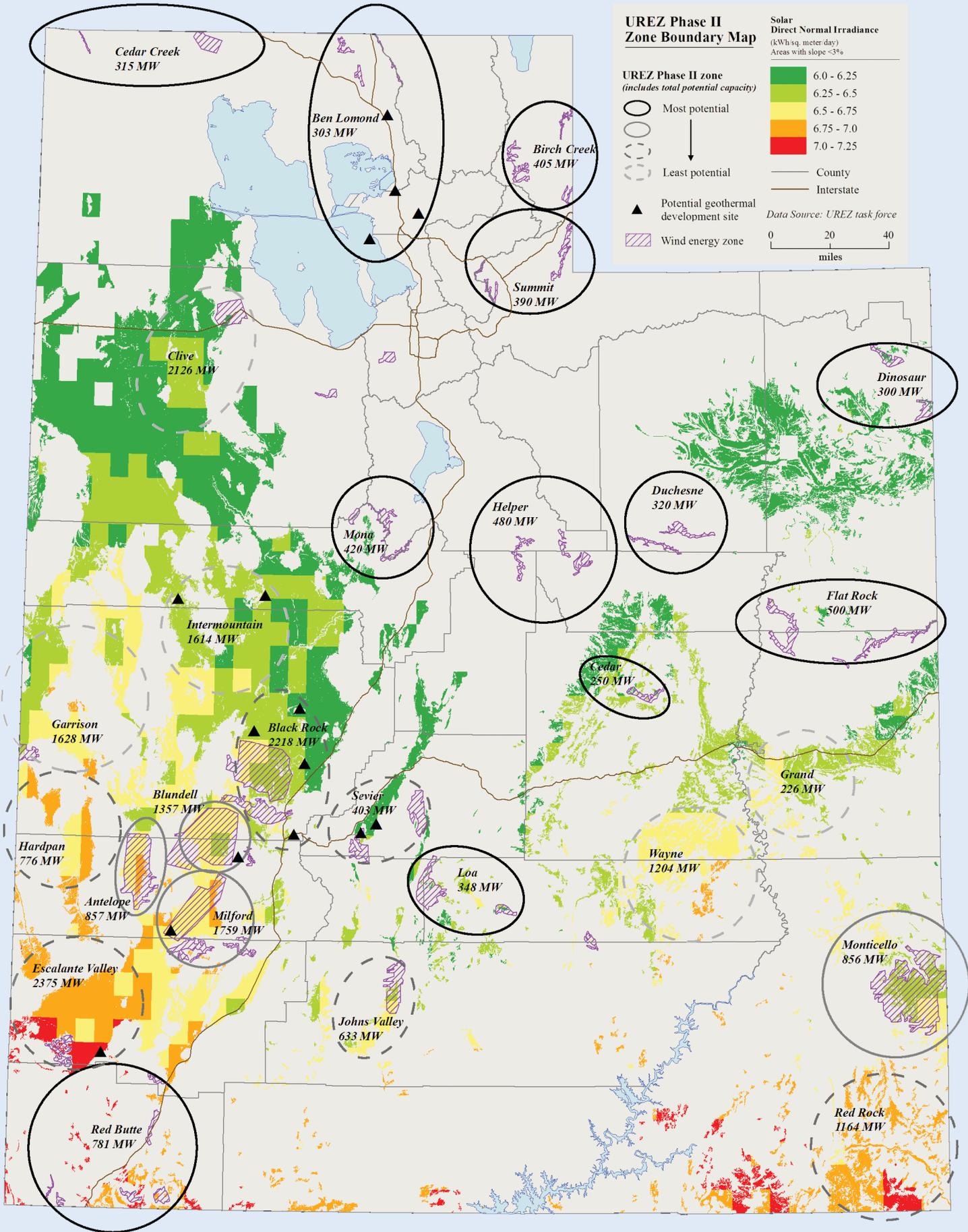
In 2008, Phase I of the study identified renewable energy zones totaling approximately 13,262 square miles and an estimated 837 gigawatts (GW) of electrical generating potential. Although most counties have some solar, wind, or geothermal energy potential, significant quantities of all three resources were found co-located in southwest Utah. In addition, large concentrations of wind resources were identified along the Utah and Wyoming border.

The scope of work for Phase I of the UREZ process was not to assess the development potential from an economic perspective. Rather, analogous to estimating resources and reserves in the oil and gas industry, this project's scope of work was to identify the potential resources, within reason, for short-term (~10 years) and long-term (~>10 years) potential. Again, similar to estimating conventional natural resource reserves, the quantity is a constantly changing value. More importantly, this macro-level assessment identified likely areas of multiple resource zones that may have utility-scale generation potential.

In 2010, UREZ Phase II focused on evaluating the transmission needed to bring renewable energy generation to markets. The report considers the potential of resource zones and identifies the transmission requirements necessary to deliver the energy from these zones to Utah consumers and energy markets in the Western Interconnect. While the report provides scenarios and examples of generation and transmission, the model is designed to enable the resource and transmission industries to evaluate their own development and transmission objectives. The Phase II effort identified approximately 25,000 MW of potential renewable generating resources located in 27 zones scattered throughout Utah (see map on next page).

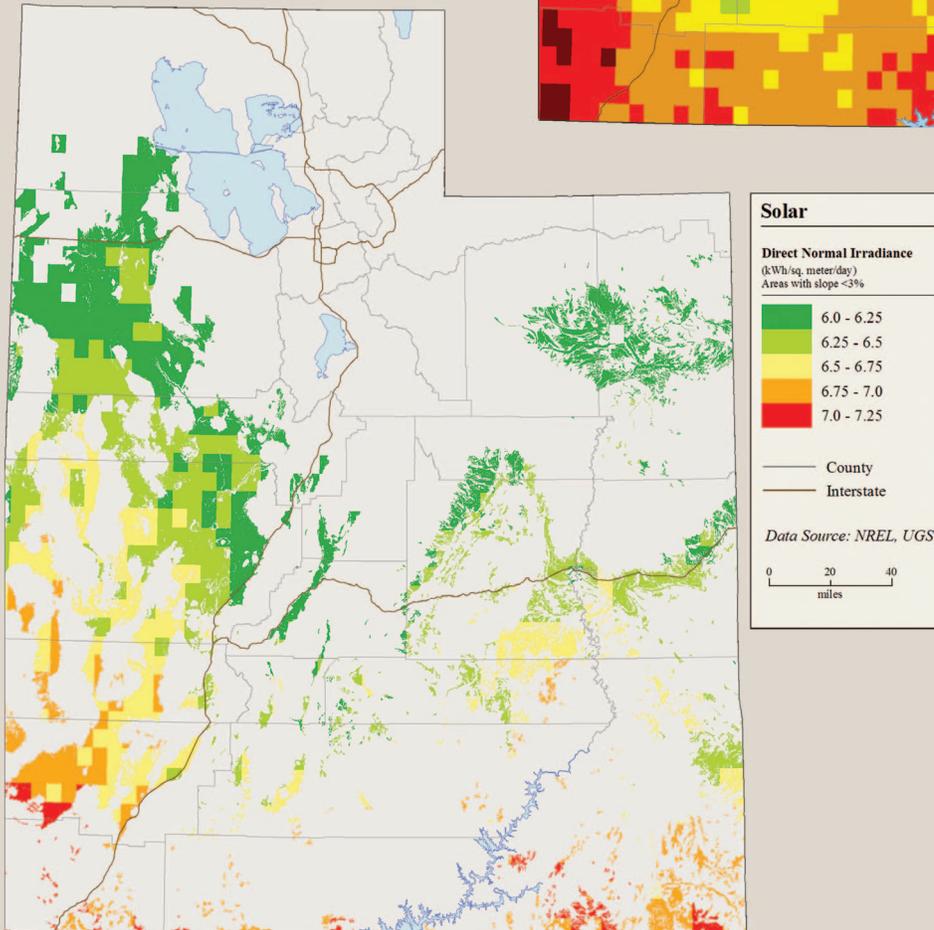
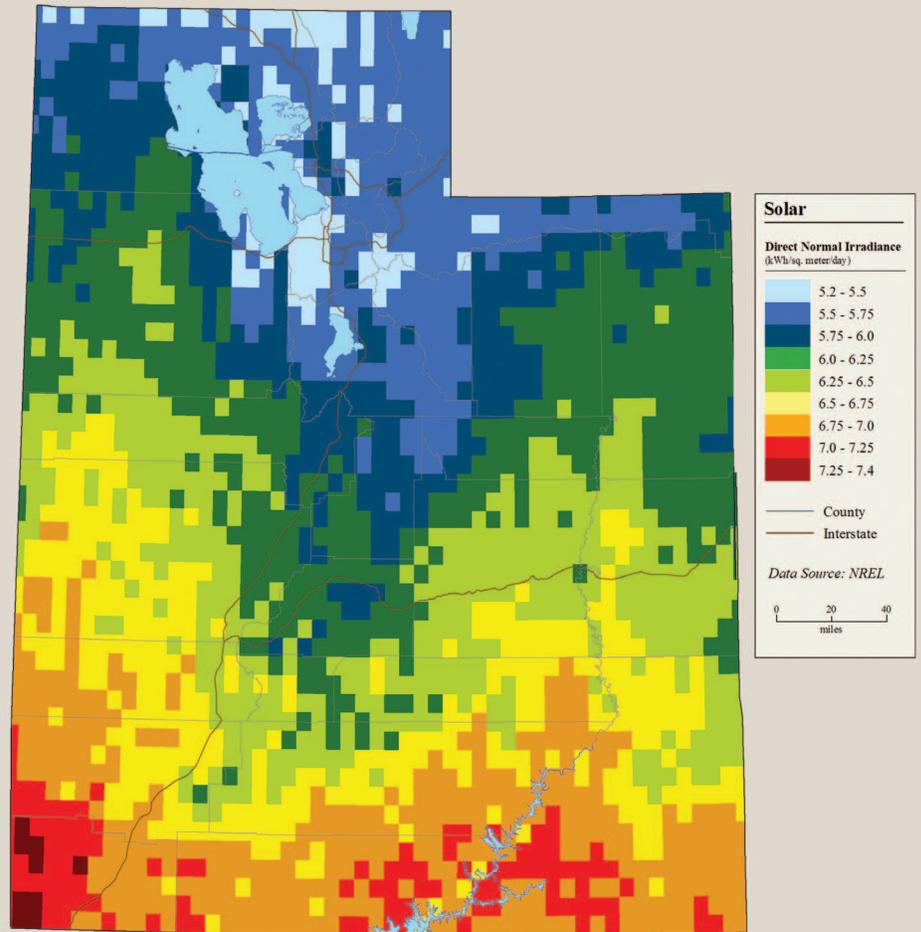
UREZ Phase I report: [geology.utah.gov/sep/renewable\\_energy/urez/phase1](http://geology.utah.gov/sep/renewable_energy/urez/phase1)

UREZ Phase II report: [geology.utah.gov/sep/renewable\\_energy/urez/phase2](http://geology.utah.gov/sep/renewable_energy/urez/phase2)



## SOLAR ASSESSMENT

Utah's solar resources are clearly abundant (map on right, no screening applied). The analysis identified 6,371 square miles of land that have a theoretical potential of about 826 gigawatts (GW) of utility-scale capacity. The solar analysis used several criteria to shape the methodology (map below): (1) measurements of Direct Normal Irradiance (DNI), with a threshold value of 6.0 kilowatt-hours per meter squared (kWh/m<sup>2</sup>)/day or greater, (2) screening out steeper areas (slopes of 3% or greater) unable to accommodate a large solar collection field, (3) screening out environmentally sensitive areas such as national parks, wilderness areas, wetlands, etc., that are not available for development, and (4) applying proxy technology, of a 50 megawatt (MW) parabolic trough concentrating solar thermal power plant, to estimate electrical energy capacity.



### Major findings from the solar assessment:

- Sixteen thousand five hundred (16,500) theoretically potential 50 MW solar Renewable Energy Zone (REZ) areas (1 km square zones) were identified (826 GW).
- The geospatial distribution of the quality of the solar resource follows a simple north to south trend.
- Southern Utah has the higher quality resources (6.5 kWh/m<sup>2</sup>/day or greater), while northern Utah has a slightly lower quality solar resource (6.0 kWh/m<sup>2</sup>/day or less).
- The prime solar REZ areas constitute less than 1.5% of the identified sites, while the majority of the sites (43.2%) have a lower resource potential.
- The total area of the solar REZs is 6,371 square miles.

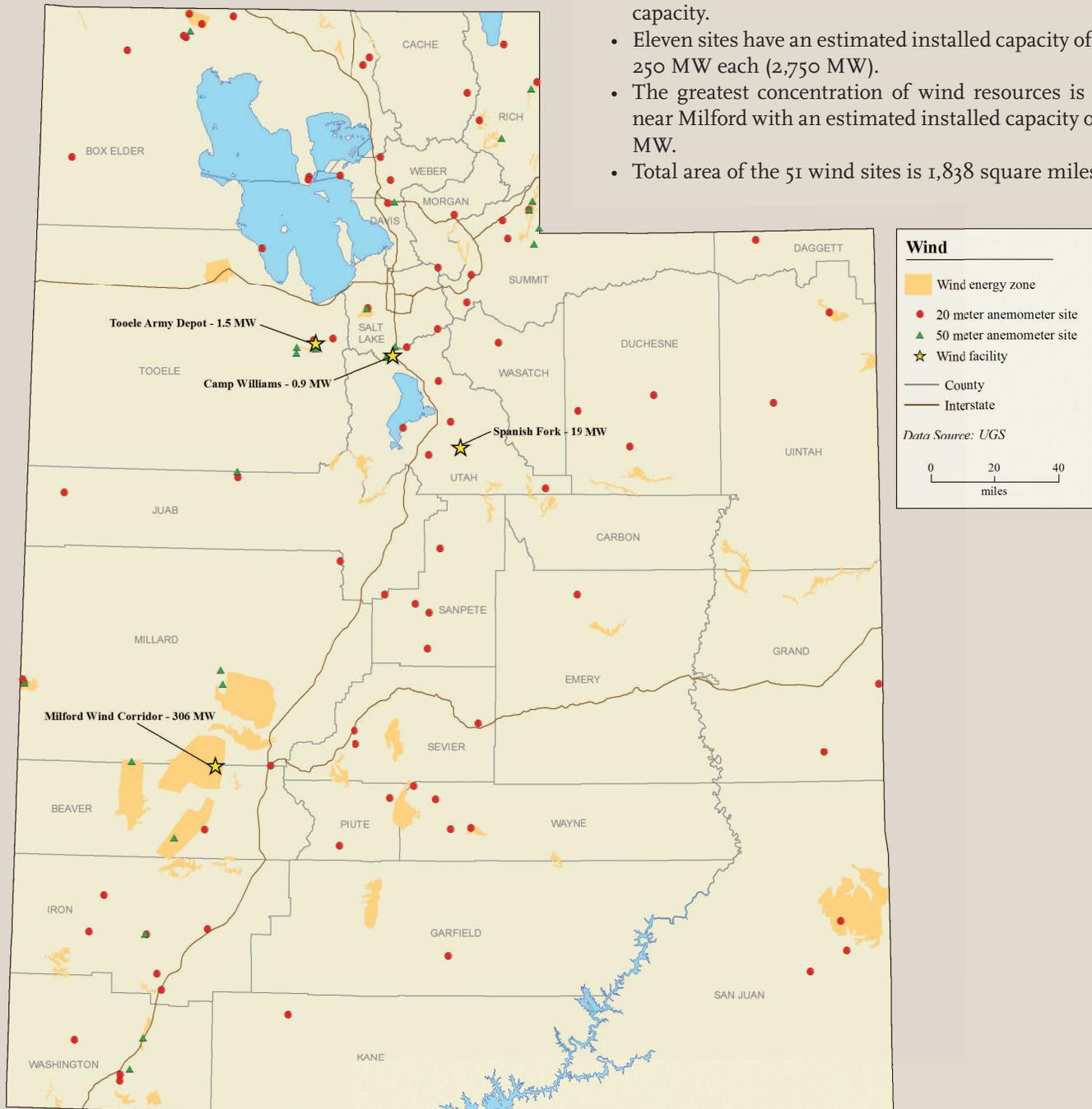
## WIND ASSESSMENT

Utah's extreme diversity in landscape and climate are well known. These factors significantly affect Utah's wind resources. As a result, Utah has a wide array of locations that may be viable options for wind energy development. The resource analysis to identify REZs was based upon wind data collected from 109 anemometer towers stationed throughout the state. The wind resource analysis incorporated several criteria to shape the methodology: (1) screening out environmentally sensitive areas, (2) setting a maximum elevation of 9500 feet, (3) eliminating land too rugged for development, (4) deleting military operating airspace, and (5)

using a proxy wind turbine, General Electric 1.5 sle model, to estimate electrical energy capacity from identified sites.

### Major findings from the wind assessment:

- The combined technical electrical generating potential is approximately 9,145 MW from the 51 wind REZs (orange areas on map).
- The estimated annual average gross capacity factor for the 51 REZ sites is 27.4%.
- Twelve sites have expected gross capacity factors of at least 30%, accounting for 1,830 MW or greater of generating capacity.
- Eleven sites have an estimated installed capacity of at least 250 MW each (2,750 MW).
- The greatest concentration of wind resources is located near Milford with an estimated installed capacity of 2,500 MW.
- Total area of the 51 wind sites is 1,838 square miles.



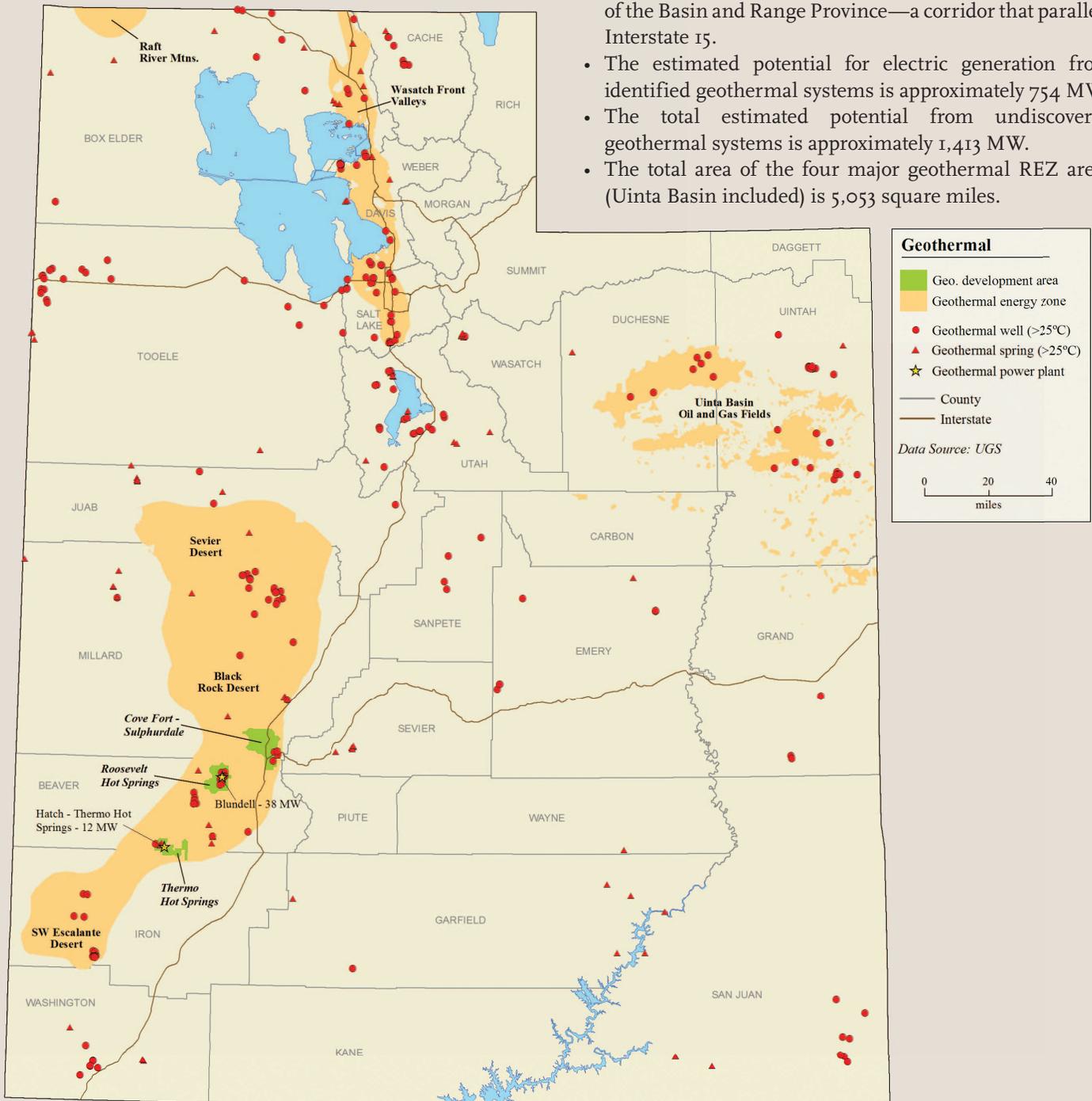
# GEOHERMAL ASSESSMENT

Although a number of geothermal power projects are currently underway, there is a general lack of subsurface drill-hole information for specific resource areas. The effort described here uses published information from various sources, but mostly relies on deep well data and shallow thermal-gradient information. The geothermal analysis incorporated the following criteria to shape the methodology: (1) screening out environmentally sensitive areas not available for development, (2) calculating reservoir volume, and (3) factoring in porosity

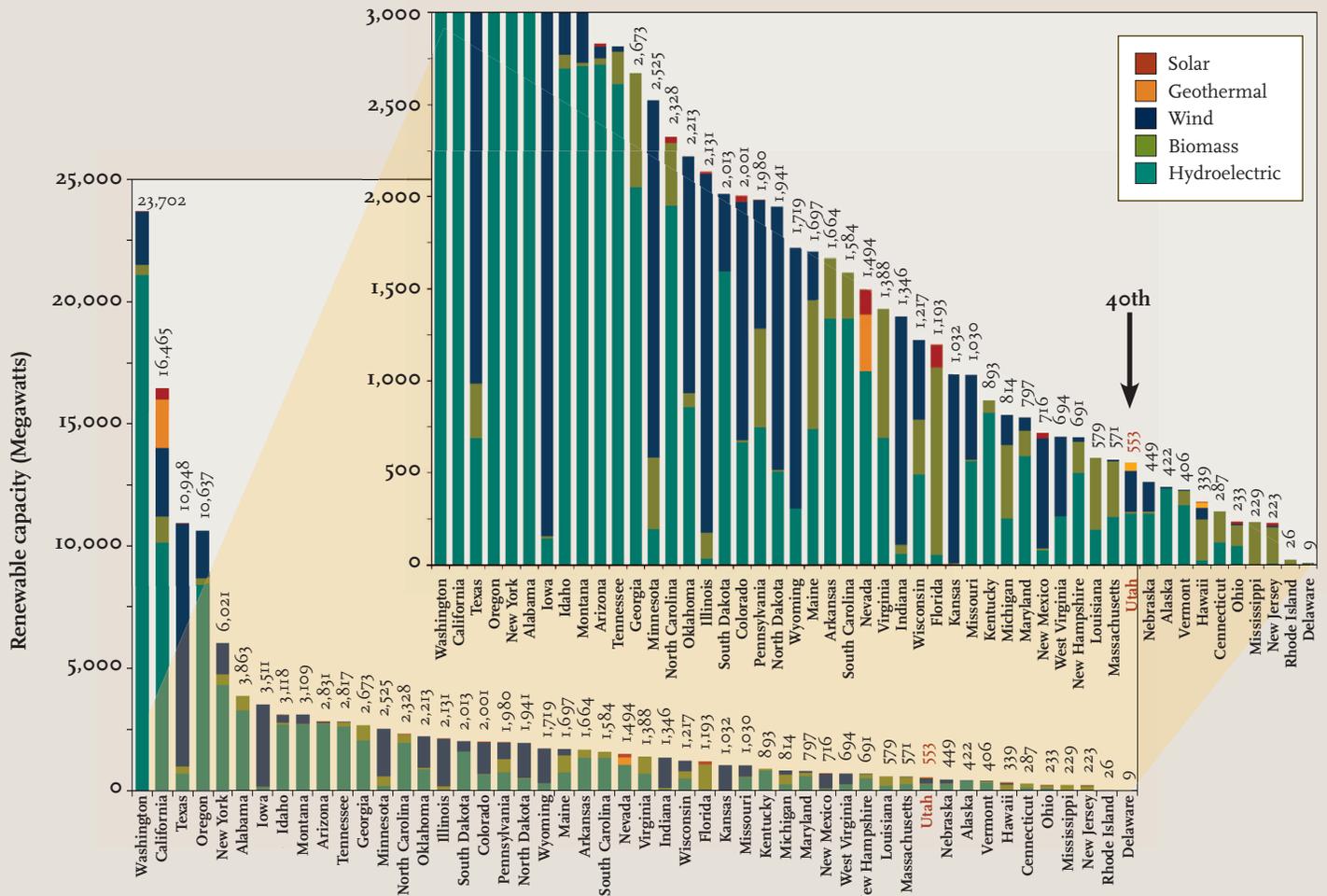
and sweep efficiency, which characterize the ability of the reservoir to transfer heat.

## Major findings from the geothermal assessment:

- A total of 2,166 MW of geothermal development potential exists within the state (orange areas on map).
- Utah's identified higher-quality geothermal resources lie within a 50-mile-wide corridor along the eastern margin of the Basin and Range Province—a corridor that parallels Interstate 15.
- The estimated potential for electric generation from identified geothermal systems is approximately 754 MW.
- The total estimated potential from undiscovered geothermal systems is approximately 1,413 MW.
- The total area of the four major geothermal REZ areas (Uinta Basin included) is 5,053 square miles.



## RENEWABLE NET SUMMER CAPACITY BY ENERGY SOURCE AND STATE, 2010

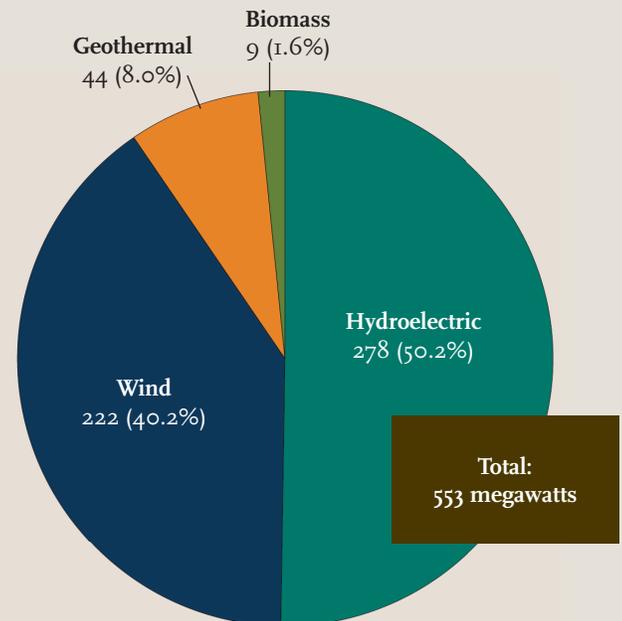


In 2010, Utah ranked 40th in the nation in total renewable net summer electric capacity.

Utah's renewable electric capacity is dominated by 64 hydroelectric plants (the largest being Flaming Gorge at 152 MW) and two wind farms, Milford Phase I (204 MW) and Spanish Fork (19 MW) (Milford Wind Farm Phase II, an additional 102 MW of capacity, came online in mid-2011). The geothermal portion consists of Raser Technology's Hatch/Thermo Hot Springs plant (10 MW) and PacifiCorp's Blundell plant (34 MW), whereas the biomass portion is mainly from Wasatch Front landfill gas operations. The SunSmart solar array in St. George is Utah's first utility-owned solar installation, but at only 0.25 MW capacity, it is too small to be recorded by EIA or in the graphs on this page.

## UTAH'S RENEWABLE NET SUMMER CAPACITY BY ENERGY SOURCE, 2010

Megawatts (Percent of total)

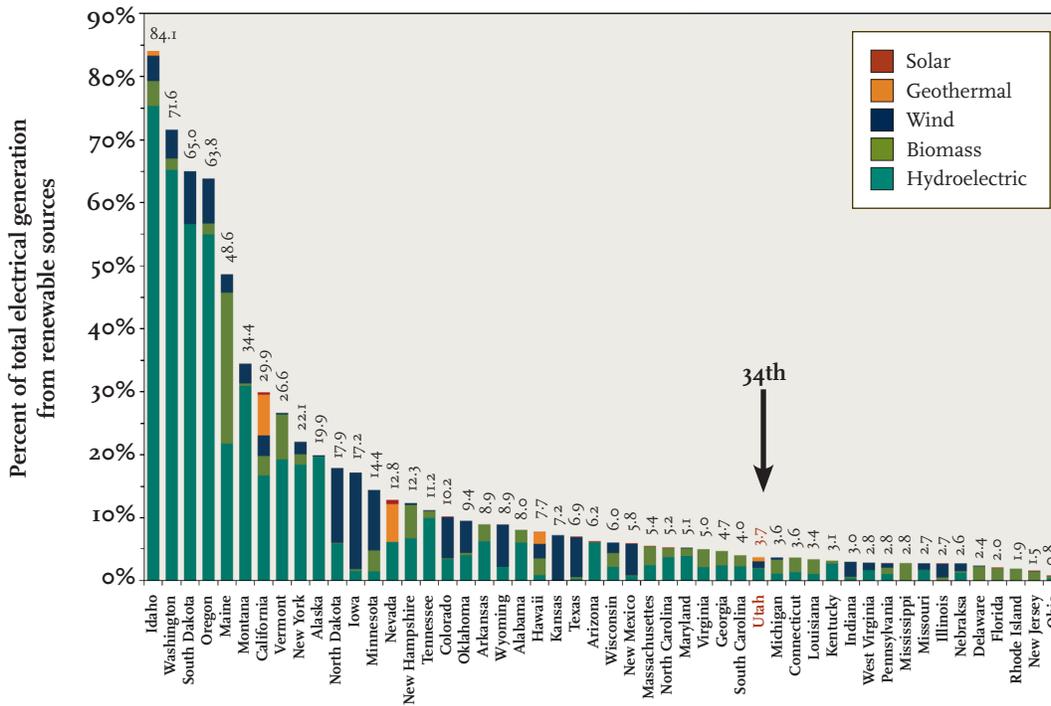


UEMS website table: Table 6.1

Source: EIA, UGS

Note: Only includes utility scale capacity. Milford Wind Farm Phase II (102 MW capacity) came online in mid-2011.

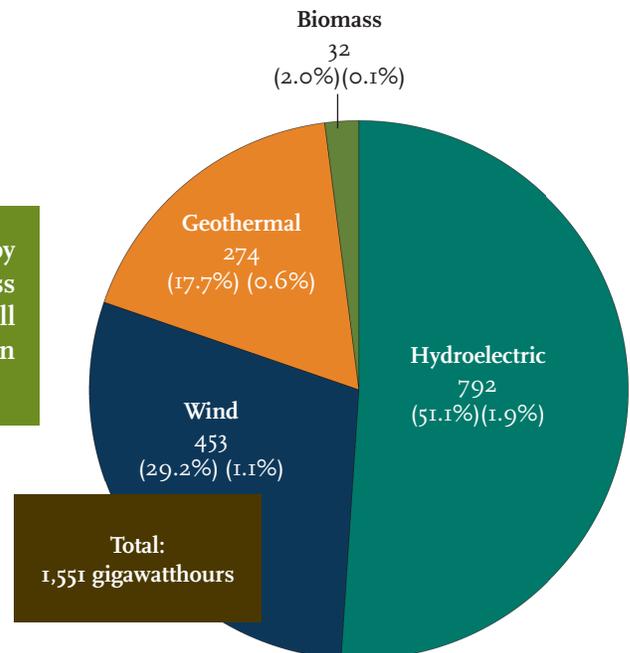
## RENEWABLE ELECTRIC GENERATION BY STATE, 2010



In 2010, Utah ranked 34th in the nation in percent of total net electricity generation from renewable resources. Of particular note, Utah is one of only five states where electricity is generated from geothermal resources.

## RENEWABLE ELECTRIC GENERATION IN UTAH, 2010

Gigawatt-hours  
(Percent of total renewables) (Percent of total net generation)



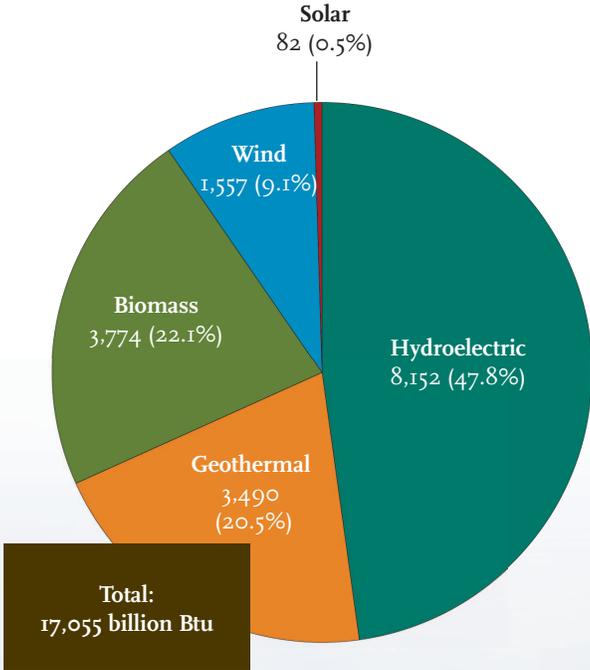
Utah's renewable electric generation is dominated by hydroelectric, wind, and geothermal power. The biomass portion is mainly electricity generated from burning landfill gases. Two smaller scale anaerobic digesters are located in Utah, but are not utility scale.

UEMS website table: Table 6.2  
Source: EIA

# RENEWABLE ENERGY CONSUMPTION IN UTAH

2009

Billion Btu (Percent of total)



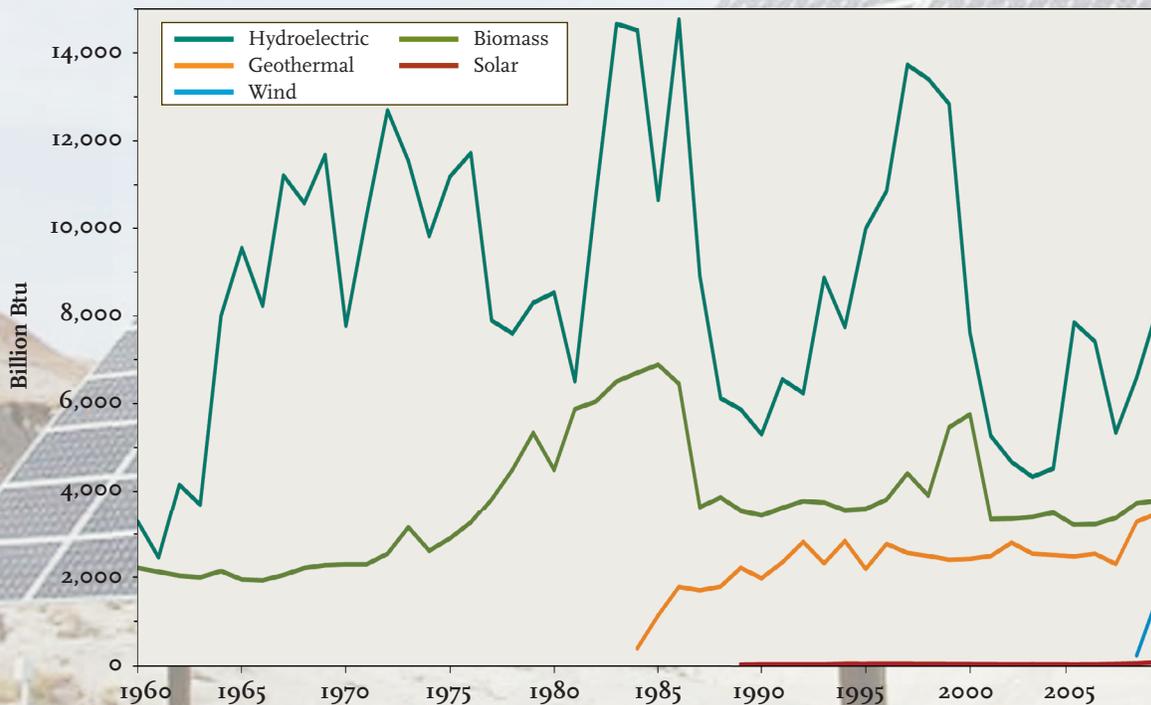
Utah's 2009 consumption of energy from renewable resources is dominated by hydroelectric power generation, followed by geothermal, biomass, and increasingly, wind resources. The very small amounts of solar power generation came from commercial- and residential-scale photovoltaic arrays.

UEMS website table: Table 6.7

Source: EIA

Notes: 2010 data are not yet available; includes the electric utility sector.

1960–2009



# UNCONVENTIONAL PETROLEUM RESOURCES

## OIL SHALE

In 2008, the Utah Geological Survey completed a comprehensive oil shale resource assessment for deposits in the state of Utah. This assessment answers the questions of “where” and “how much” that many people ask regarding Utah’s largest unconventional resource by providing detailed basin-wide resource maps and estimates of in-place shale oil.

- A continuous interval of oil shale that averages **50 gallons of oil per ton of rock (GPT)** contains an in-place resource of **31 billion barrels** of shale oil.
- A continuous interval of oil shale that averages **35 GPT** contains an in-place resource of **76 billion barrels** of shale oil.
- A continuous interval of oil shale that averages **25 GPT** contains an in-place resource of **147 billion barrels** of shale oil (see included map).
- A continuous interval of oil shale that averages **15 GPT** contains an in-place resource of **292 billion barrels** of shale oil.

After calculating in-place resource numbers, the UGS imposed several constraints on the total endowment to offer a more realistic impression of Utah’s potentially economic oil shale resource. The constraints used were:

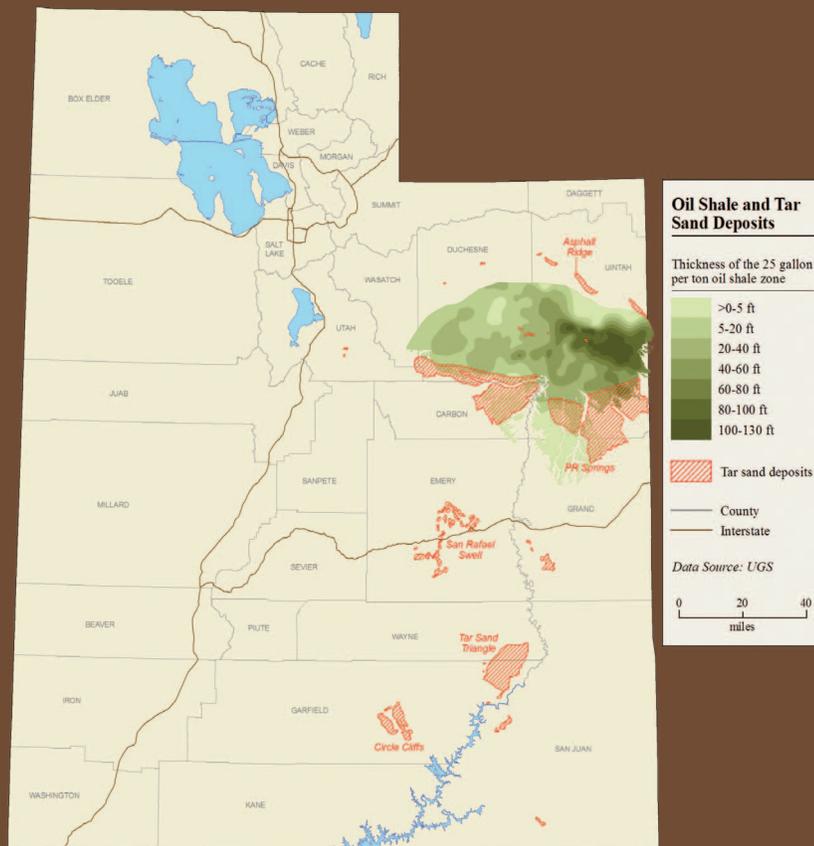
- deposits having a richness of at least 25 GPT (assumed minimum grade),
- deposits that are at least 5 feet thick (assumed minimum mining thickness),
- deposits under less than 3,000 feet of cover (maximum underground mining depth),
- deposits that are not in direct conflict with current conventional oil and gas operations, and
- deposits located only on U.S. Bureau of Land Management, state trust, private, and tribal lands.

Accounting for these constraints, UGS estimates that approximately **77 billion barrels** of shale oil are located in north-central Utah.

Currently, only a handful of companies are pursuing oil shale development in Utah, all focusing on near surface deposits in the southeastern part of the resource.

## TAR SANDS

North America has the greatest tar sand resources in the world, the majority of which are in Canada. Utah’s tar sand resource, though small in comparison to that of Canada, is the largest in the United States. Utah’s tar sand deposits contain 14 to 15 billion barrels of measured in-place oil, with an additional estimated resource of 23 to 28 billion barrels. Twenty-four individual deposits exist in the Uinta Basin, mainly around its periphery, and an



**The most prospective unconventional fossil fuel resources are located in the Uinta Basin in northeastern Utah.**

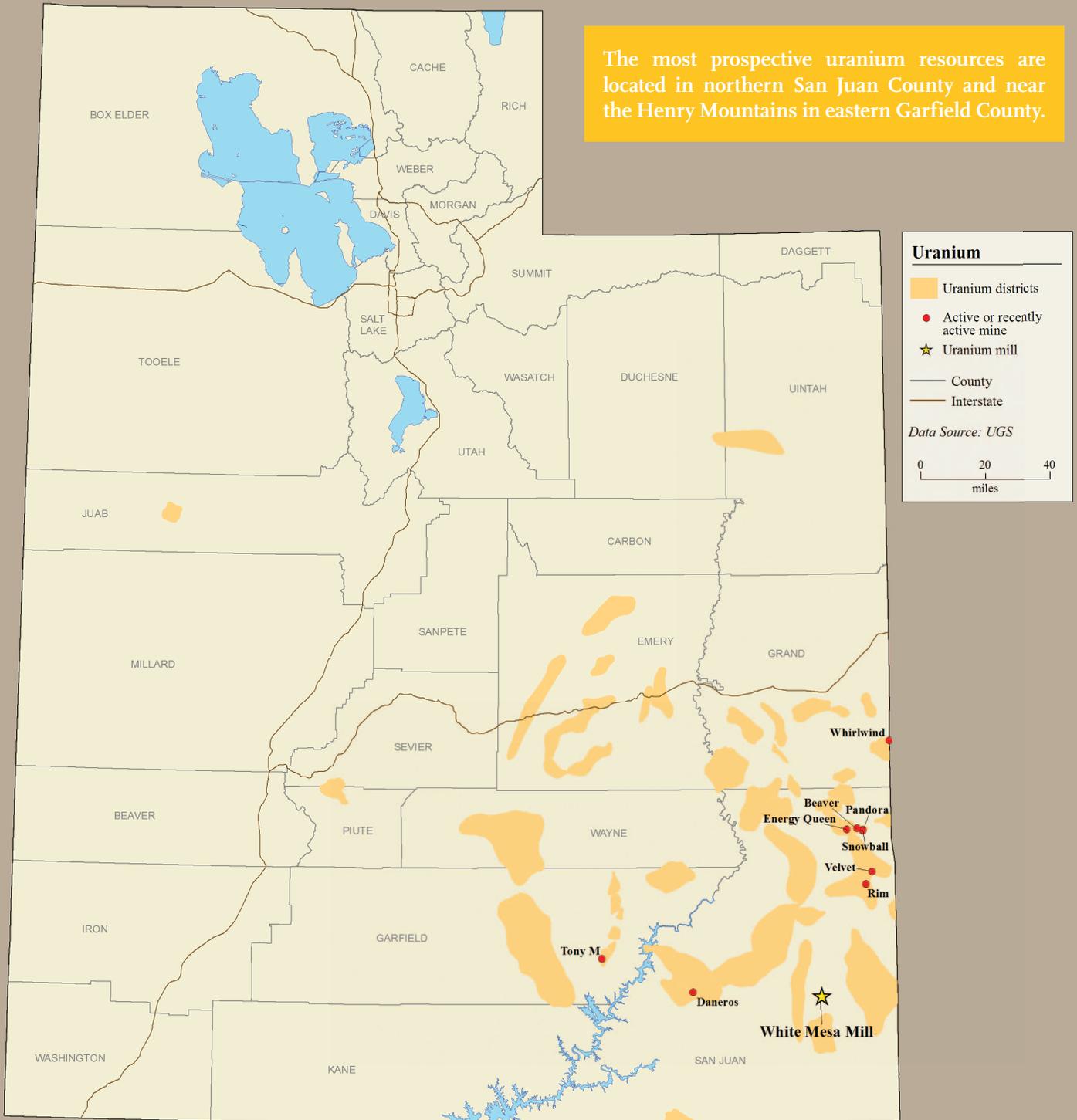
additional 50 deposits are scattered throughout the southeastern part of the state. Utah’s major tar sand deposits individually have areal extents ranging from 20 to over 250 square miles, as many as 13 pay zones, gross thickness ranging from 10 to more than 1000 feet, and overburden thickness ranging from zero to over 500 feet.

With the current high price of crude oil as an incentive, new drilling, bitumen extraction, and upgrading techniques developed in Canada may provide the necessary knowledge for successful and sustainable development of tar sand in Utah in the near future. However, factors such as site accessibility, adequate infrastructure, water availability, environmental concerns, land access and permitting, and the problems associated with the heterogeneity of reservoir sands must be resolved before economically viable tar sand development can become a reality in Utah.

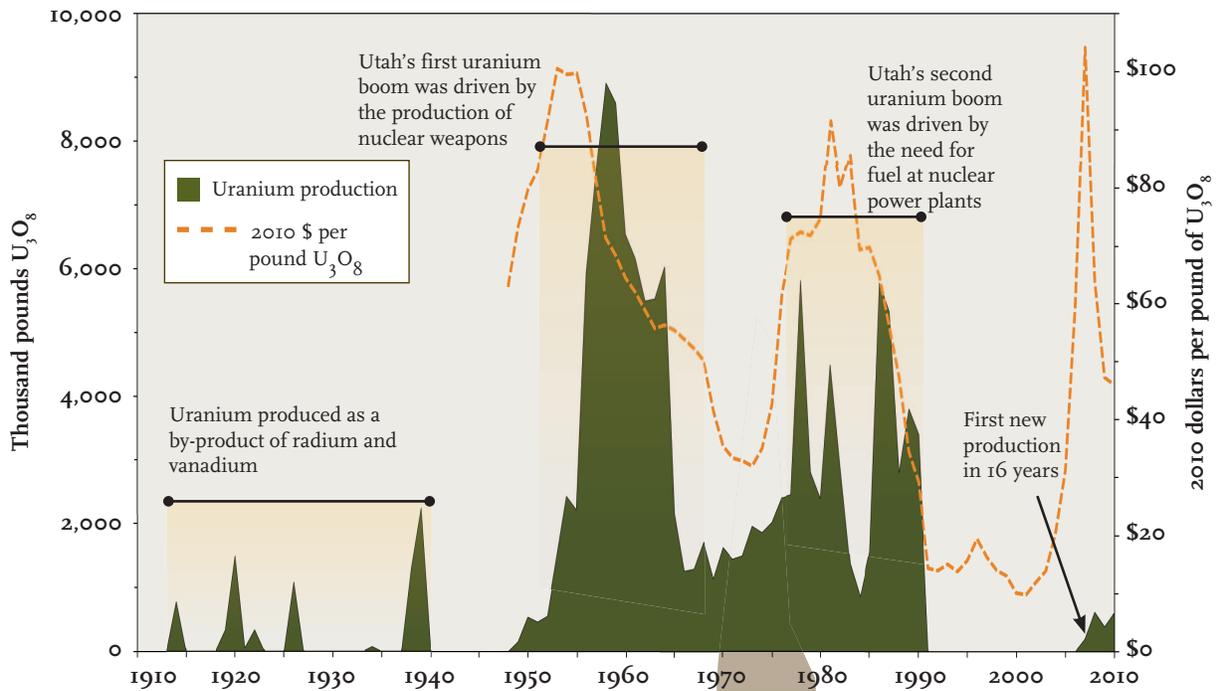
Currently, two companies are researching development of tar sands within the Asphalt Ridge deposit, and one company is looking at possible development in the PR Springs area.

# URANIUM

The most prospective uranium resources are located in northern San Juan County and near the Henry Mountains in eastern Garfield County.



## URANIUM PRODUCTION IN UTAH, 1910–2010

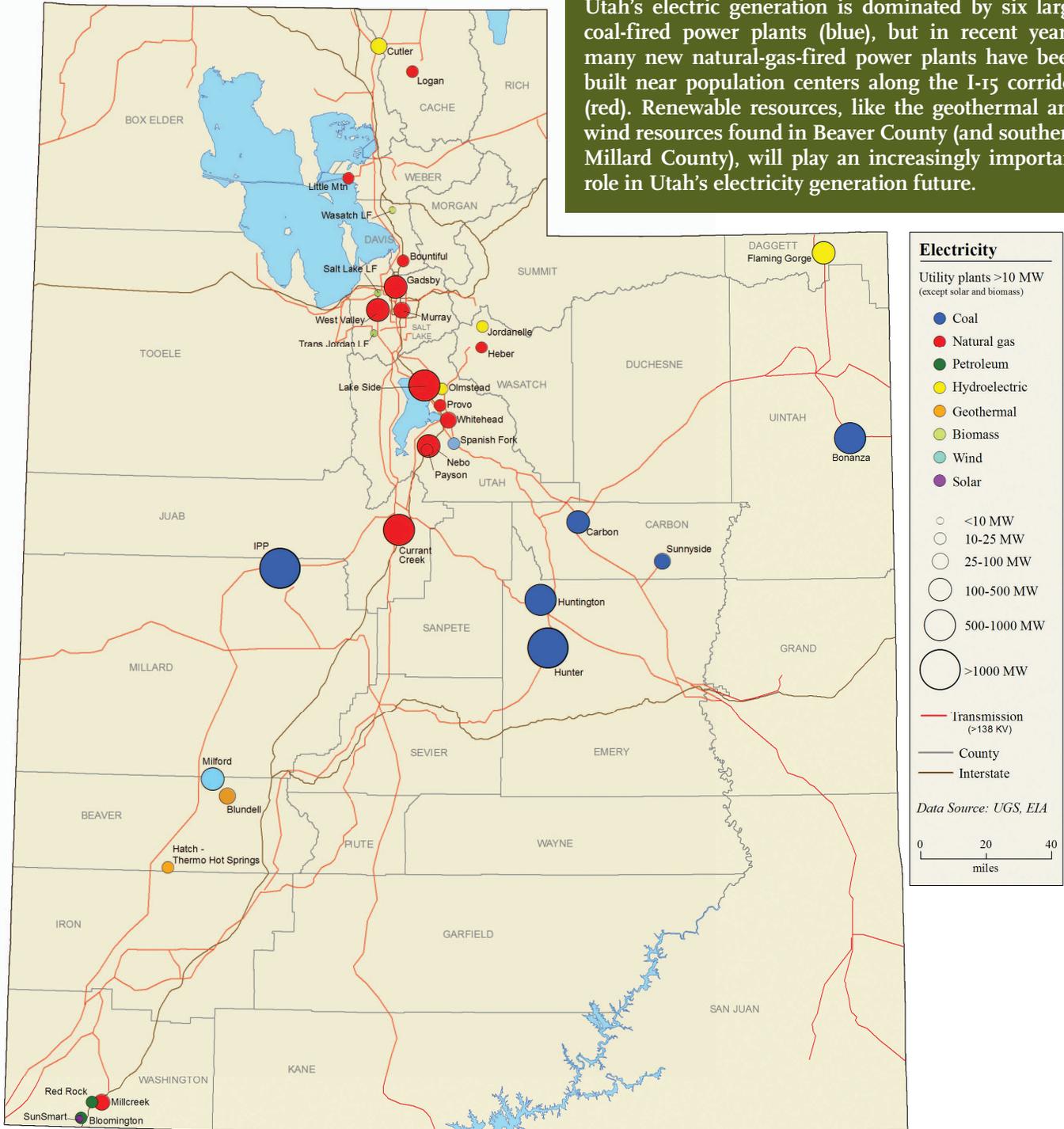


From 1909 to 1940, uranium was produced as a byproduct of first radium, then vanadium. Utah's first big uranium boom started in 1948 when the U.S. Atomic Energy Commission set a guaranteed price and bonus schedule for domestic uranium ore, driven by the requirements of nuclear weapons production. Utah's uranium production grew rapidly during the late-1940s and 1950s, peaking in 1958 at 8.9 million pounds of U<sub>3</sub>O<sub>8</sub> before declining in the mid-1960s. During this time, production occurred at over 500 individual mines. A second period of uranium production began in the early-1970s with the development of the nuclear power industry, peaking in 1978 at 5.8 million pounds U<sub>3</sub>O<sub>8</sub>. Since the mid-1980s, Utah's underground ores had difficulty competing with other lower cost operations, exacerbated by the discovery of very large, high-grade, near-surface uranium ore in Canada and Australia. By 1990, all of Utah's uranium production had ceased and within a few years there were no longer any underground uranium mines operating in the United States. Beginning in 2004, the price of uranium began to rise, reaching an inflation-adjusted record high of \$104 per pound in 2007. This resurgence in uranium price resulted in the reopening of several Utah uranium mines which produced 613,000 pounds in 2010. In addition, the White Mesa uranium mill, located outside of Blanding, Utah, once again began processing uranium ore.

UEMS website table: Table 9.1  
 Source: EIA, UGS

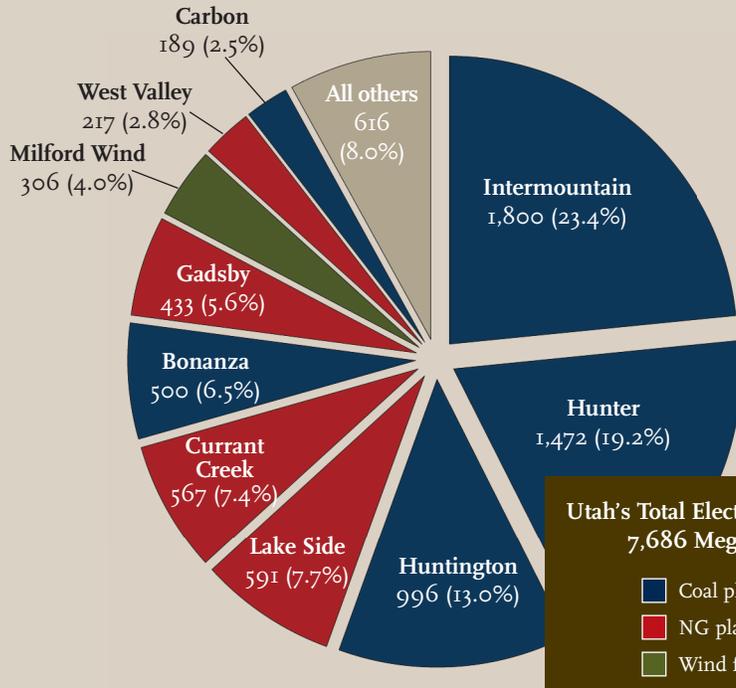
# ELECTRICITY

Utah's electric generation is dominated by six large coal-fired power plants (blue), but in recent years, many new natural-gas-fired power plants have been built near population centers along the I-15 corridor (red). Renewable resources, like the geothermal and wind resources found in Beaver County (and southern Millard County), will play an increasingly important role in Utah's electricity generation future.



## UTAH'S 10 LARGEST POWER PLANTS

Capacity in megawatts (Percent of total)



Utah's electricity portfolio is dominated by coal-fired power plants. However, several new natural gas plants have been built in the past nine years (Lake Side – 2007, Currant Creek – 2005–2006, West Valley – 2002, and three new units at Gadsby – 2002) decreasing the reliance on coal generation. Also, the newly constructed Milford wind farm has added 306 MW of renewable capacity to Utah's energy mix.

UEMS website table: Table 5.1  
Source: EIA  
Note: Only includes utility plants.

Utah's Total Electric Capacity:  
7,686 Megawatts

- Coal plant
- NG plant
- Wind farm

Fossil Fuels:  
7,025 MW (91.4%)  
Renewable sources:  
661 MW (8.6%)

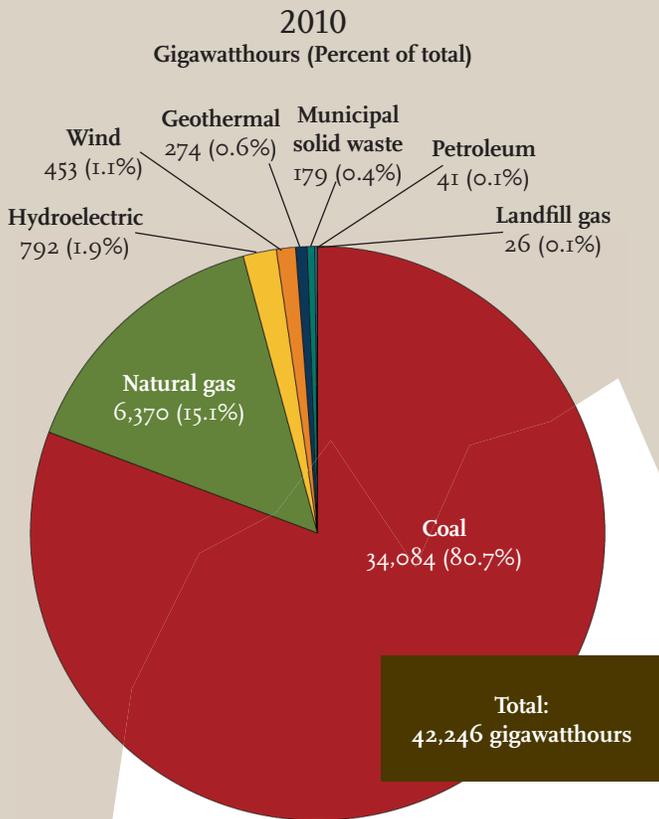
## U.S. ELECTRICITY GENERATION BY STATE, 2010



Utah's total net generation of electricity ranked 35th in the nation in 2010.

UEMS website table:  
Table 5.9  
Source: EIA  
Note: 2010 data are preliminary, includes District of Columbia.

# NET GENERATION OF ELECTRICITY IN UTAH BY ENERGY SOURCE

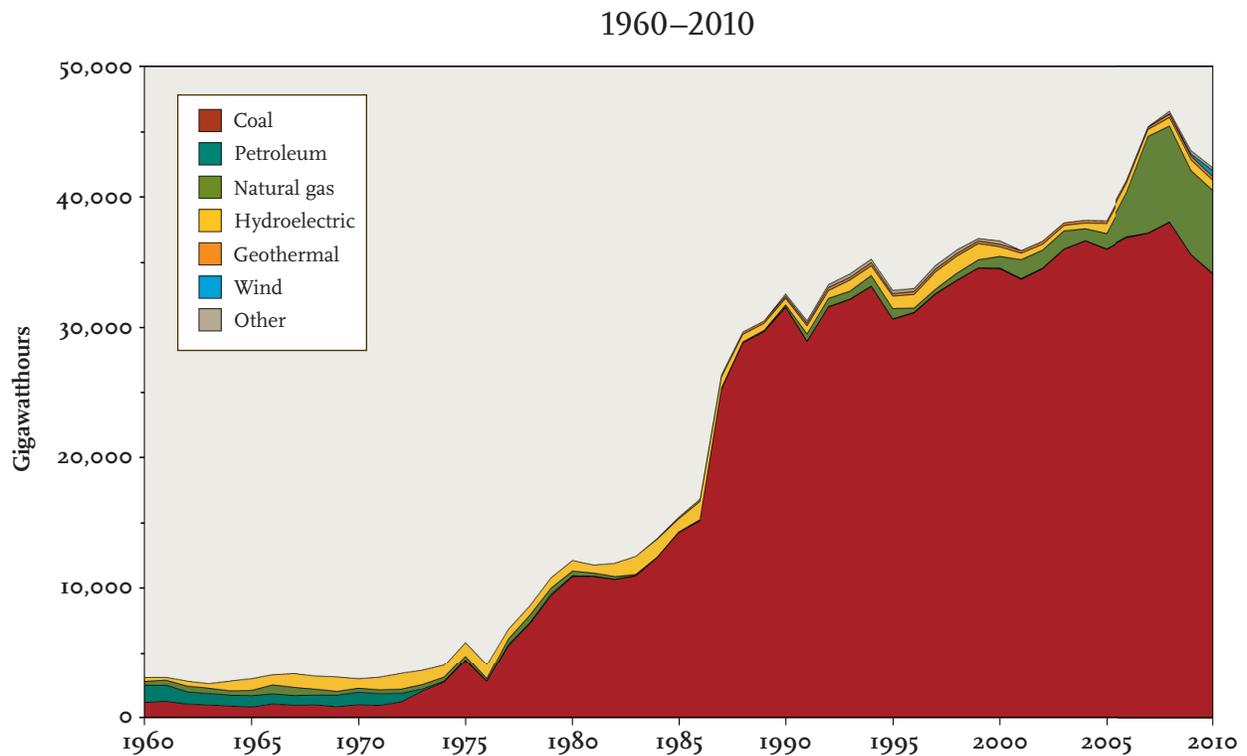


Coal has dominated Utah's electricity generation portfolio, accounting for 94.2% of Utah's total net generation in 2005. However, since 2004, 1338 megawatts of new natural-gas-fired electric capacity were built, decreasing coal's overall share to 80.7% in 2010 and increasing natural gas's share to 15.1%. Utah's share of electricity generated from renewable resources has jumped to 3.7% with the recent addition of the 306-megawatt Milford wind farm.

UEMS website table: Table 5.10

Source: EIA

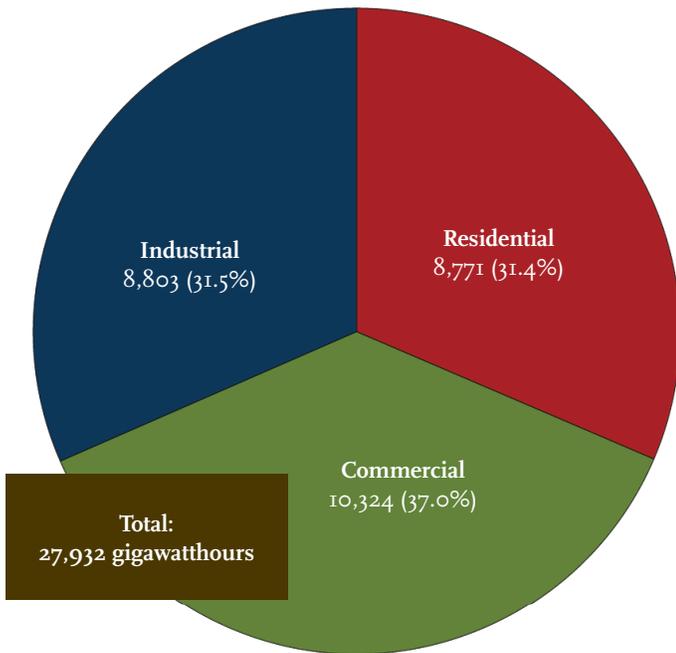
Notes: 2010 data are preliminary; "Other" includes municipal solid waste, landfill gas, and other gases derived from fossil fuels.



# SALES OF ELECTRICITY IN UTAH BY SECTOR

2010

Gigawatthours (Percent of total)



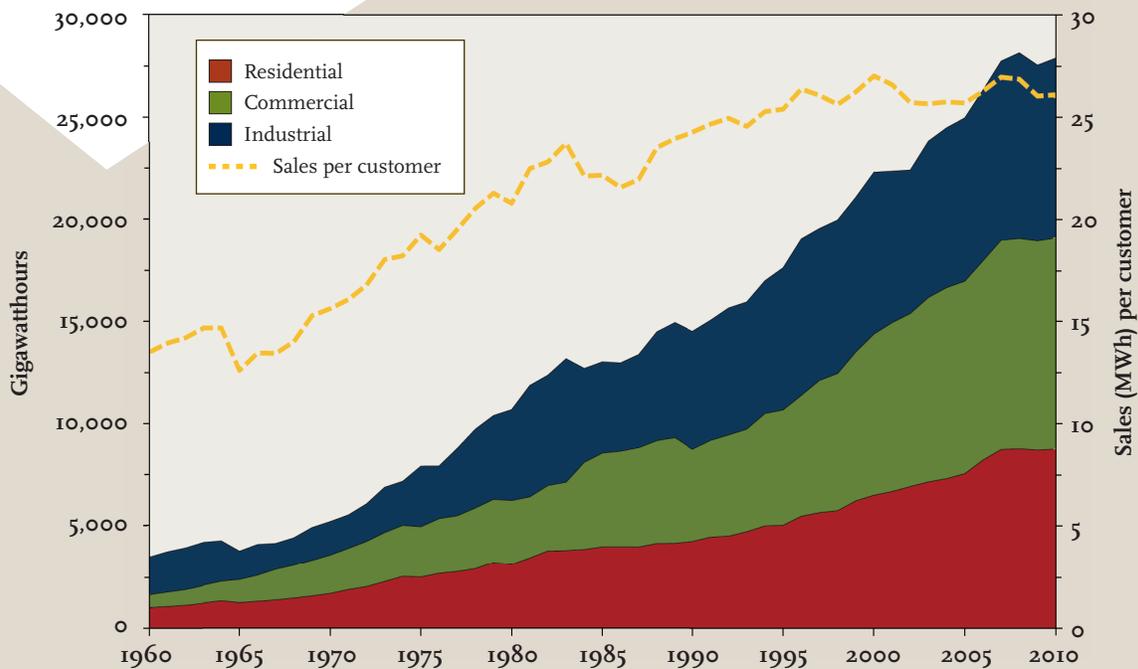
Electricity sales in Utah have averaged a 4.3% increase each year since 1960, roughly following increases in population (an average increase of 2.3% per year) and increases in per customer electricity use (an average increase of 1.4% per year). In 1960, each customer in Utah used about 13 MWh every year. Currently, the average customer usage has doubled to 26 MWh per year.

UEMS website table: Table 5.19

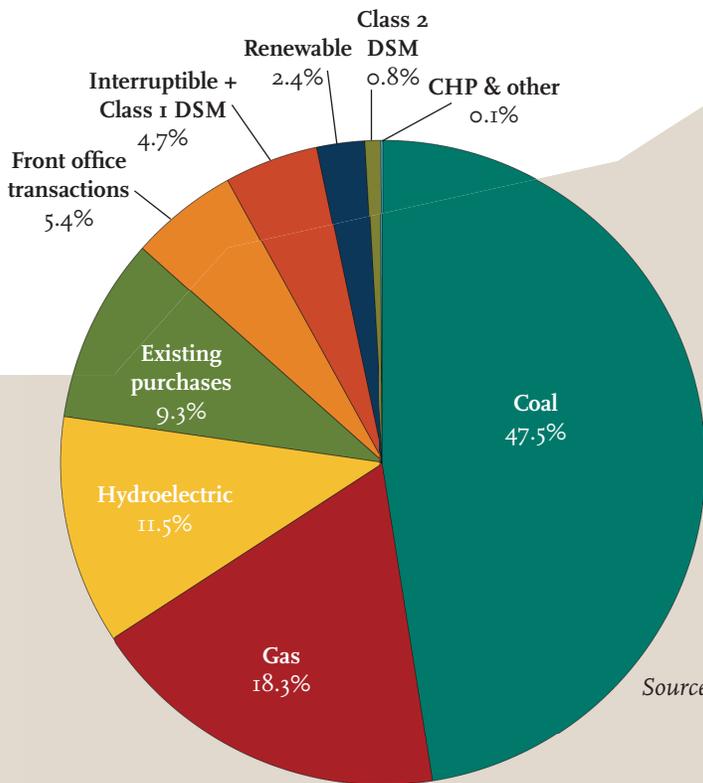
Source: EIA

Notes: 2010 data are preliminary; electricity used by the transportation sector (UTA transit) is very small (34 GWh in 2010) and is not shown on the graphs.

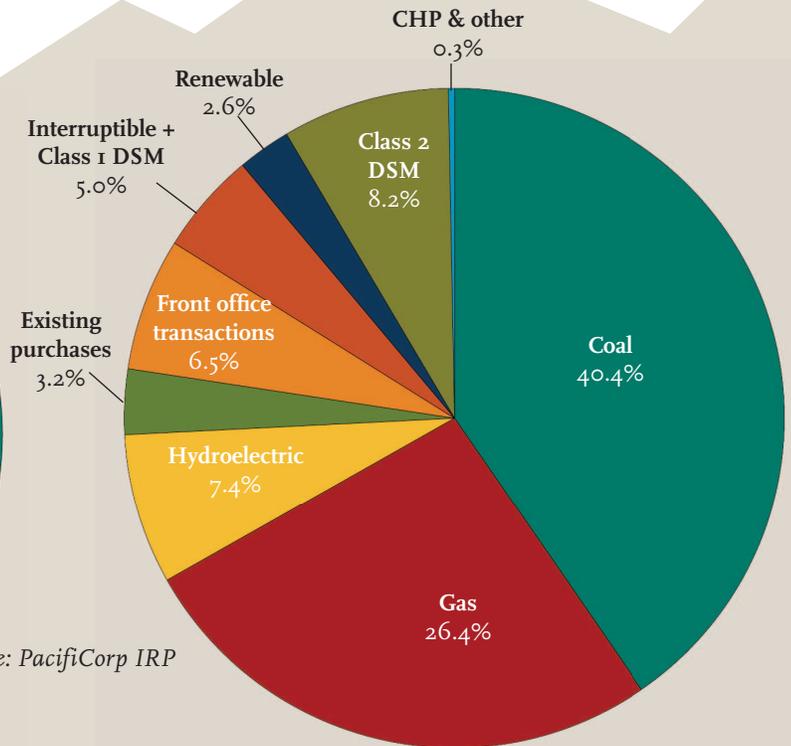
1960–2010



## PACIFICORP'S 2011 RESOURCE ENERGY MIX



## PACIFICORP'S 2020 PROJECTED RESOURCE ENERGY MIX



Source: PacifiCorp IRP

Utah's net generation portfolio shows the fuel used to generate electricity at power plants in Utah; however, it is not a reliable indicator of the source of the electricity Utahns actually use since much of the electricity generated in Utah travels out of state (e.g., about 75% of the electricity generated at IPP is consumed in California). The source of electricity at the customer's outlet can be estimated based on PacifiCorp's (Utah's largest electricity provider) resource energy mix. For example, in 2011, PacifiCorp customers can assume that 2.4% of the electricity they consume was generated by renewable resources such as wind, solar, or geothermal and that 11.5% comes from hydroelectric sources.

CHP: Combined heat and power

Class 1 DSM: Demand side management (i.e., energy efficiency measures) – Class 1 programs are those for which capacity savings occur as a result of active company control or advanced scheduling. Once customers agree to participate in Class 1 DSM program, the timing and persistence of the load reduction is involuntary on their part within the agreed limits and parameters of the program. In most cases, loads are shifted rather than avoided.

Class 2 DSM: Demand side management (i.e., energy efficiency measures) – Class 2 programs are those for which sustainable energy and capacity savings are achieved through facilitation of technological advancements in equipment, appliances, lighting, and structures. Class 2 programs generally provide financial and/or service incentives to customers to replace equipment and appliances in existing customer owned facilities (or to upgrade in new construction) to more efficient lighting, motors, air conditioners, insulation levels, windows, etc. Savings will endure over the life of the improvement.

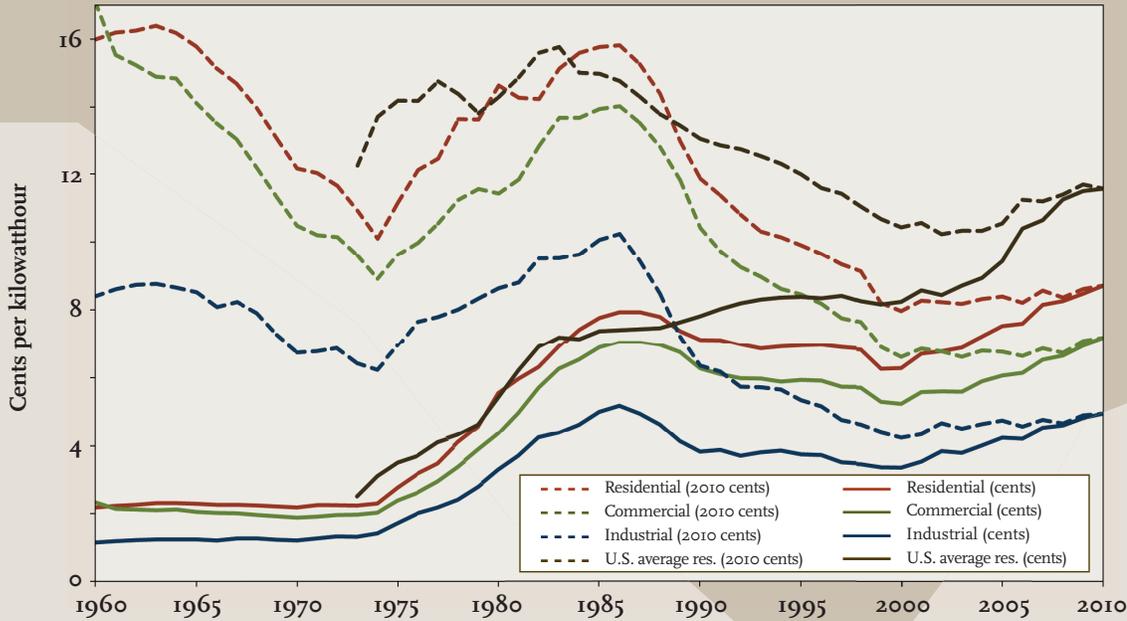
Existing Purchases: Power purchase agreements, PURPA qualified facilities (may include renewables).

Front Office Transactions: Proxy resources that represent procurement activity made on an annual forward basis to help the company cover short positions (i.e., spot market purchases, which may include renewables).

Interruptible: Directly curtailed loads

Renewable: Wind, geothermal, and solar

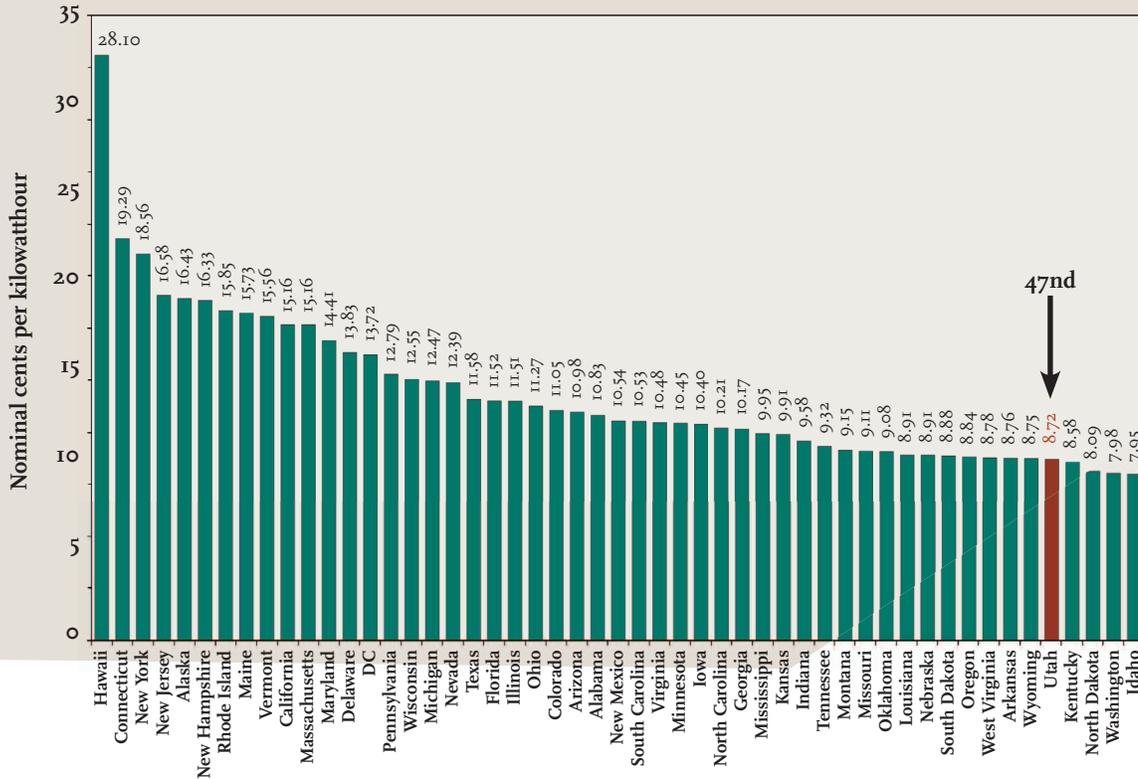
## PRICE OF ELECTRICITY IN UTAH BY SECTOR, 1960–2010



UEMS website table:  
Table 5.20  
Source: EIA  
Note: 2010 data are preliminary.

The price of electricity in Utah has generally decreased (when examining inflation-adjusted prices) over the years, with an average residential price of 8.7 cents per kilowatthour in 2010. Since 1989, Utah's residential price of electricity has been below the national average, with a steadily widening gap through the years (Utah's residential electricity price was 2.9 cents per kilowatthour less than the national average in 2010).

## AVERAGE RESIDENTIAL PRICE OF ELECTRICITY BY STATE, 2010

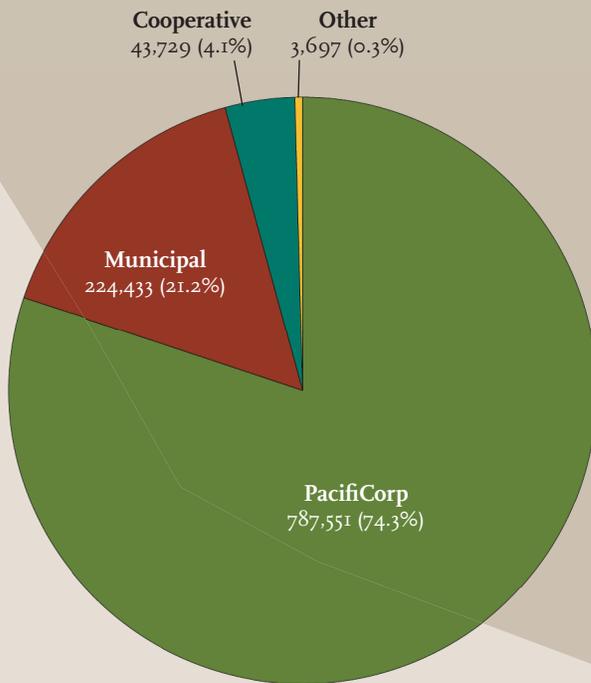


UEMS website table:  
Table 5.21  
Source: EIA  
Notes: 2010 data are preliminary;  
includes District of Columbia.

Utah's average price of residential electricity ranked 5th lowest in the nation in 2010 because of Utah's fully amortized coal-fired generation.

## ELECTRIC UTILITY CUSTOMERS IN UTAH BY CLASS OF OWNERSHIP, 2009

# of customers (Percent of total)



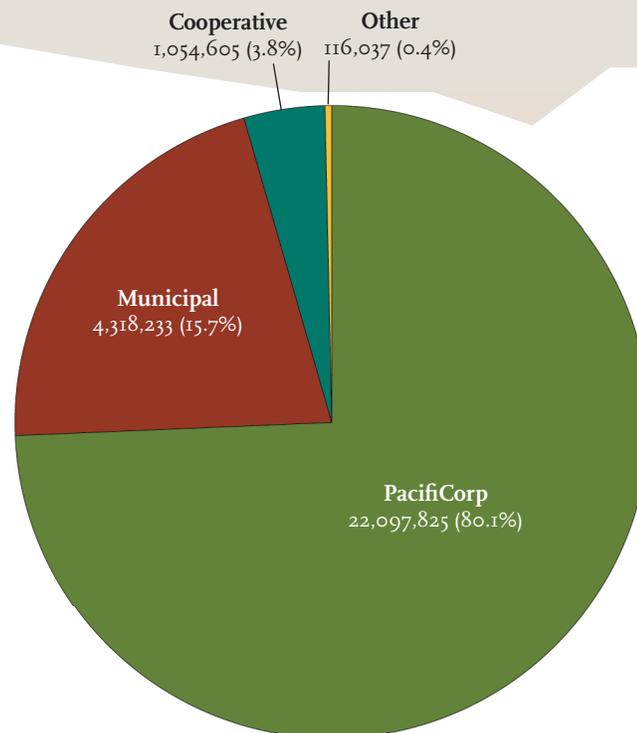
The majority of electricity in Utah is provided by PacifiCorp, supplying 74% of Utah customers and accounting for 80% of in-state sales. Thirty-eight municipal-owned utilities provide the next-largest contribution, followed by nine cooperative electric utilities.

UEMS website table: Table 5.24  
Source: EIA

Notes: 2010 data are not yet available; "Other" includes state, political subdivision, and federal.

## ELECTRIC UTILITY SALES IN UTAH BY CLASS OF OWNERSHIP, 2009

Megawatthours (Percent of total)



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