Utah's Energy Landscape

4th Edition

by Michael D. Vanden Berg









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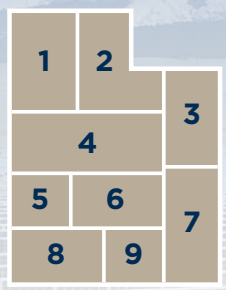

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Background photo: Milford 2 solar farm, Beaver County.

INTRODUCTION

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 oil shale and oil sand resources. This publication, *Utah's Energy Landscape*, now in its fourth edition, was created to offer a complete, visually-based description of Utah's diverse energy portfolio.

The graphs 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), the Utah Division of Oil, Gas, and Mining (DOGM), the Governor's Office of Energy Development (OED), and the Utah State Tax Commission, as well as surveys and conversations with individuals and companies.

Utah Energy and Mineral Statistics (UEMS) is a web-based data repository located on the UGS website and contains all the energy data used to create the graphs 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/resources/energy/utah-energy-and-mineral-statistics/

SUMMARY

Two recent events have dominated Utah's energy scene in the past few years: 1) the collapse of crude oil prices due to a worldwide oversupply, and 2) the exponential increase in both utility-scale and residential PV (photovoltaic) solar capacity. First, Utah's crude oil price dropped from a high of about $100 per barrel in the summer of 2014 to a low of about $30 in late 2015, with prices dipping to $20 a barrel in early 2016. Consequently, the number of drilling rigs in Utah decreased from about 23 in late 2014, down to 3 rigs in late 2015, and finally down to zero in early March 2016. Since new oil wells are not being drilled to make up for production declines at existing wells, crude oil production in the state decreased nearly 10% in 2015 and is projected to continue to decline as long as prices remain low and rigs remain idled. Similarly, natural gas prices (down 43%) and production (down 7%) have also decreased due to oversupply from the country's prolific shale reservoirs. Second, in 2015, 166 MW of new utility-scale solar capacity was installed in southwestern Utah and nearly 680 MW is currently under construction or in development. By 2017, nearly 850 MW of new solar capacity will be online, more than wind, hydroelectric, geothermal, and biomass combined. This surge in solar was also seen in the residential sector; the total number of renewable energy tax credits filed in Utah has grown exponentially in the past 6 years, from only 153 in 2009 to 3,174 in 2015, of which 94% were for residential PV.

Additionally, coal production in Utah is at a 30-year low as out-of-state demand, especially in Nevada and California, diminishes as coal plants convert to natural gas or close. Production of electricity in Utah also decreased slightly (4%) in 2015, while Utah's 2015 average cost of electricity remained well below the national average, mainly due to our reliance on established, low-cost, coal-fired generation. Consumption of petroleum products is expected to increase in 2015, possibly as a result of lower gasoline and diesel prices, while natural gas and electricity consumption dropped in 2015 due to mild winter and summer weather. Utah will continue to be a net-exporter of energy by producing more natural gas, coal, and electricity than is used in-state, but will remain reliant on other states and Canada to satisfy our demand for crude oil and petroleum products.

OUTLOOK

Production and Consumption. With the dramatic decline in the price of crude oil, and without enough rigs drilling new wells to offset steep production declines at existing wells, Utah crude oil production will continue to decrease in 2016, possibly by another 20%. In contrast, demand for petroleum products in Utah should continue its upward trend as the economy continues to improve and as prices for motor gasoline hover near $2 a gallon. Utah's natural gas production will follow a downward trend similar to crude oil, possibly dropping another 10 to 12%, as many drilling rigs are idled and the price for natural gas remains between $2 and $3 per Mcf (prices in early 2016 briefly dipped below $1.50 per Mcf, but are expected to rebound above $2). Currently no firm plans exist for the construction of additional natural-gas-fired power plants in Utah, so consumption should remain relatively steady depending on the severity of the heating and cooling seasons. Coal production in Utah is expected to remain in the

14 to 15 million tons per year range for the near future, as in-state demand remains steady and out-of-state demand continues to be weak. Production could increase if new foreign coal export markets are established. Electricity generation is expected to gradually increase in the next few years as population continues to grow and electricity consumption per capita continues to increase. Renewable energy generation in Utah continues to climb with the addition of the new Latigo wind farm (62 MW) near Monticello and, as stated above, the addition of nearly 850 MW of new utility-scale solar capacity.

Prices. Crude oil prices decreased a dramatic 50% in 2015 to an average of about $40 per barrel for the year. In early 2016, crude oil in Utah was selling for only about $20 per barrel, but was starting to rebound (back to over $35 per barrel) at the time of this writing (mid-April 2016). How long these low prices will persist is unknown, but most estimates indicate low prices for the next several years as worldwide supply continues to outpace demand. Similar to crude oil, the price of natural gas decreased 43% in 2015 to an average of $2.47 per Mcf, and early 2016 prices dropped below $1.50 per Mcf due to mild winter weather. The price of natural gas is also expected to remain low throughout 2016 as gas supplies continue to exceed demand. Utah's mine-mouth coal price is expected to remain steady as demand stabilizes and should average about $35 per ton in coming years. With regard to electricity, Utah's well established coal-fired power plants will assure affordable, reliable electric power for the foreseeable future and help keep Utah's electricity prices nearly 15% below the national average.

ENERGY HIGHLIGHTS

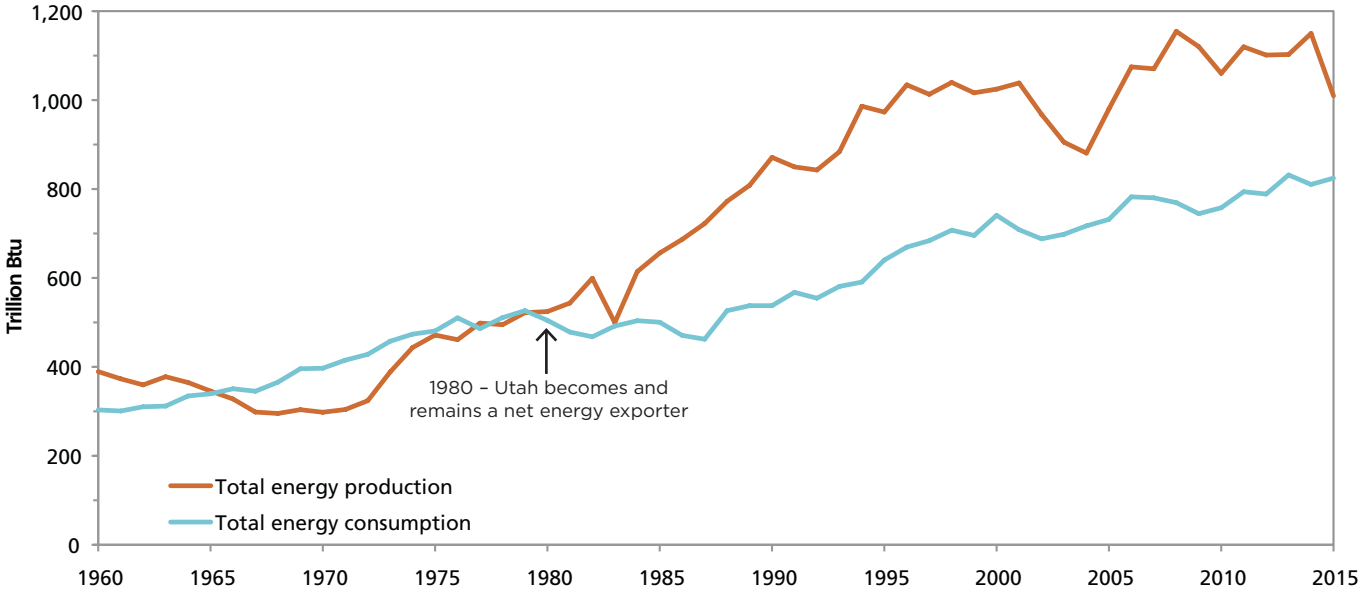
- **Overview**: The largest source of annual energy production in Utah is from natural gas, which surpassed coal for the first time in Utah's history in 2010 (page 4).
- **Economics**: The value of Utah's energy-related production was only $3.1 billion in 2015, half of the 2014 total due to lower prices and lower production (page 7).
- **Economics**: Wages for energy-related jobs are nearly double the average annual wage for all employment in Utah (page 9).
- **Renewables**: Utah's largest utility-scale solar facility, Red Hills in Iron County, was installed in 2015 adding 80 MW of renewable energy capacity to Utah's electric generation portfolio. Nearly 850 MW of new utility-scale solar capacity is expected to be installed by 2017 (page 12).
- **Renewables**: Utah is one of only seven states to produce electricity from geothermal sources (page 14).
- **Coal**: Utah coal production in 2015 was down to 14.4 million tons, a level not seen since 1986 (page 19).
- **Crude oil and natural gas**: In 2015, there were only 305 oil and gas well completions in Utah, down significantly from the average of 944 per year over the past 10 years, but still higher than the 274 wells per year averaged throughout the 1990s (page 23).
- **Crude oil**: Utah refineries received record amounts of crude oil in 2014 and only slightly less in 2015, with 43% coming from in-state and 8% coming from Canada (page 26).
- **Crude oil**: The value of crude oil produced in Utah reached an all-time inflation-adjusted high of $3.2 billion in 2014, but then dropped to only $1.5 billion in 2015 (page 28).
- **Natural gas**: Natural gas production in Utah reached a record high in 2012 of 491 billion cubic feet, but has since dropped to 423 billion cubic feet in 2015 (page 31).
- **Natural gas**: Utah's average price of residential natural gas in 2015 was $9.72 per thousand cubic feet, the 17th lowest in the nation (page 33). As recently as 2011, Utah's price was the third lowest in the nation, but new natural gas pipelines have better connected our once captive market with the rest of the United States.
- **Electricity**: In 2015, 76% of the electricity generated in Utah was from coal-burning power plants. Electricity generation from natural-gas power plants more than doubled since 2007, increasing its total share in 2015 to 19% (page 39).
- **Electricity**: Since 1960, electricity sales in Utah increased at an average annual rate of 4.1% (page 40).
- **Electricity**: Utah's average price of residential electricity in 2015 was 11 cents per kWh, the 15th lowest in the nation and 13% lower than the national average (page 41).

Background photo: Book Cliffs outside Price, UT

overview

Utah Energy Balance

Production and Consumption, 1960–2015



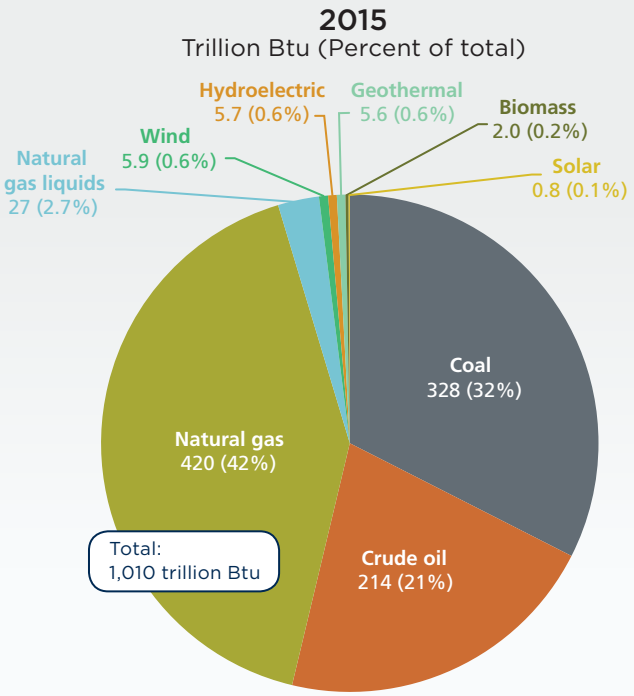
UEMS website table: Table 1.4 | Source: EIA, UGS

Note: Consumption data for 2015 are estimated. Production data for 2015 are preliminary.

Utah produced 18% more energy than it consumed in 2015, continuing its status as a net-energy exporter. This percentage is usually closer to 30%, but production of fossil fuels was significantly down in 2015. The majority of the excess energy was in the form of exported natural gas. Utah also exports significant amounts of electricity, produced from both fossil fuels and renewable sources.

Department of Natural Resources solar array

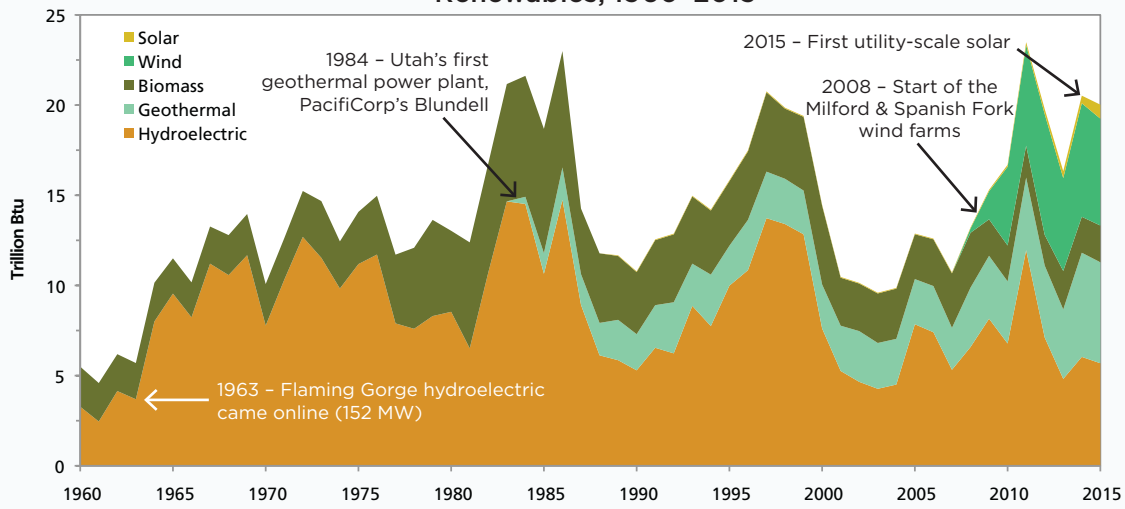
Energy Production in Utah by Source



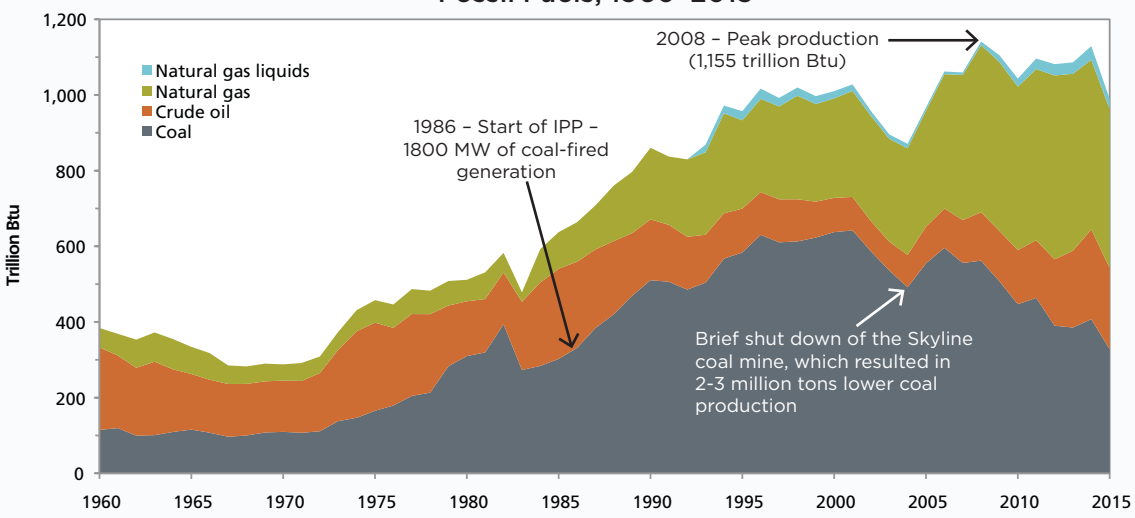
Fossil fuels made up 98% of Utah's total energy production in 2015, while renewable sources accounted for only 2% of Utah's production portfolio. Coal has historically dominated Utah's energy production (in terms of Btu), but starting in 2010, natural gas became the dominant annual energy production source. Renewable energy has historically been dominated by hydroelectric power, but recently geothermal and wind have grown in significance. Utility-scale solar came online in 2015 and is expected to become the dominant renewable energy source in the near future as over 1 gigawatt of new capacity is in development; more capacity than present hydroelectric, geothermal, and wind combined.

UEMS website table: Table 1.8 | Source: EIA, UGS
Note: Natural gas liquids included with natural gas prior to 1993.
IPP = Intermountain Power Plant. 2015 data are preliminary.

Renewables, 1960–2015

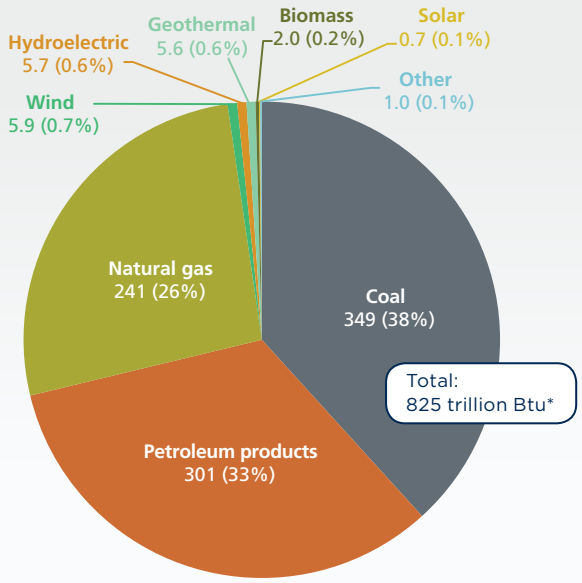


Fossil Fuels, 1960–2015



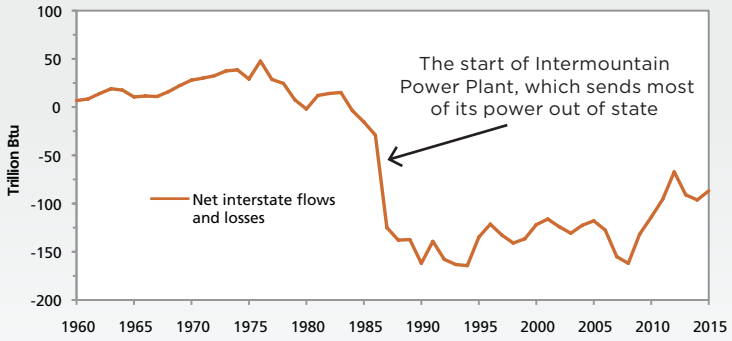
Energy Consumption in Utah by Source

2015
Trillion Btu (Percent of total)



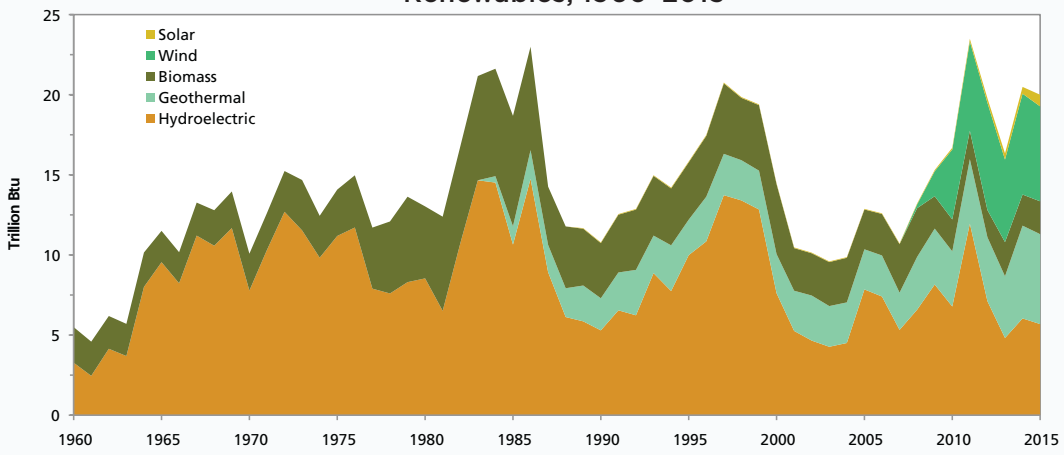
*Total includes net interstate flows and losses. Net interstate flow of electricity is the difference between the amount of energy in the electricity sold within a state (including associated losses) and the energy input at the electric utilities within the state. A positive number indicates that more 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.

Net Interstate Electricity
Flows and Losses in Utah, 1960–2015

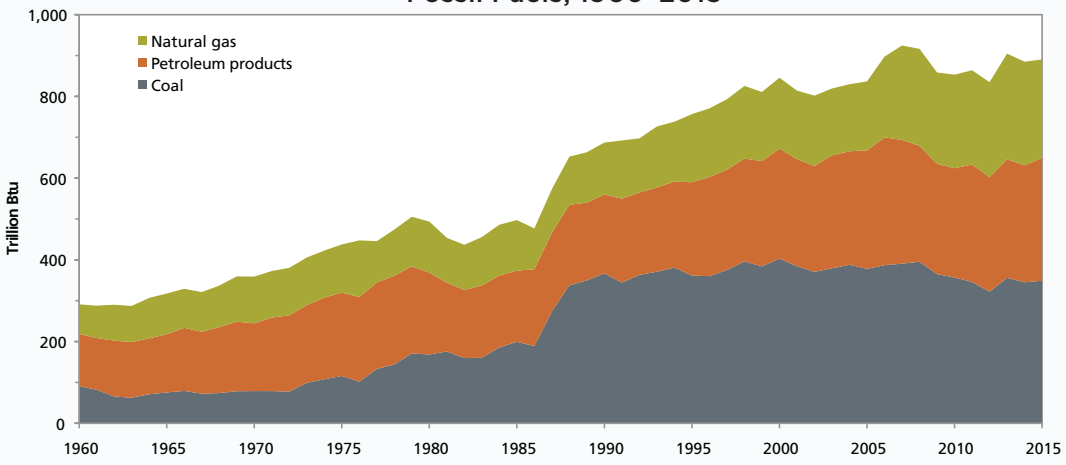


UEMS website table: Table 1.14 | Source: EIA, UGS
Note: EIA assumes that all renewable electric generation originating in Utah is also consumed in Utah, but this is not always the case (e.g., electricity from the Milford wind farm is sold to California). 2015 data are estimated.

Renewables, 1960–2015



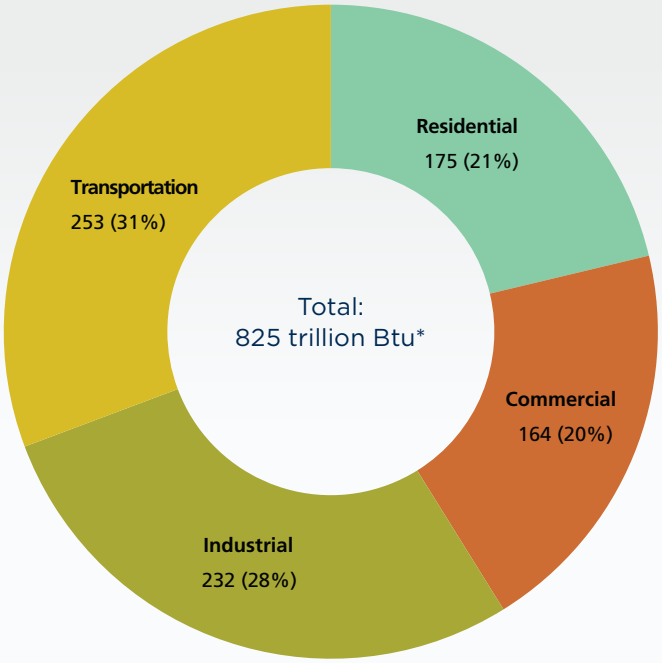
Fossil Fuels, 1960–2015



Fossil fuels made up 97.8% of Utah's total energy consumption in 2015, while renewable sources only accounted for 2.2% of Utah's consumption portfolio. These graphs do not include net interstate flows and losses (see inset graph); Utah exported 87 trillion Btu of electricity (including losses) in 2015, resulting in a net total consumption of 825 trillion Btu.

Energy Consumption in Utah by Sector

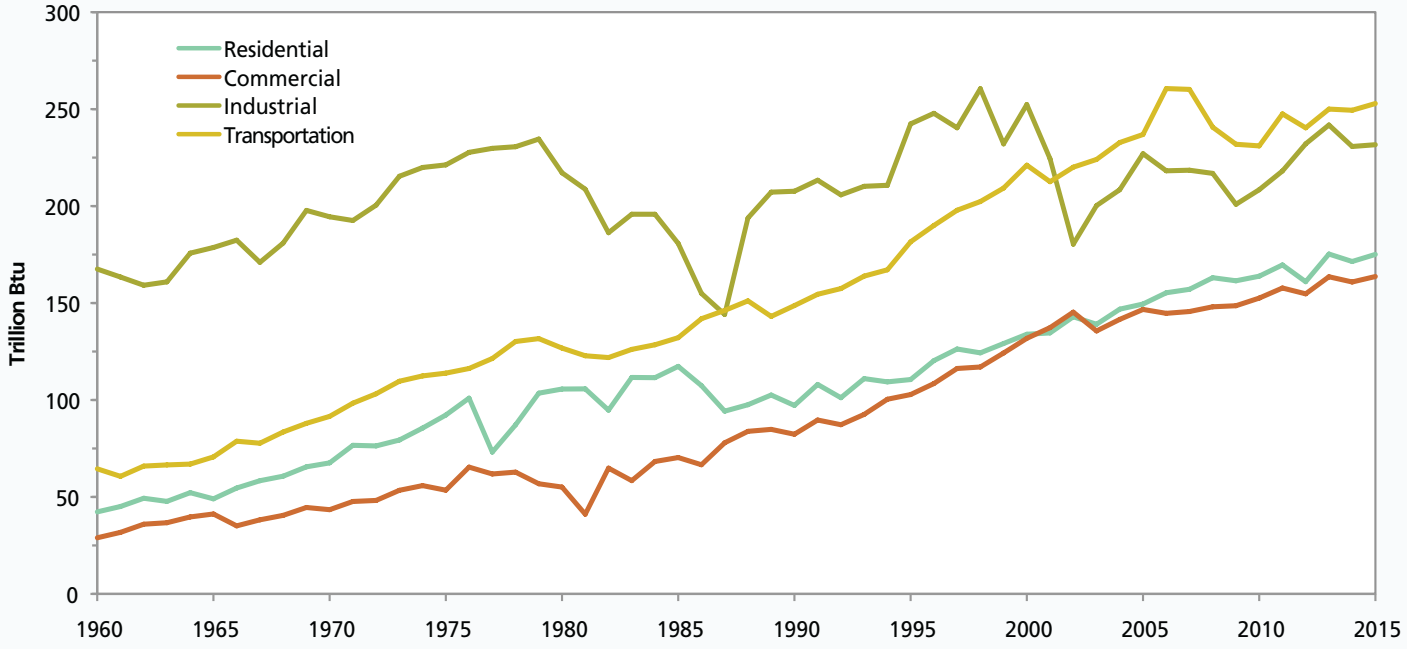
2015
Trillion Btu (Percent of total)



*Includes net interstate flows and losses
UEMS website table: Table 1.16 | Source: EIA
Note: 2015 data are estimated.

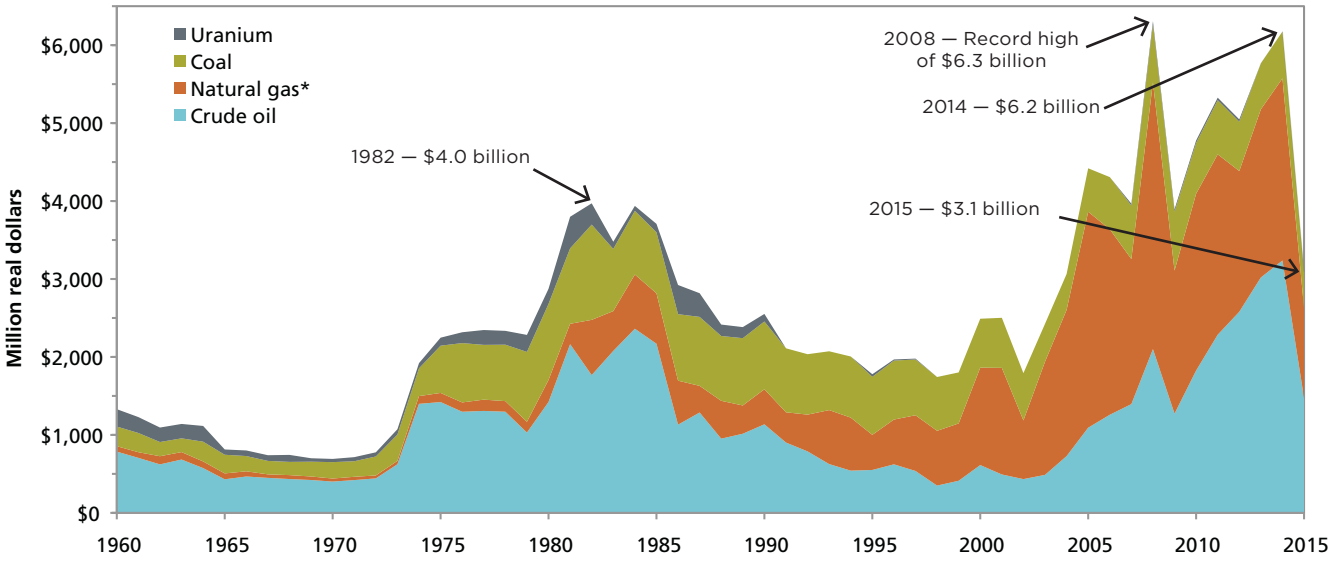
The transportation sector, mostly gasoline and diesel for vehicles, was the largest consumer of energy in Utah in 2015 (31%). The residential, commercial, and transportation sectors have all gradually increased over time, consistent with increasing population and increasing energy consumption per capita, while the industrial sector follows a pattern more closely tied to the national economy (e.g., economy-related dips in the mid-1980s, early 2000s, and 2009–2010).

1960–2015



energy economics

Value of Energy Production in Utah, 1960–2015



*Includes natural gas liquids

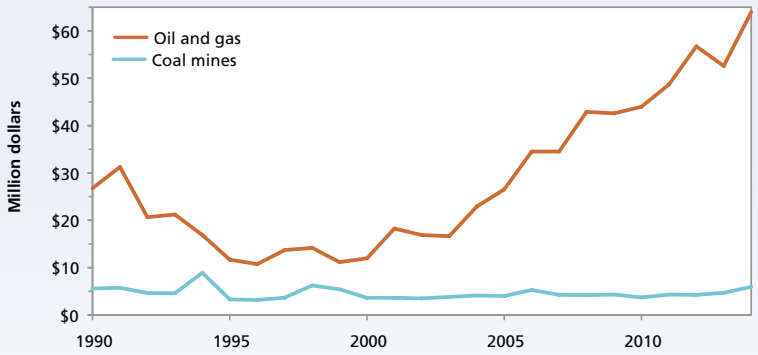
Source: UGS

Note: Real = inflation-adjusted dollars calculated using the Consumer Price Index from the U.S. Bureau of Labor Statistics.

The value of energy-related fossil fuel production (electric generation from renewable sources is not included) in Utah totaled $3.1 billion in 2015, only 50% of the 2014 value. Energy production values have been high since 2004 (even after adjusting for inflation) when crude oil and natural gas prices surged to levels not seen since the early 1980s.

Drill rig in the Natural Buttes natural gas field.

Property Taxes Charged Against Petroleum and Coal Extraction Activities, 1990–2014



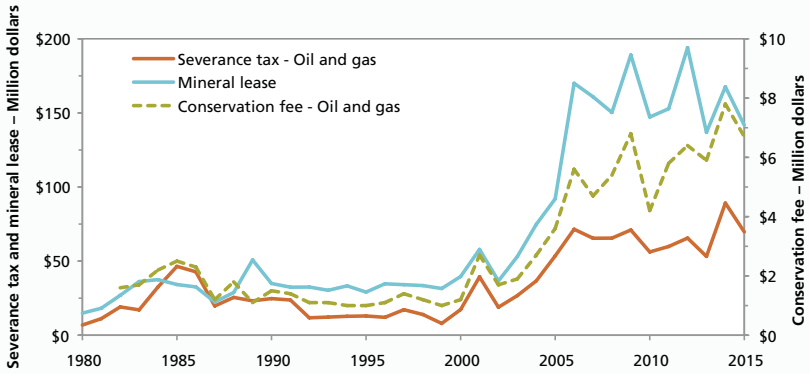
Source: Utah State Tax Commission

Note: Calendar year, presented in nominal dollars.

2015 data are not yet available.

Property taxes charged against Utah oil and gas activities have increased more than six times since 1996, totaling nearly $64 million in 2015. Property taxes charged against coal mines have remained nearly steady for the past 10 years, averaging about $4.5 million. Both are expected to drop in 2015 with lower assessed value resulting from lower prices and production.

Tax Collections on Oil and Gas Production in Utah and Total Mineral Lease Disbursements, 1980–2015



Source: Utah State Tax Commission

Note: State fiscal year, presented in nominal dollars.

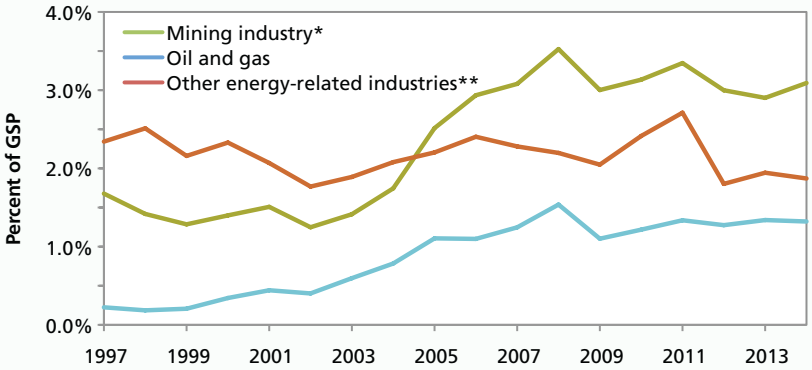
Severance tax, conservation fees, and federal mineral lease payments are all closely related to oil and gas prices, increasing significantly in the mid-2000s, but down in 2015.

The **oil and gas severance tax** is based on the value at the well of oil and gas produced and saved, sold, or transported from the field where it is produced. The Utah tax rate ranges from 3 to 5%, based on the value of the oil or gas, and is 4% for natural gas liquids.

The **oil and gas conservation fee** is 0.2% of the value at the well of oil, gas, and natural gas liquids produced and saved, sold, or transported from the production sites.

Mineral lease disbursements from the federal government to Utah are roughly 50% (less administrative costs) of the value of minerals produced (includes minor non-energy minerals) on federal lands within the state.

Percentage of Utah's Gross State Product from Energy-Related Activities, 1997–2014



*Includes oil and gas, coal, and nonfuel mining

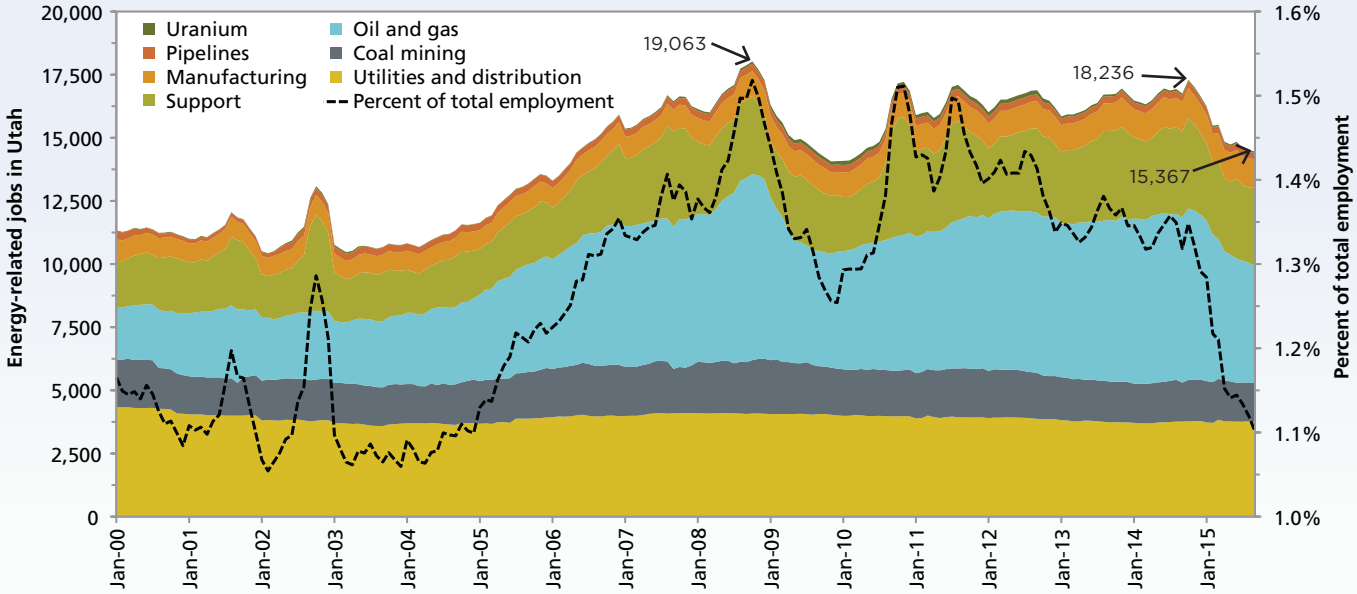
**Includes utilities (including non-energy-related water and sewer), pipelines, and refineries

Source: U.S. Bureau of Economic Analysis

Note: 2015 data are not yet available.

According to the U.S. Bureau of Economic Analysis, the mining industry as a whole (including non-energy minerals) in Utah accounts for about 3.1% of the gross state product (GSP), of which the oil and gas industry accounts for about 1.3%. Utilities (including some non-energy sectors), refineries, and pipeline transportation and maintenance account for an additional 1.9% of Utah's GSP.

Direct Energy-Related Employment in Utah (monthly data), 2000–2015

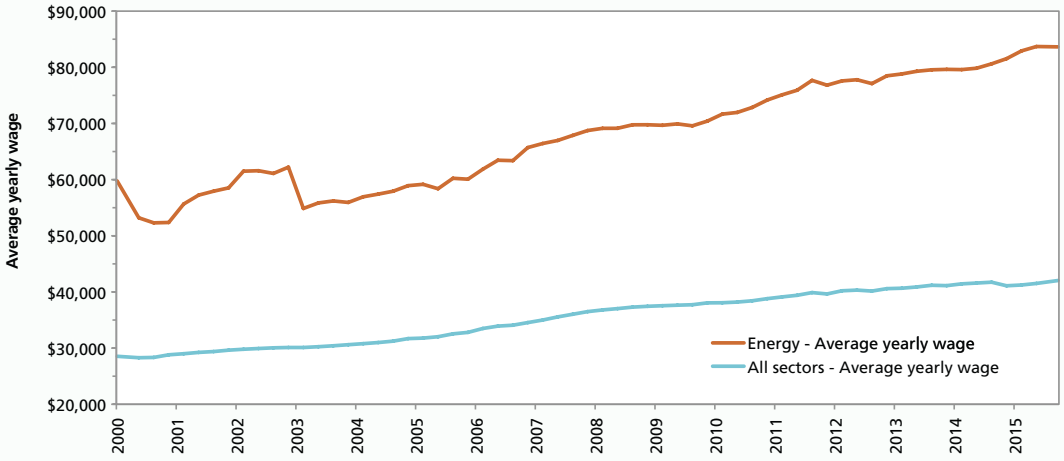


Source: Utah Department of Workforce Services

Note: Employment statistics are based on the North American Industry Classification System for businesses. While these statistics accurately capture many types of energy-related employment, they do not include employment related to renewable energy construction and energy efficiency, or employment in other industries that only exists because of the energy sector. For example, many renewable energy and energy-efficiency jobs are instead classified as part of a larger "construction" category. For this reason, the statistics above are a conservative estimate of energy-related employment in Utah; actual energy-related employment will be larger.

Energy-related employment in Utah declined to 15,367 in September of 2015 (down 16% from the 18,236 recorded in October 2014; pre-oil price crash), of which the majority (30%) came from the oil and gas sector. Power generation (utilities and distribution) made up 24% of the total, while support industries accounted for 20%. Energy-related jobs account for 1.1% of total employment, decreasing in recent years as the oil and gas sector contracted with decreasing prices.

Annual Average Wages in Utah (quarterly data), 1990–3rd Quarter 2015



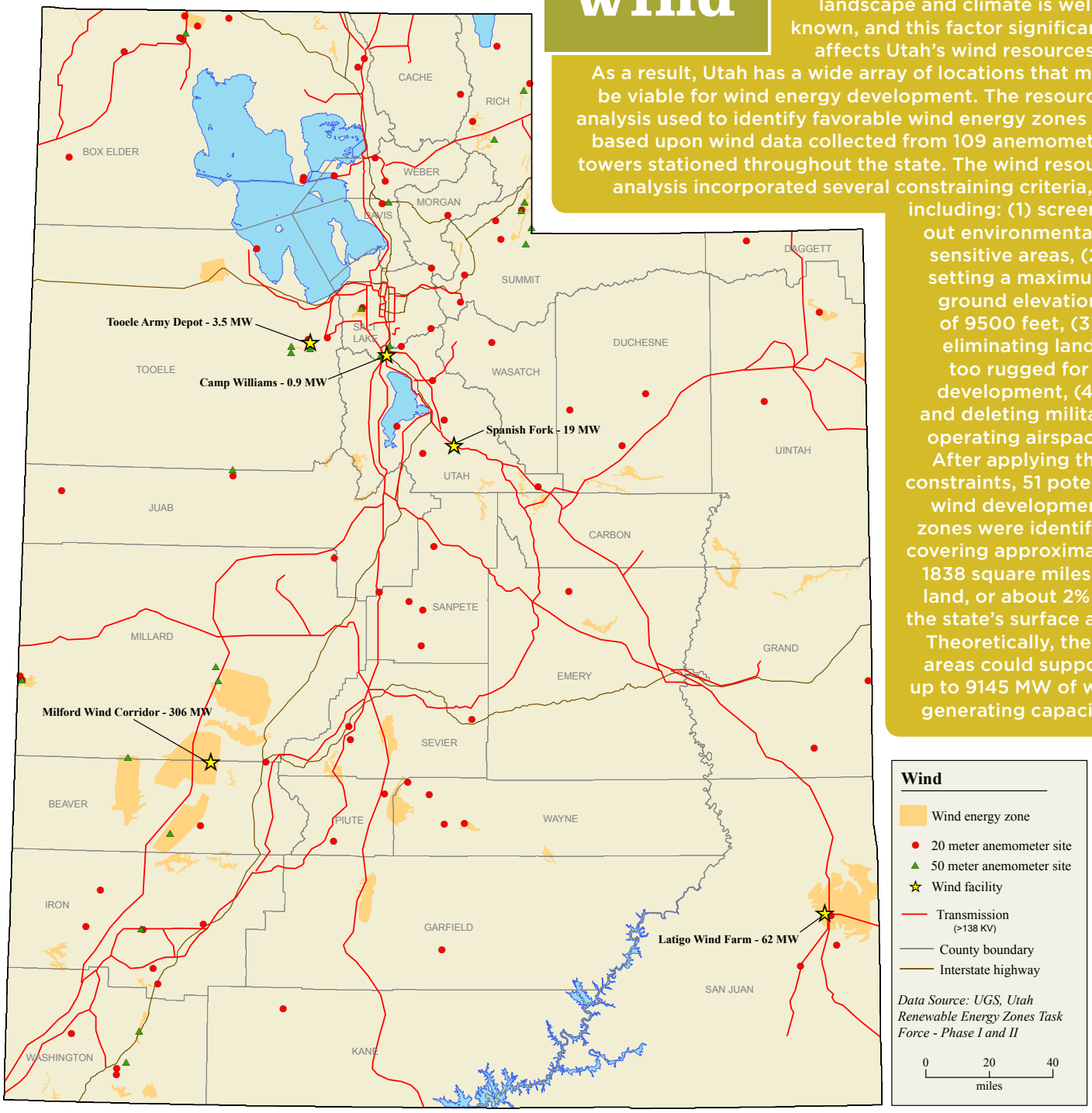
Average yearly wages in the energy sector ($83,400, first three quarters of 2015) are more than double the statewide average annual wage ($41,500, first three quarters of 2015).

Source: Utah Department of Workforce Services

renewable resources

wind

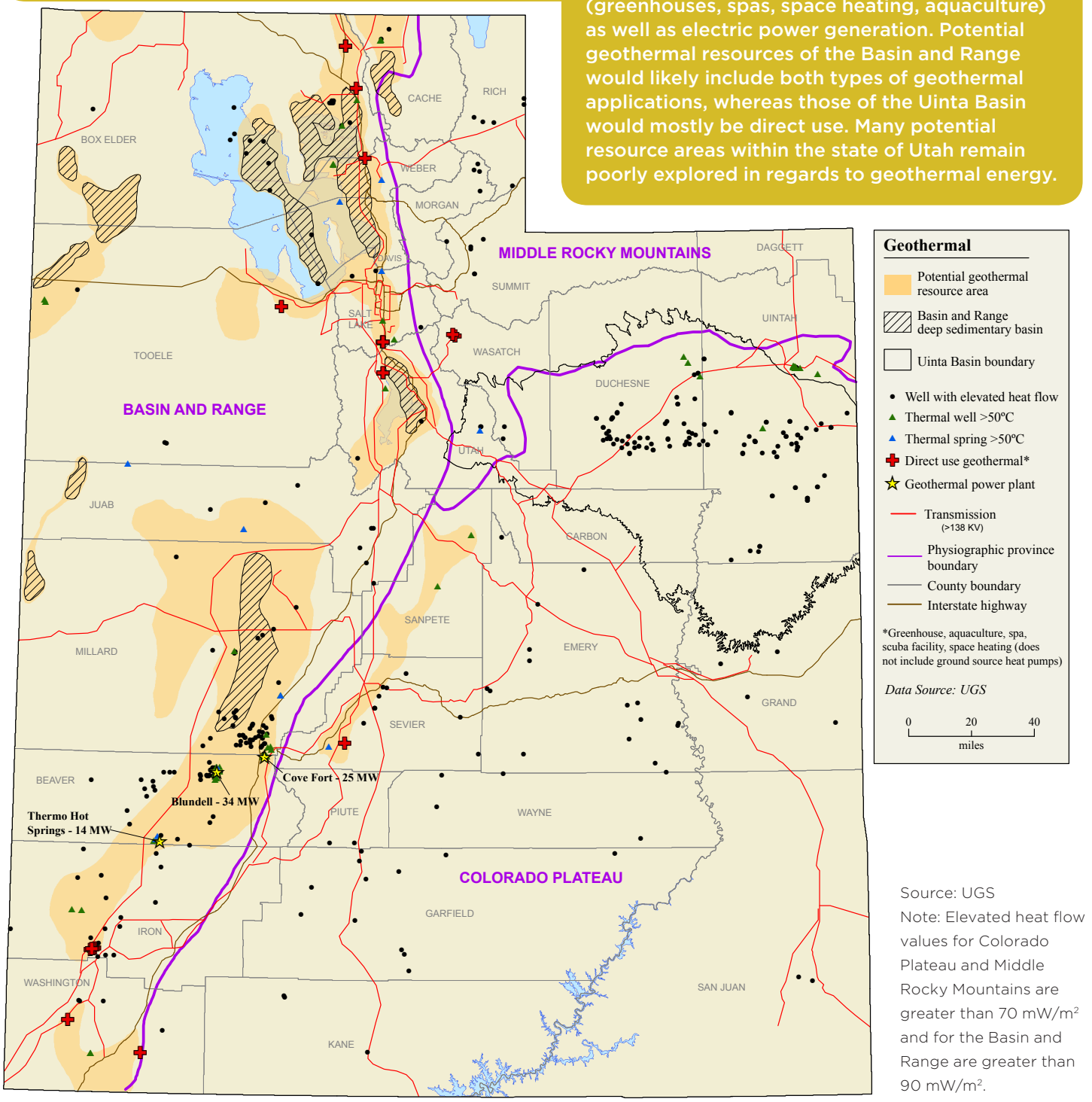
Utah's extreme diversity in landscape and climate is well known, and this factor significantly affects Utah's wind resources. As a result, Utah has a wide array of locations that may be viable for wind energy development. The resource analysis used to identify favorable wind energy zones was based upon wind data collected from 109 anemometer towers stationed throughout the state. The wind resource analysis incorporated several constraining criteria, including: (1) screening out environmentally sensitive areas, (2) setting a maximum ground elevation of 9500 feet, (3) eliminating land too rugged for development, (4) and deleting military operating airspace. After applying the constraints, 51 potential wind development zones were identified covering approximately 1838 square miles of land, or about 2% of the state's surface area. Theoretically, these areas could support up to 9145 MW of wind generating capacity.



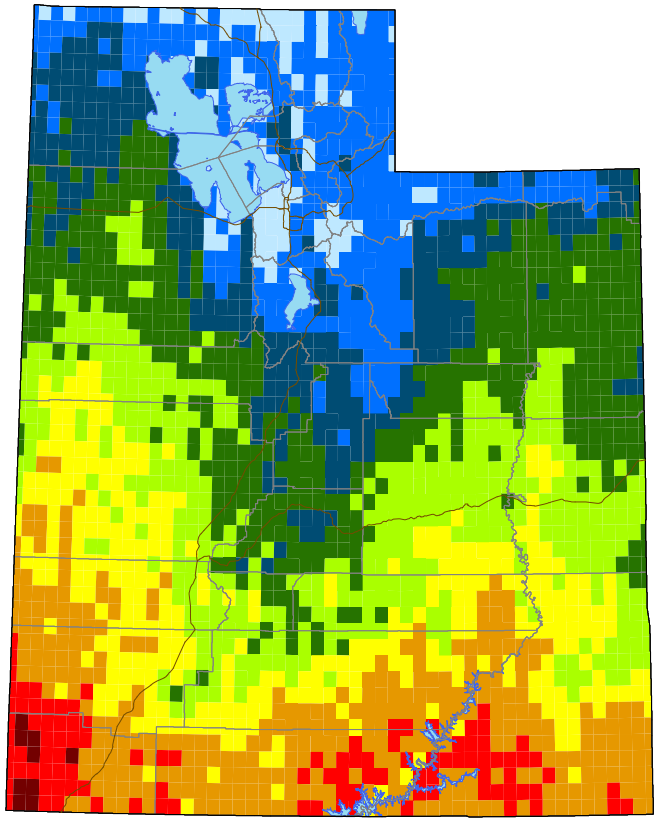
Source: Utah Renewable Energy Zones Task Force – Phase I and II

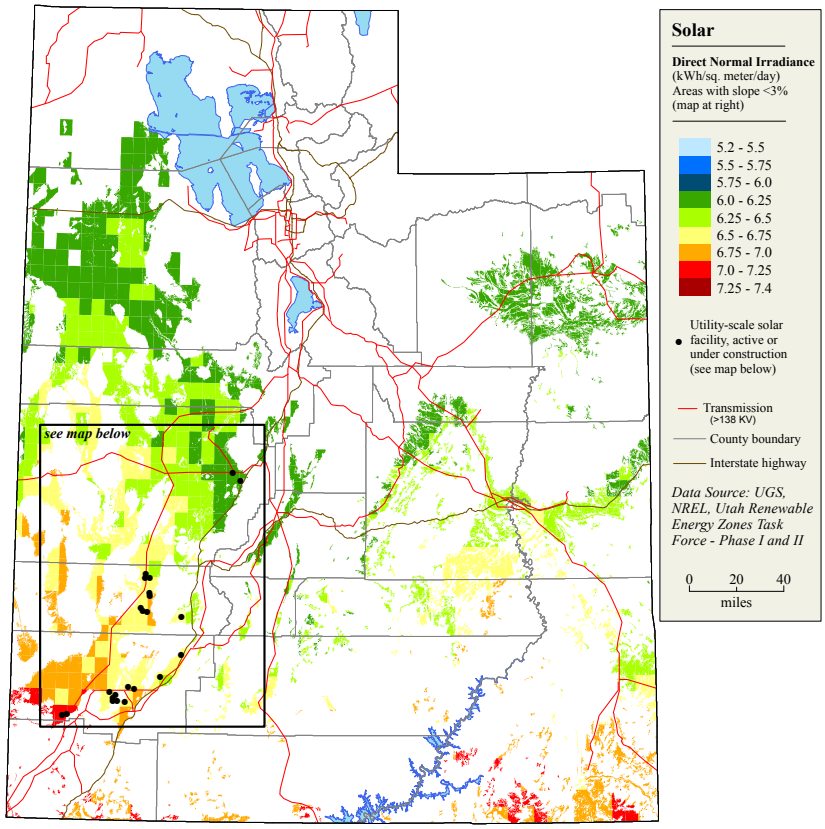
geothermal

The geothermal energy resource potential of Utah has been evaluated on the basis of information extracted from various types of thermal data throughout the state. Heat-flow data, thermal spring and well temperatures, and fluid chemistries are typically used as a first step in the screening for geothermal resources. Recent studies indicate deep (>10,000 ft) sedimentary basins within the Basin and Range physiographic province of western Utah may have significant geothermal potential. The Uinta Basin also has a potential geothermal resource due primarily to the existence of well infrastructure from the oil and gas industry combined with favorable data on co-produced fluid temperatures and production rates. Utah is home to a variety of geothermal resource utilization projects for both direct applications (greenhouses, spas, space heating, aquaculture) as well as electric power generation. Potential geothermal resources of the Basin and Range would likely include both types of geothermal applications, whereas those of the Uinta Basin would mostly be direct use. Many potential resource areas within the state of Utah remain poorly explored in regards to geothermal energy.



Source: UGS
Note: Elevated heat flow values for Colorado Plateau and Middle Rocky Mountains are greater than 70 mW/m^2 and for the Basin and Range are greater than 90 mW/m^2.



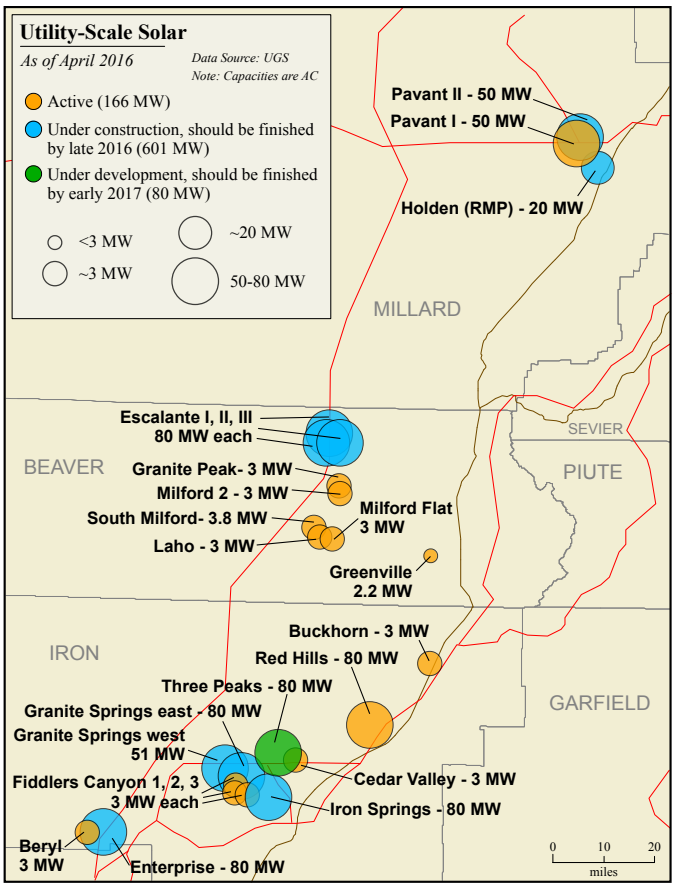


solar

Utah's solar resources are clearly abundant (map at upper left, no screening applied), but to estimate a theoretical solar resource potential, several constraining criteria were used, including: (1) measurements of Direct Normal Irradiance (DNI), with a threshold value of 6.0 kilowatthours per meter squared (kWh/m²)/day or greater, (2) screening out steeper areas (slopes of 3% or greater) unable to accommodate a large solar collection field, and (3) screening out environmentally sensitive areas such as national parks, wilderness areas, wetlands, etc., that are not available for development. After applying the constraints, approximately 6371 square miles of land (7.5% of the state's surface area) are suitable for solar power generation at the utility scale (at lower left). Theoretically, this land could support up to 826 GW of solar generating capacity.

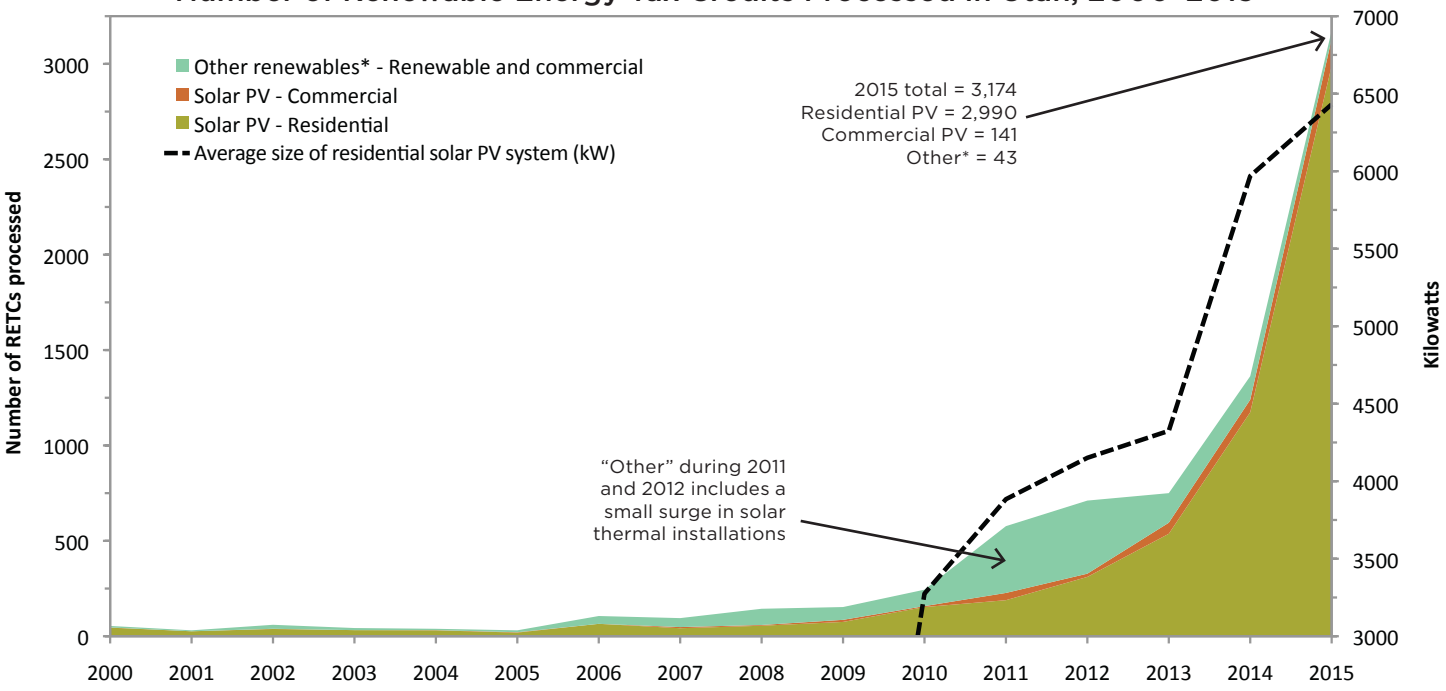
Source: UGS, Utah Renewable Energy Zones Task Force - Phase I and II

As of April 2016, 166 MW of new solar generating capacity has come online in southwestern Utah. In addition, approximately 600 MW of capacity are currently under construction and roughly 80 MW of capacity are under development and should be completed by the end of the year. By 2017, Utah's utility-scale solar capacity will total 847 MW, more than wind, geothermal, biomass, and hydroelectric combined.



Note: An attempt was made to locate all utility-scale solar facilities currently active or under development in southwest Utah. This map is a snap-shot in time (April 2016); this industry is currently undergoing a significant transformation and plans for proposed sites could change.

Number of Renewable Energy Tax Credits Processed in Utah, 2000–2015

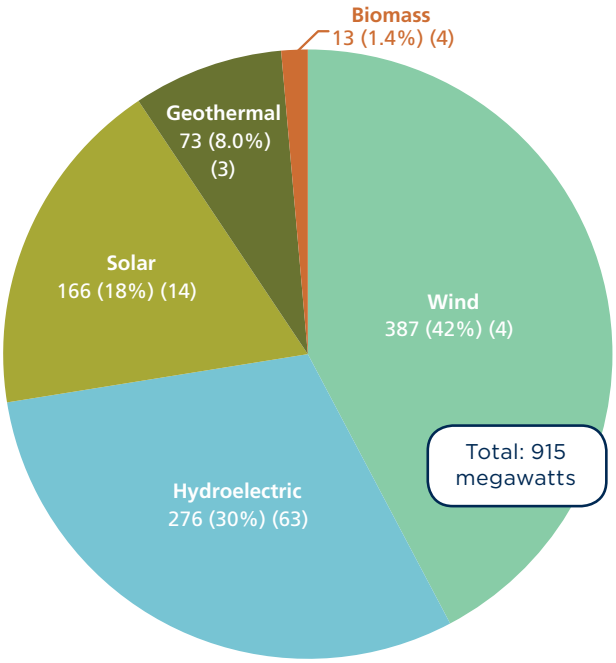


*Solar thermal, wind, and geothermal heat pumps | Source: OED | Note: 2015 data are preliminary

The number of renewable energy tax credits processed by the State of Utah has increased exponentially in the past few years, from 153 tax credits processed in 2009 to 3,174 tax credits processed in 2015. The vast majority of these tax credits (94% in 2015) are for residential solar photovoltaic (PV) systems. Also of note, the average size (capacity) of residential solar PV systems has nearly doubled in the past 5 years from 3.3 kW in 2010 to 6.4 kW in 2015. It is thought that this increase is due to decreasing installation and equipment costs as well as a shift towards the desire to cover nearly 100% of a household's electricity usage. Total solar capacity for the commercial and residential sector in Utah is estimated at about 55 MW.

Utah's Total Utility-Scale Renewable Capacity by Energy Source, 2015

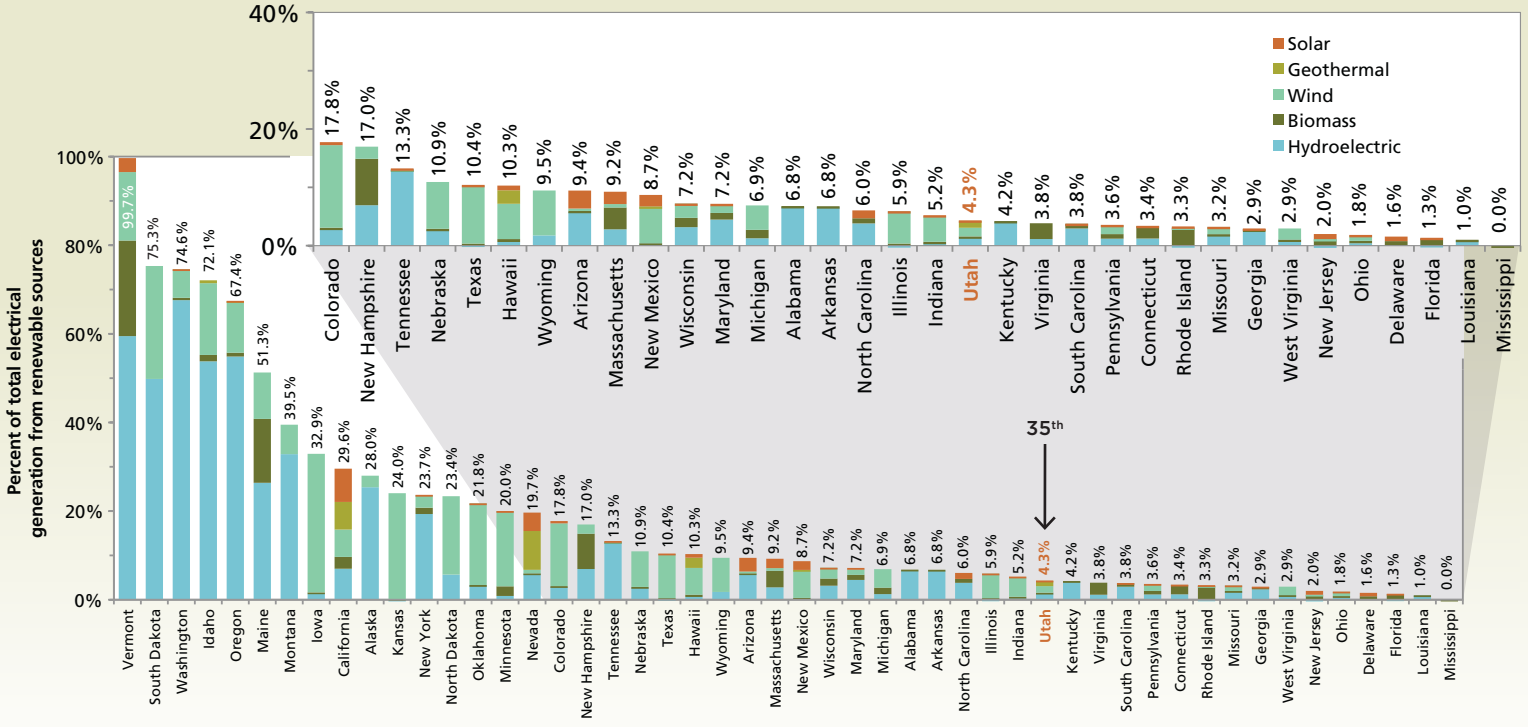
Megawatts (Percent of total) (Number of facilities)



Utah's renewable electric capacity is dominated by three large wind farms, Milford (306 MW), the newly built Latigo (62 MW), and Spanish Fork (19 MW), and 63 hydroelectric plants, the largest being Flaming Gorge at 152 MW. The geothermal portion consists of PacifiCorp's Blundell plant (34 MW), the Thermo Hot Springs plant (14 MW), and the Cove Fort plant (25 MW), whereas the biomass portion is mainly from Wasatch Front landfill gas operations. Utah has a combined 166 MW (at the end of 2015) of installed solar capacity, dominated by the newly built Red Hills solar farm in Iron County (80 MW) and the Pavant solar farm in Millard County (50 MW). However, another 680 MW of solar capacity is slated for installation by the end of 2016 (for a total of about 850 MW, see map on page 12), which will be more than all other renewable energy sources combined.

UEMS website table: Table 6.4 | Source: EIA, UGS

Renewable Electric Generation by State, 2015

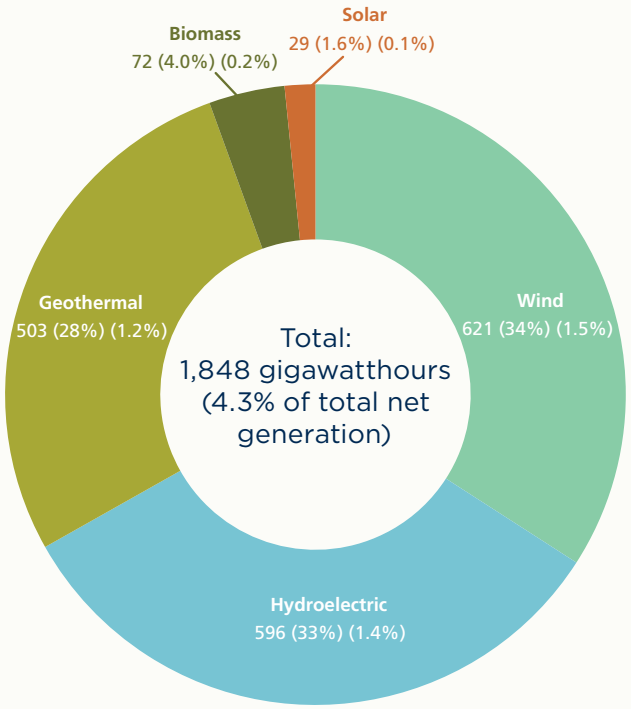


In 2015, Utah ranked 35th in the nation in percent of total net electric generation from renewable resources (4.3%). Of particular note, Utah is one of only seven states where electricity is generated from geothermal resources.

UEMS website table: Table 6.2 | Source: EIA

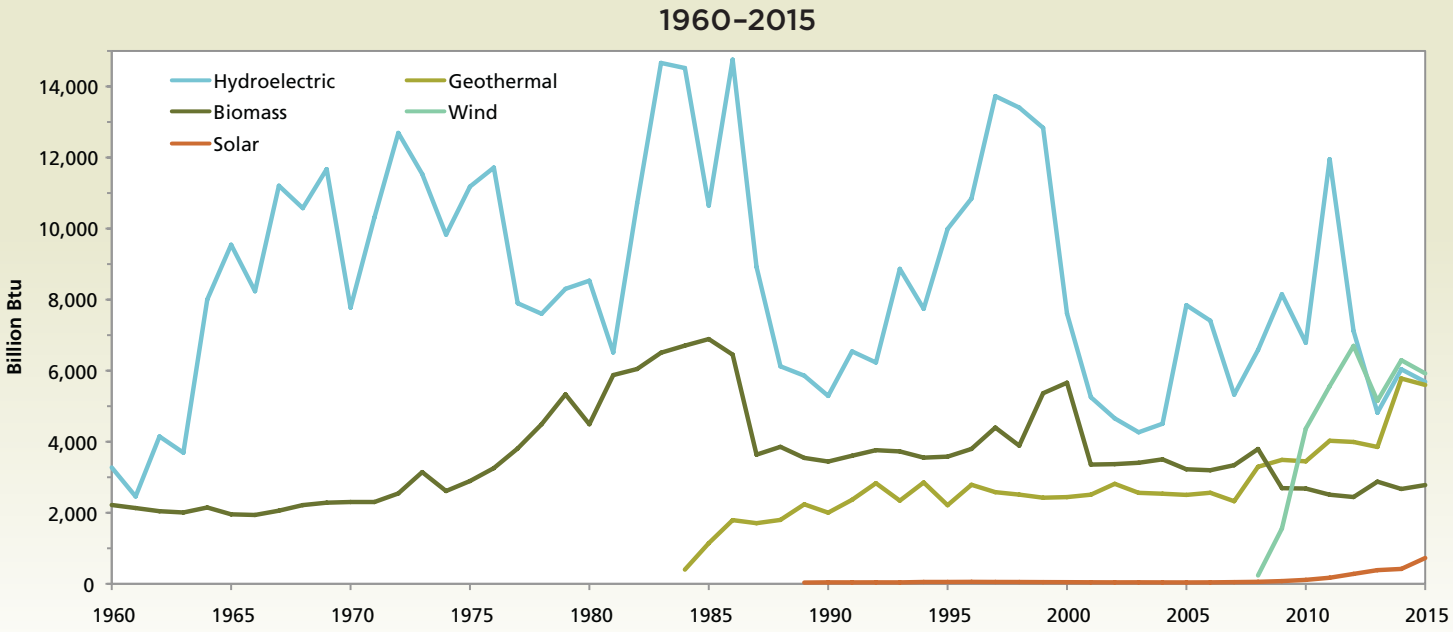
Renewable Electric Generation in Utah, 2015

Gigawatthours
(Percent of total renewables) (Percent total net generation)



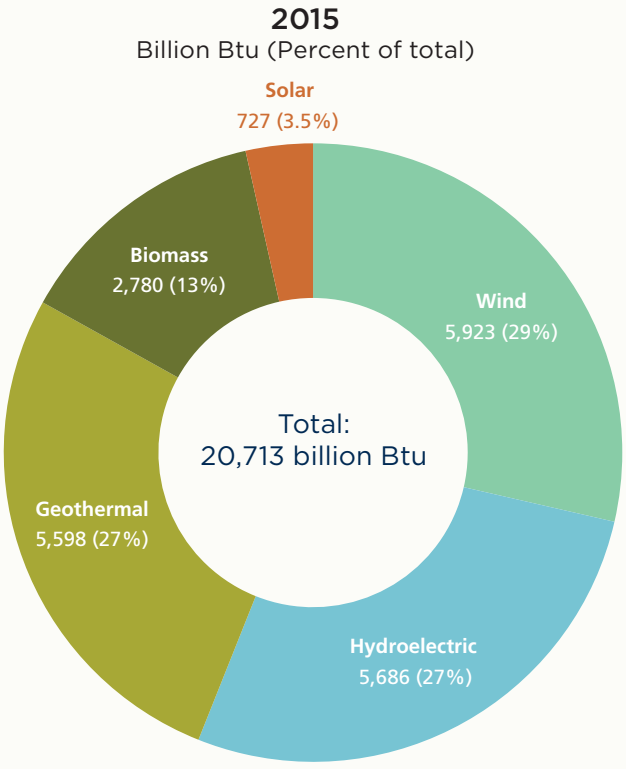
Utah's renewable electric generation is dominated by wind, hydroelectric, and geothermal power. The biomass portion is mainly electricity generated from burning landfill gases. Electricity from solar will become more prominent in the near future with the addition of nearly 850 MW of new capacity.

Renewable Energy Consumption in Utah



UEMS website table: Table 6.3
Source: EIA

Note: EIA assumes that all renewable electric generation originating in Utah is also consumed in Utah, but this is not always the case (e.g., electricity from the Milford wind farm is sold to California). 2014 and 2015 data are estimated. Includes the electric utility sector.

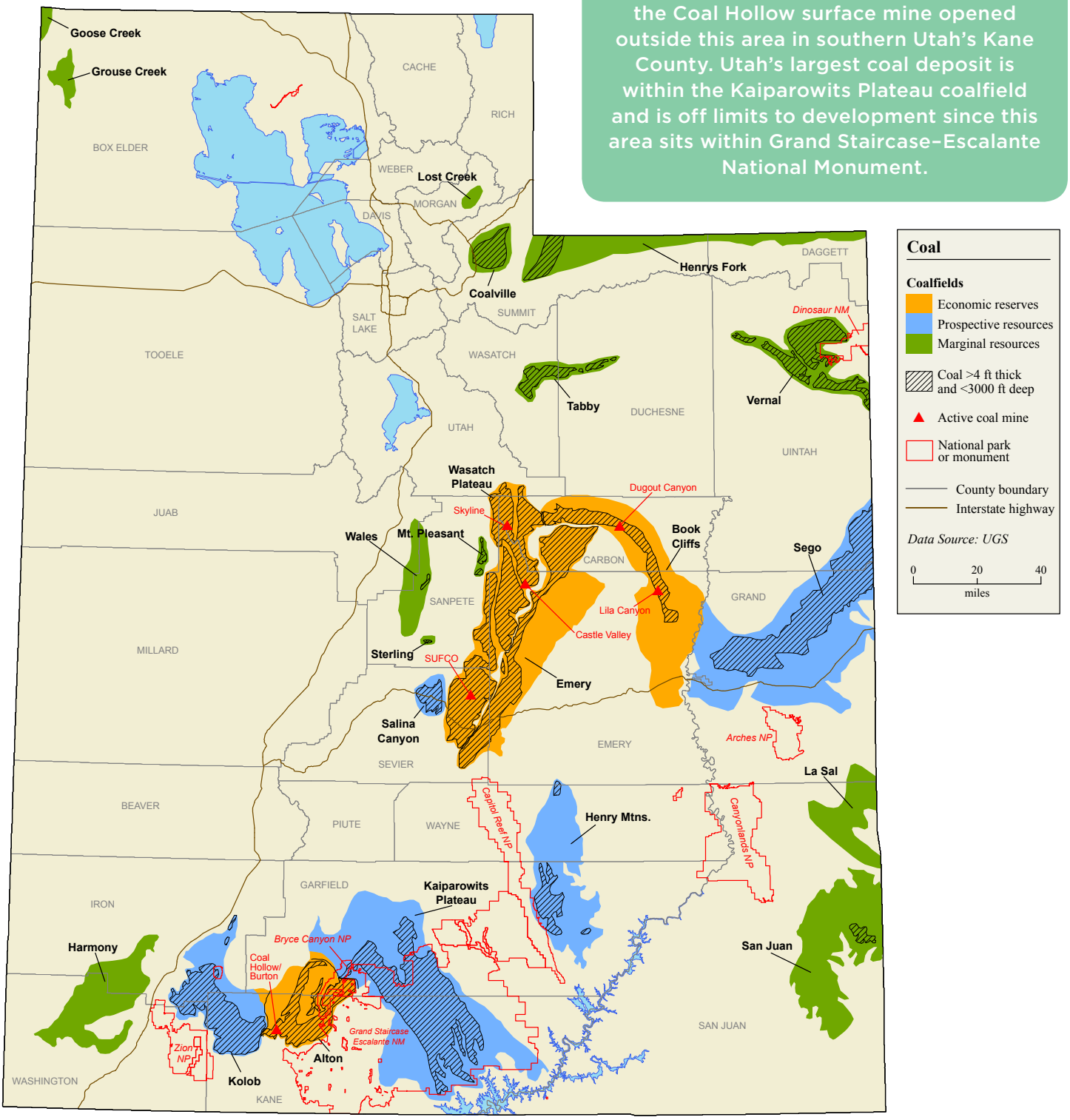


Cove Fort geothermal power plant

Utah's 2015 consumption of energy from renewable resources is dominated by wind, hydroelectric, and geothermal electricity generation. Smaller amounts of energy came from commercial- and residential-scale photovoltaic arrays, as well as burning biomass (mainly wood).

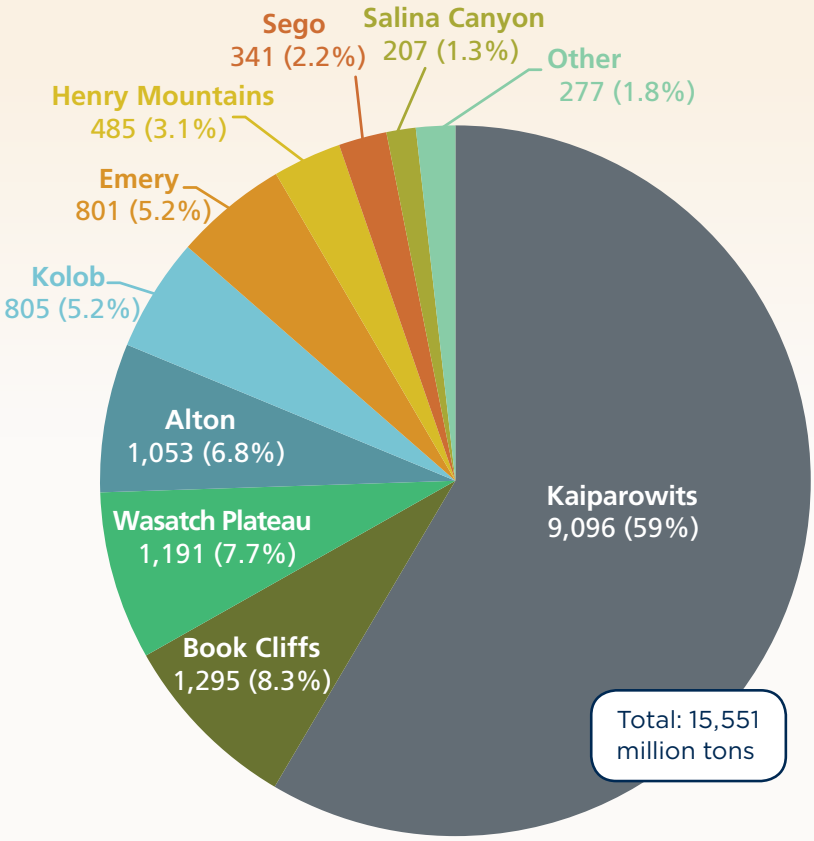
coal

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



Utah's Recoverable Coal Resources by Coalfield, 2015

Million tons (Percent of total)



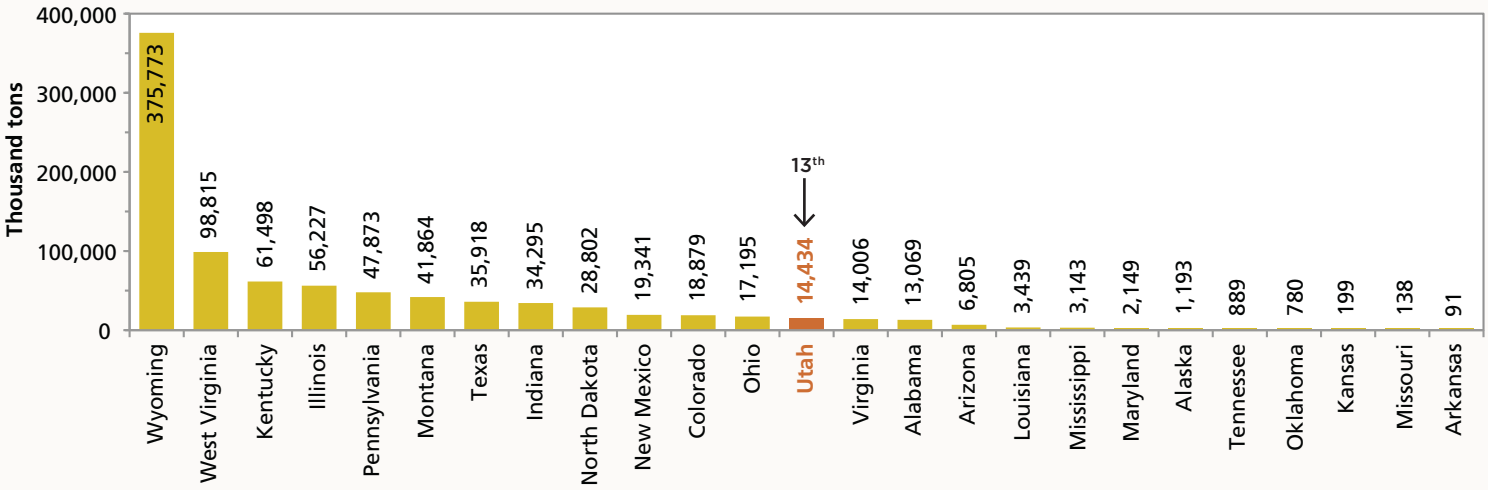
The majority of Utah's potentially recoverable coal resources are located in the Grand Staircase-Escalante National Monument within the Kaiparowits coalfield (59% of Utah's estimated recoverable coal, as of 2015). Only the Wasatch Plateau, Book Cliffs, and Alton fields currently contain active mines.

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.

Utah coal

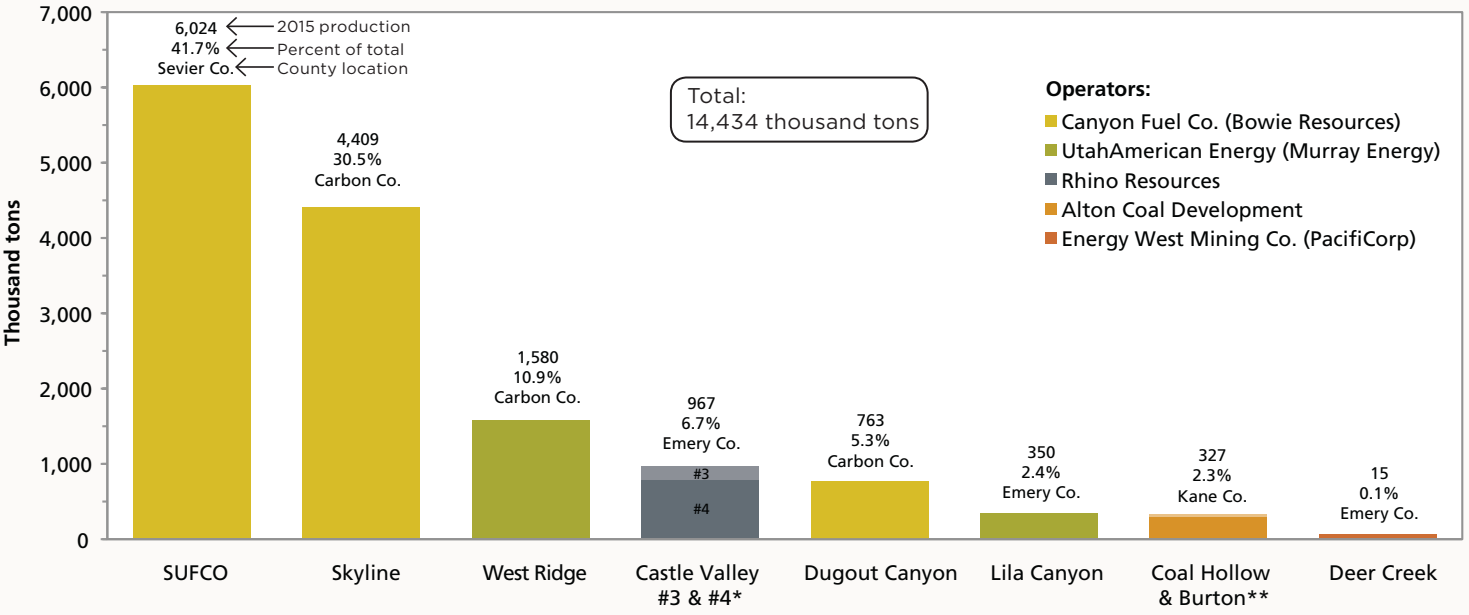
U.S. Coal Production by State, 2015



In 2015, Utah ranked as the 13th largest producer of coal in the United States.

UEMS website table: Table 2.7 | Source: MSHA, UGS

Utah Coal Production by Mine, 2015



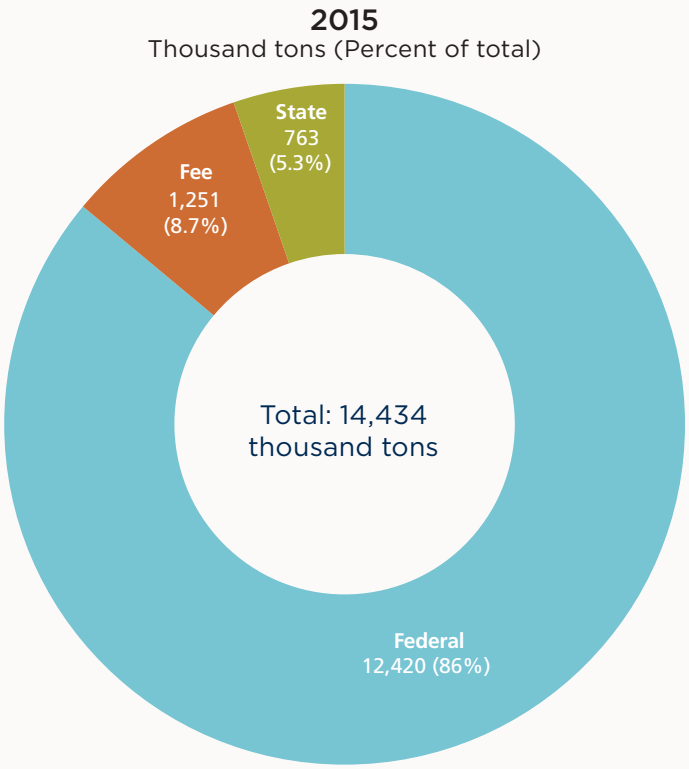
In 2015, 78% of Utah's coal production came from Canyon Fuel Company mines (Bowie Resources) located in Sevier and Carbon Counties. The Deer Creek mine closed in January 2015 after producing only 15,000 tons and the West Ridge mine closed in November 2015. The longwall mining machine at West Ridge was transferred to the Lila Canyon mine and production there will increase as a result. The Dugout mine ceased longwall production in 2012 and current production is via continuous miner machine.

UEMS website table: Table 2.8 | Source: UGS

*Castle Valley #3 (177,000 tons produced) and #4 (789,000 tons produced) are part of the same facility, but are listed as two separate mines because they operate in two different seams.

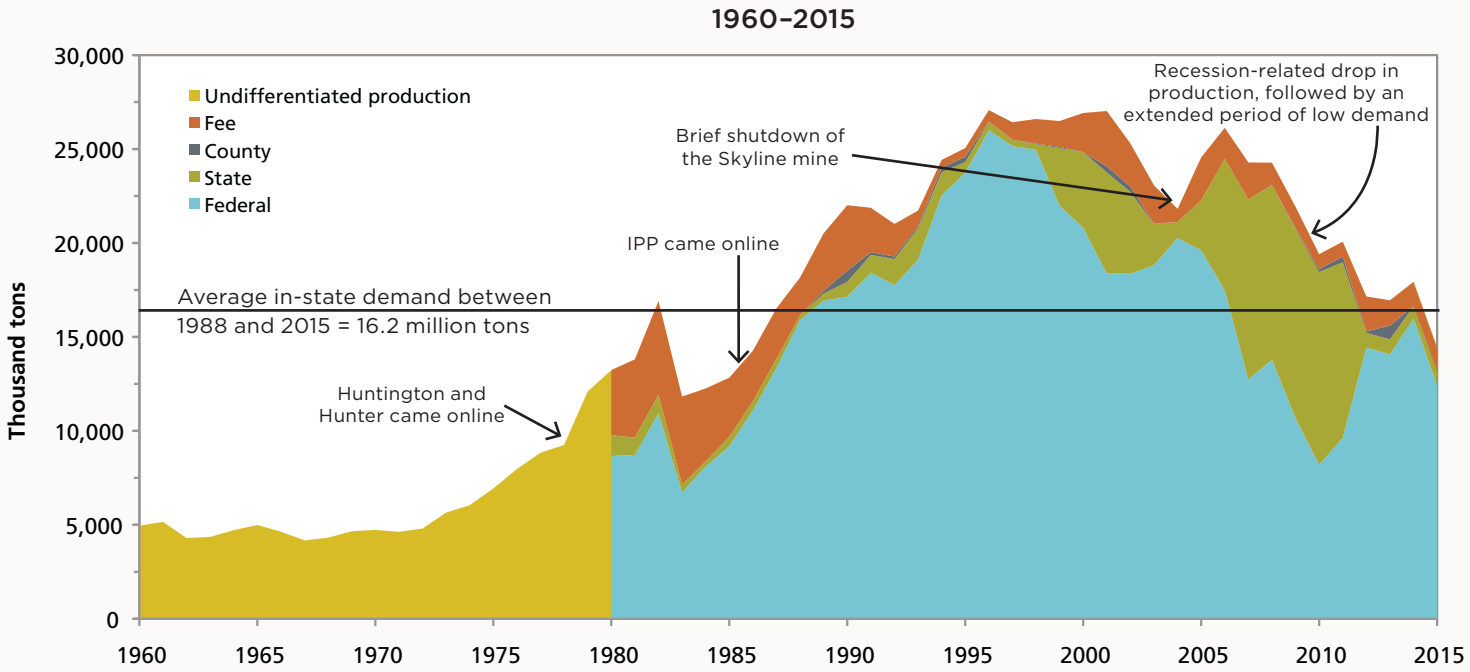
**The Coal Hollow mine (316,000 tons produced) is a surface mine in the Alton coalfield and the Burton mine (11,000 tons produced, too small to be seen on the graph) is a new underground mine at the same facility.

Utah Coal Production by Landownership

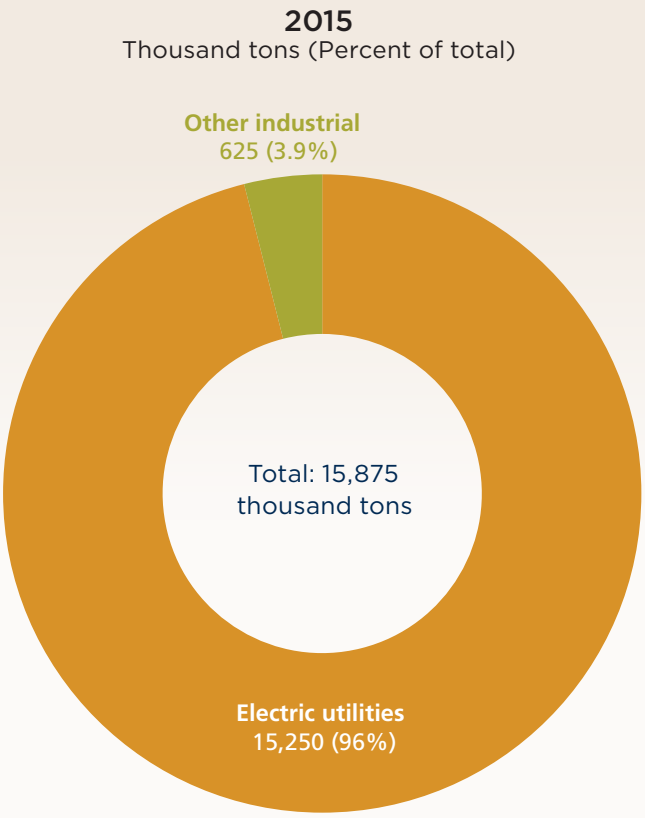


Declining Utah coal production started during the 2008 recession and has continued as coal has dropped out of favor as a fuel for electric and industrial needs. The large increase in state land production that started in 1998 was the result of lands given to Utah after the designation of the Grand Staircase-Escalante National Monument. By 2012, those state lands had been mined out, once again increasing federal coal production to over 80%.

UEMS website table: Table 2.12 | Source: UGS
Note: 2015 landownership breakdown is estimated.



Utah Coal Consumption by Sector

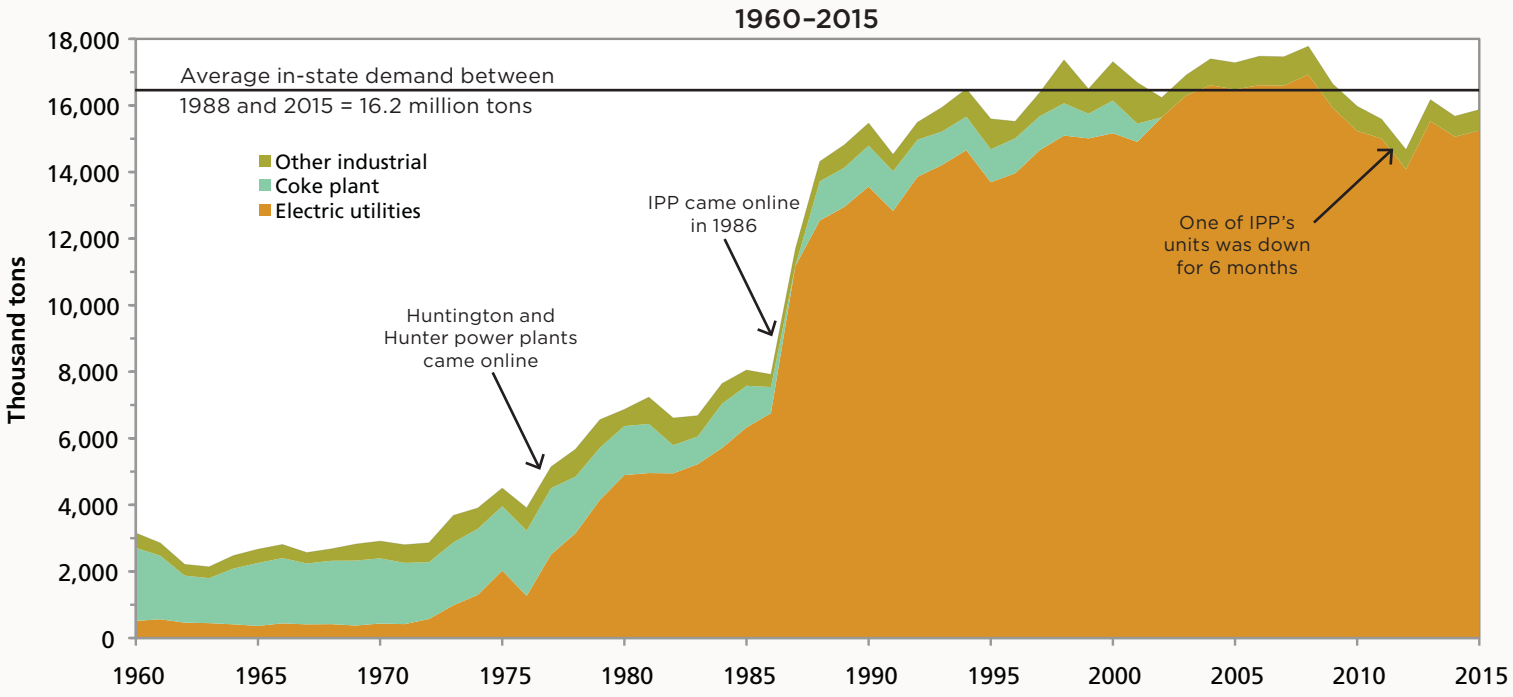


UEMS website table: Table 2.21 | Source: EIA, UGS

Note: 2015 data are estimated. Residential and commercial are too small to be seen on graph.

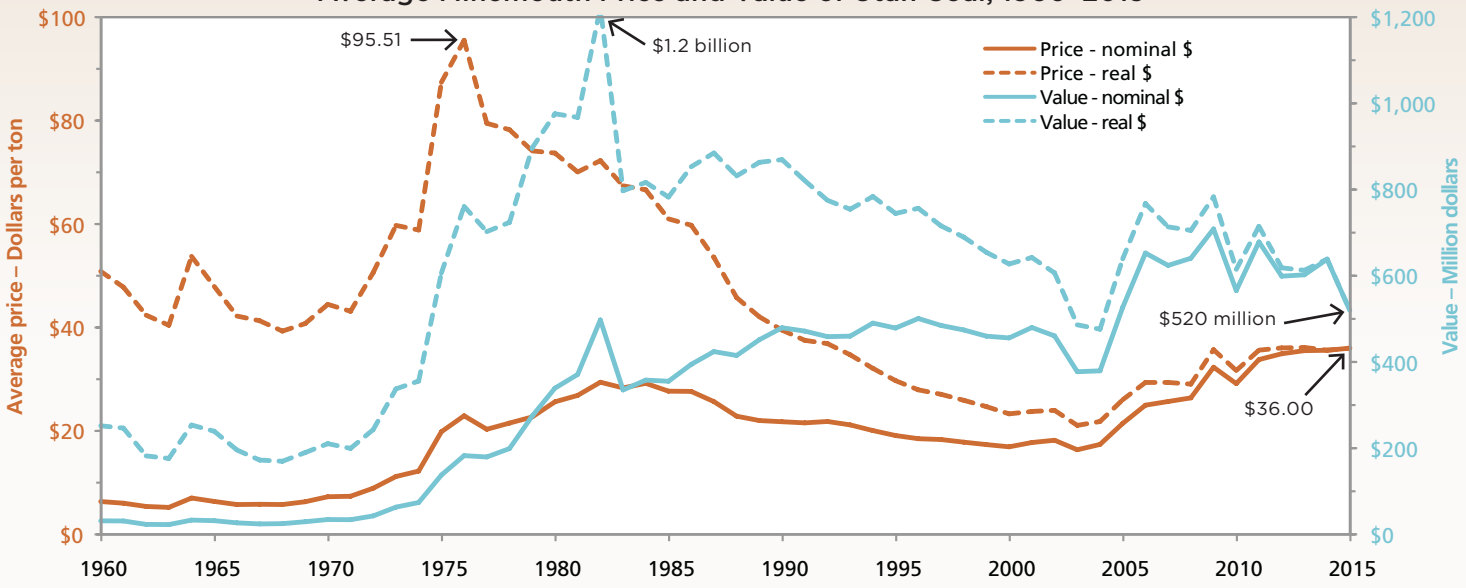
The vast majority of coal consumed in Utah (96%) is used at electric power plants. The remaining coal (3.9%) is consumed by the industrial sector at cement/lime plants and Kennecott Utah Copper's power plant (182 MW capacity) which provides electricity for copper smelting. Coke consumption ceased in 2001 when Geneva Steel went out of business and consumption in the residential and commercial sectors has been negligible for years.

Hunter coal-fired power plant



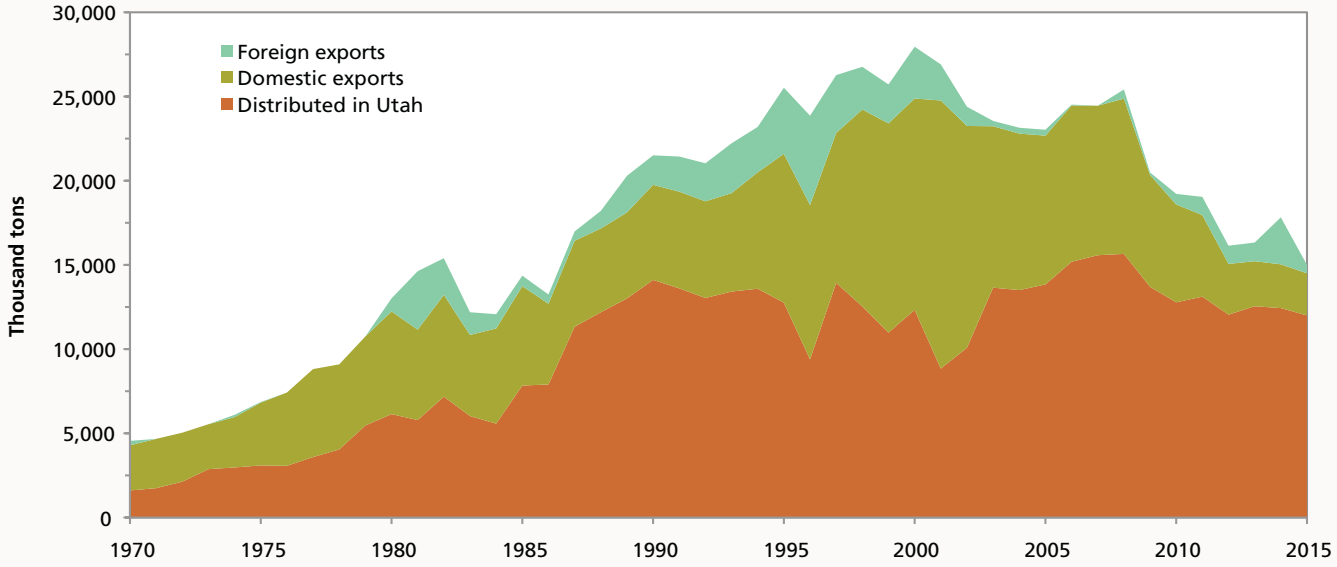
Utah's minemouth price (the price at the mine) of $36.00 per ton in 2015 was well below the real (inflation-adjusted) high of $95.51 reached in 1976. The 2015 value of produced Utah coal dropped to $520 million, much less than the inflation-adjusted value of $1.2 billion recorded in 1982.

Average Minemouth Price and Value of Utah Coal, 1960–2015



UEMS website table: Table 2.22 | Source: UGS

Distribution of Utah Coal, 1970–2015

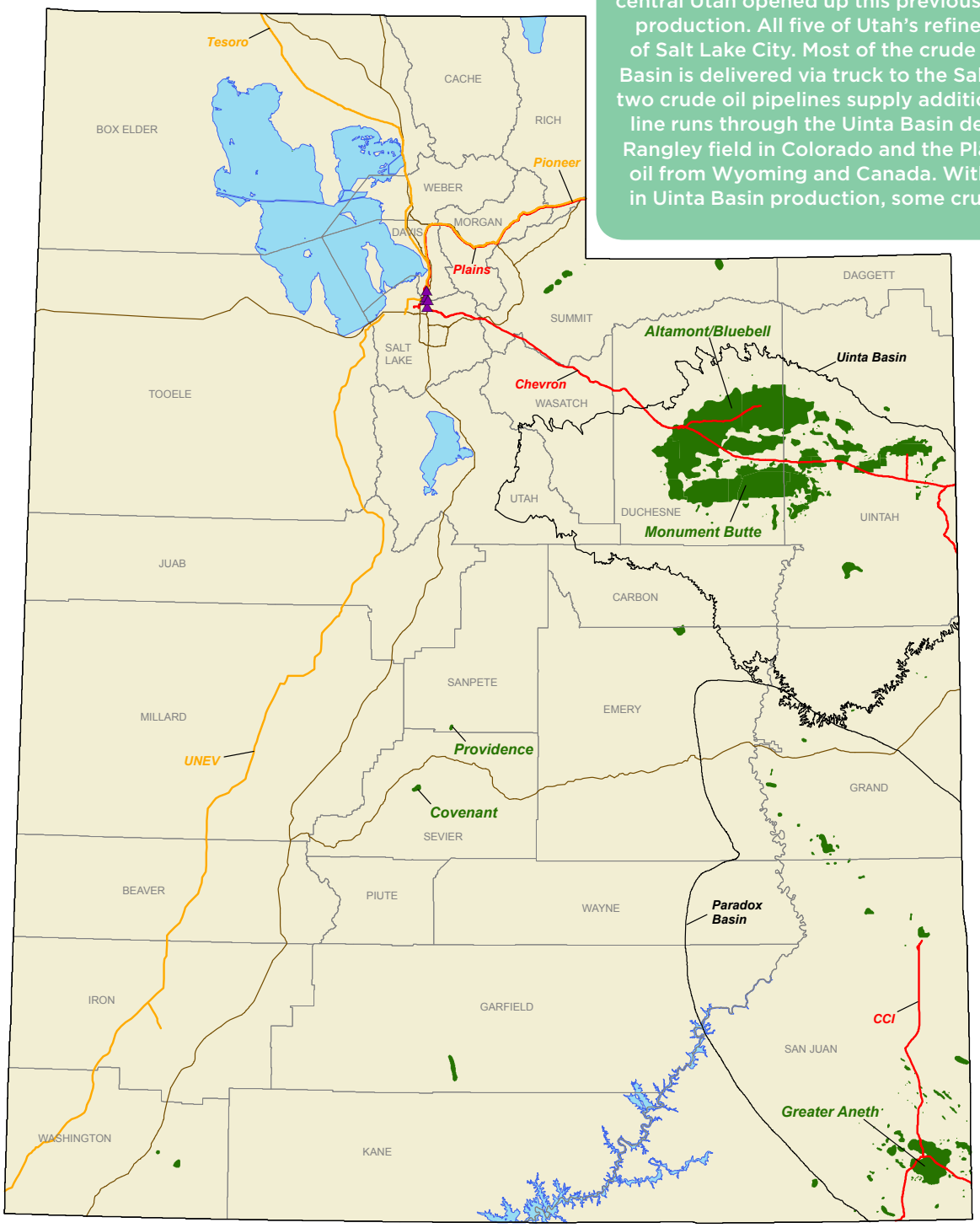


The majority of Utah coal, 80% in 2015, was used in state, while 17% was shipped out of state (up to 60% of Utah coal was shipped to others states in the early 2000s), and 3% was shipped to other countries. Foreign exports, mostly to Asia, peaked in 1996 when 5.5 million tons or 20% of Utah coal was shipped to foreign markets. Domestic exports have significantly decreased in recent years as several electric plants and industrial users in California and Nevada have switched to natural gas.

UEMS website table: Table 2.19 | Source: EIA, UGS | Note: 2015 data are estimated.

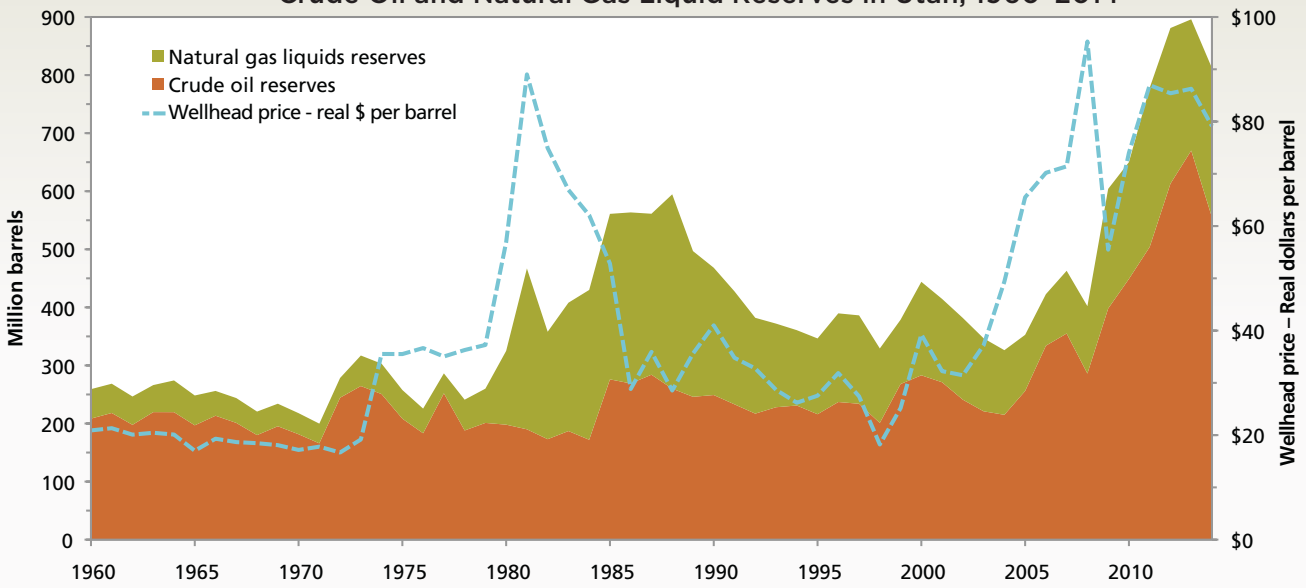
crude oil & petroleum products

Utah's crude oil production is mostly concentrated within Duchesne and Uintah Counties (Uinta Basin) to the north and San Juan County (Paradox Basin) to the south. The 2004 discovery of the Covenant field, and later the Providence field, in central Utah opened up this previously undeveloped area to new production. All five of Utah's refineries are located just north of Salt Lake City. Most of the crude oil production in the Uinta Basin is delivered via truck to the Salt Lake City refineries, while two crude oil pipelines supply additional feedstock; the Chevron line runs through the Uinta Basin delivering crude oil from the Rangley field in Colorado and the Plains pipeline delivers crude oil from Wyoming and Canada. With the recent large increase in Uinta Basin production, some crude oil is now being loaded onto trains near Price for shipment to refineries in California and to the east (train exports will most likely decline as production in the Uinta Basin has decreased in recent years). In addition, crude oil produced in southeastern Utah is shipped via pipeline to New Mexico. The Pioneer petroleum product pipeline carries refined fuel to Salt Lake City from the Sinclair refinery in Wyoming, while two product pipelines carry refined petroleum product out of Utah; the Tesoro line supplies markets in the northwest and the UNEV line delivers product to Cedar City and Las Vegas.



Crude oil and natural gas liquids reserves peaked about 5 years after the two spikes in crude oil prices. The most recent reserves peak (2013) is already in retreat as prices plummeted in 2014 and 2015.

Crude Oil and Natural Gas Liquid Reserves in Utah, 1960–2014

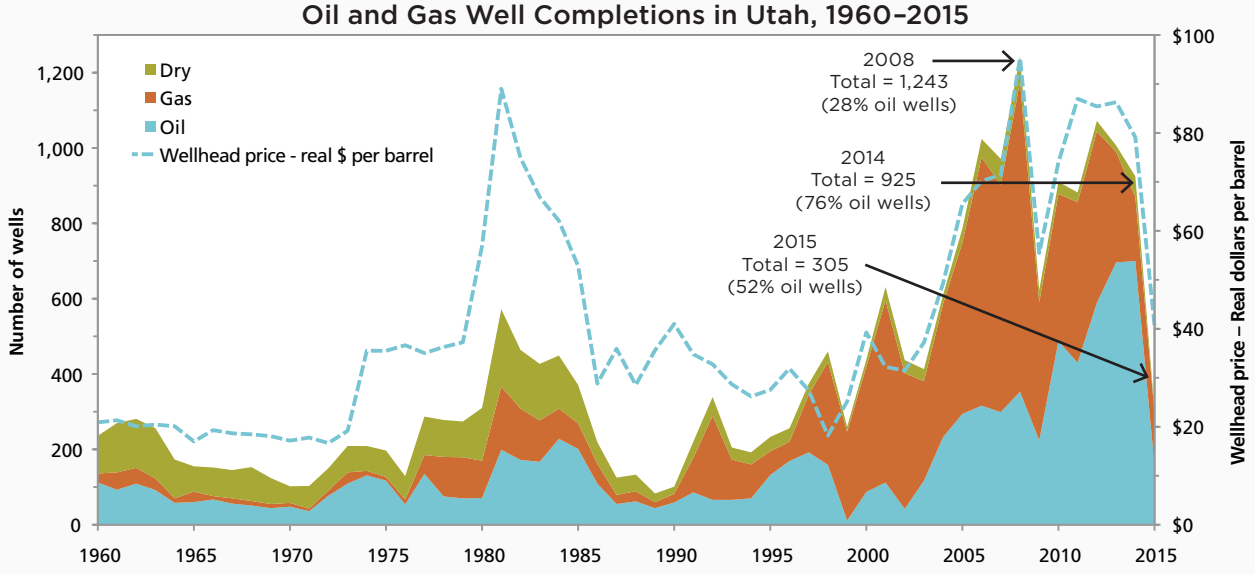


UEMS website table: Table 3.2 and Table 3.19 | Source: EIA

Note: 2015 data not yet available.

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. Of particular note is the massive drop (67%) in the number of wells drilled between 2014 (925) and 2015 (305) due to a large decrease in crude oil (and natural gas) price (49%). Also noteworthy 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.

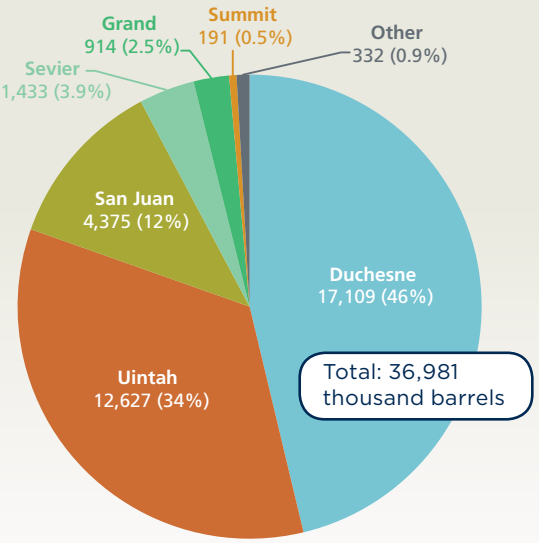
Oil and Gas Well Completions in Utah, 1960–2015



UEMS website table: Table 3.4 and Table 3.19 | Source: DOGM, EIA

Utah Crude Oil Production by County, 2015

Thousand barrels (Percent of total)

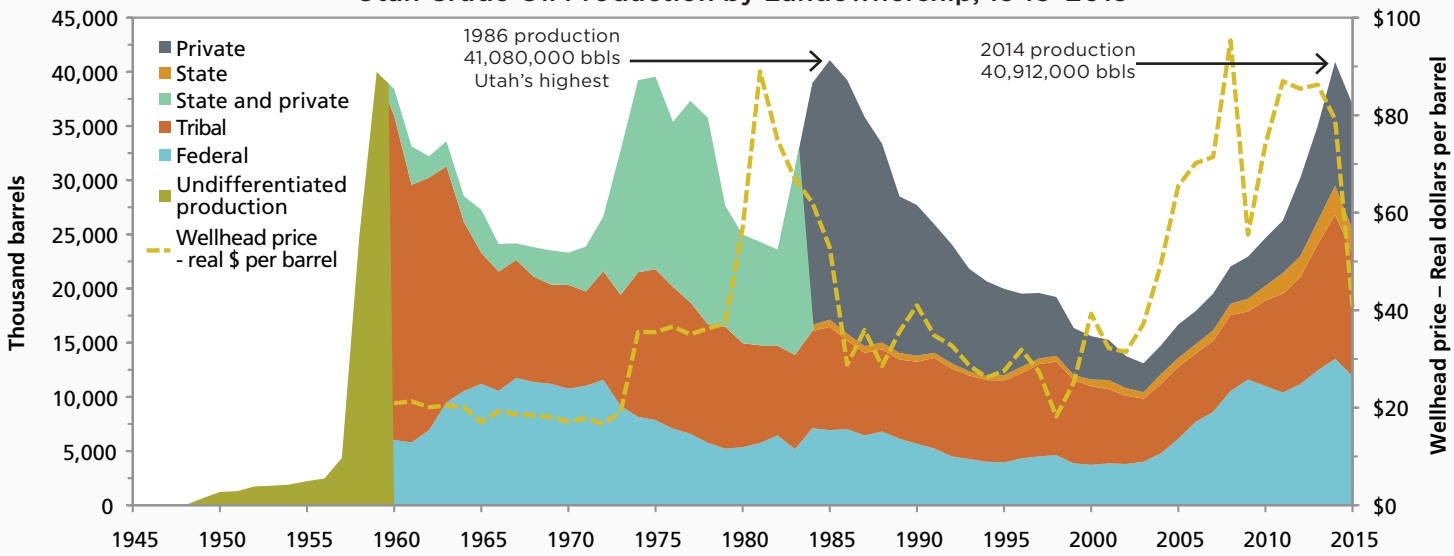


Crude oil production in Utah is mostly concentrated in Duchesne, Uintah, and San Juan Counties. Sevier County production started in 2004 with the discovery of the Covenant field.

UEMS website table: Table 3.7 | Source: DOGM

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

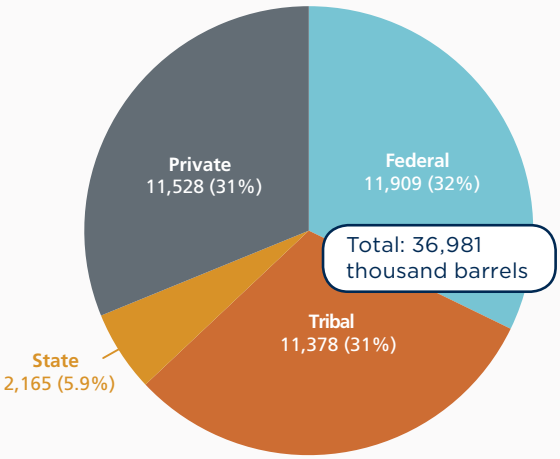
Utah Crude Oil Production by Landownership, 1945–2015



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 (mostly tribal lands) in 1955 and 1956, respectively. The second spike coincided with a 1971 increase in wellhead price and the discovery of the Altamont field (mostly private land). 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 (again, most new production was from private land). The most recent production peak is again related to higher prices which resulted in higher production from existing fields, new field discoveries in the Uinta Basin, and the discovery of the Covenant field in central Utah. With the 2015 drop in oil prices, production also dropped by 9.6% to 37.0 million barrels.

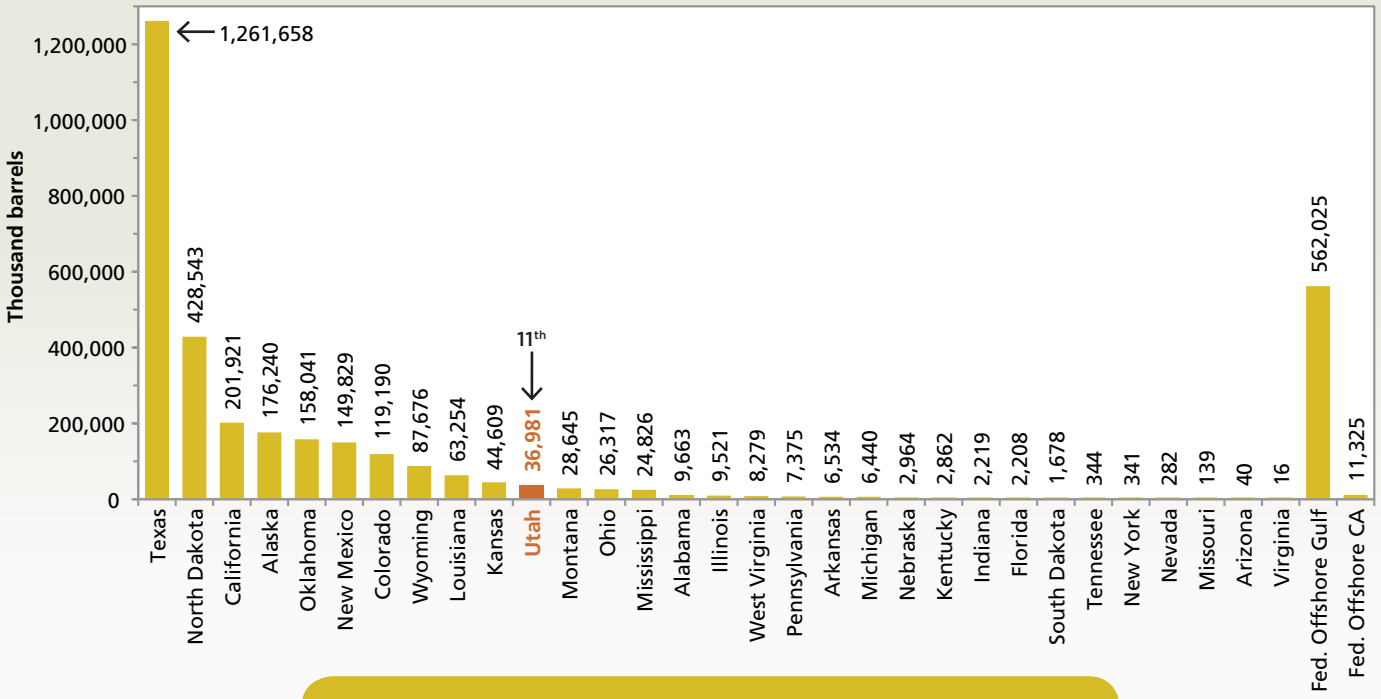
2015

Thousand barrels (Percent of total)



UEMS website table: Table 3.10 and Table 3.19 | Source: DOGM, EIA

U.S. Crude Oil Production by State, 2015

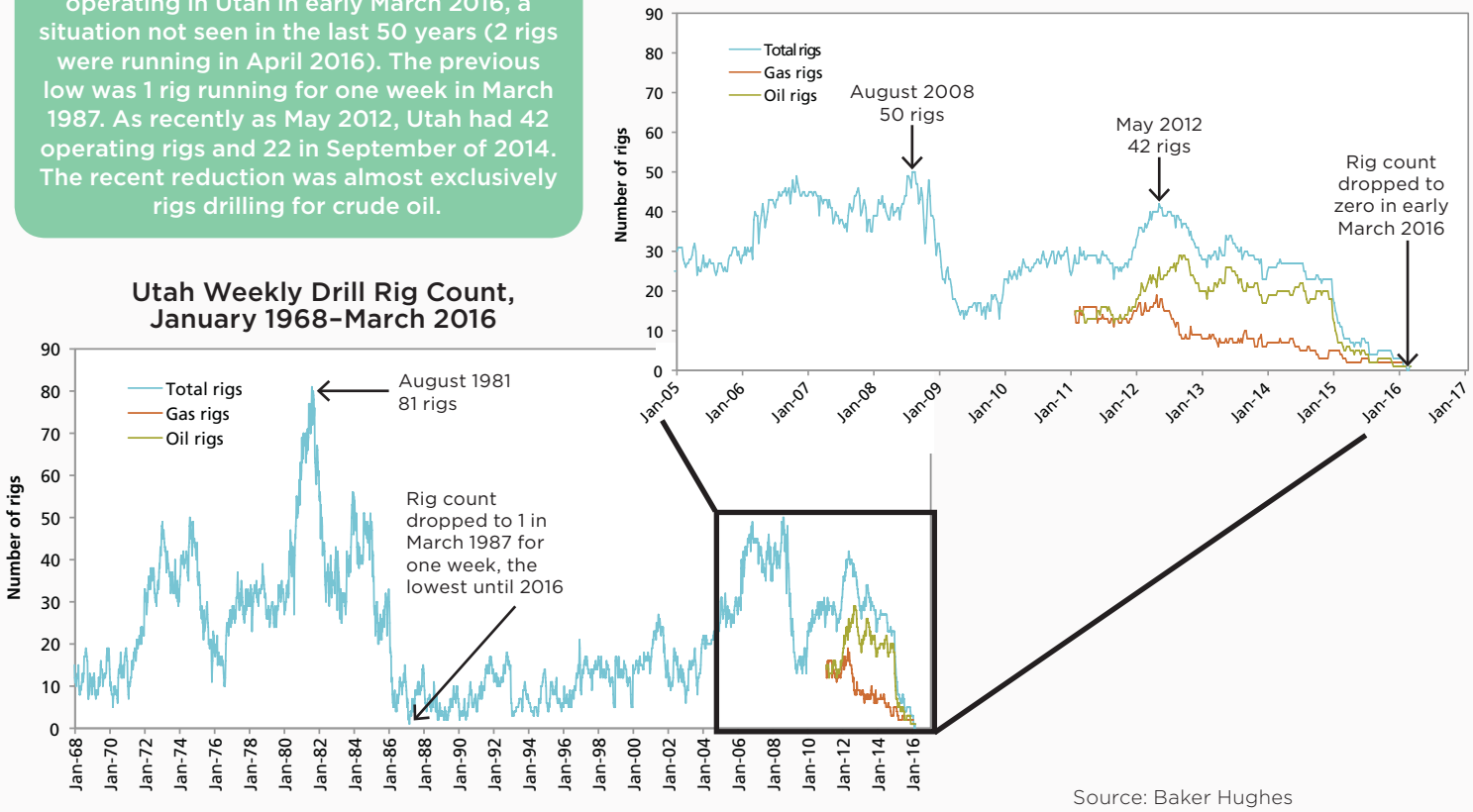


In 2015, Utah ranked as the 11th largest producer of crude oil in the United States (not including federal offshore areas).

UEMS website table: Table 3.5 | Source: EIA, DOGM

Due to low prices, no drill rigs were operating in Utah in early March 2016, a situation not seen in the last 50 years (2 rigs were running in April 2016). The previous low was 1 rig running for one week in March 1987. As recently as May 2012, Utah had 42 operating rigs and 22 in September of 2014. The recent reduction was almost exclusively rigs drilling for crude oil.

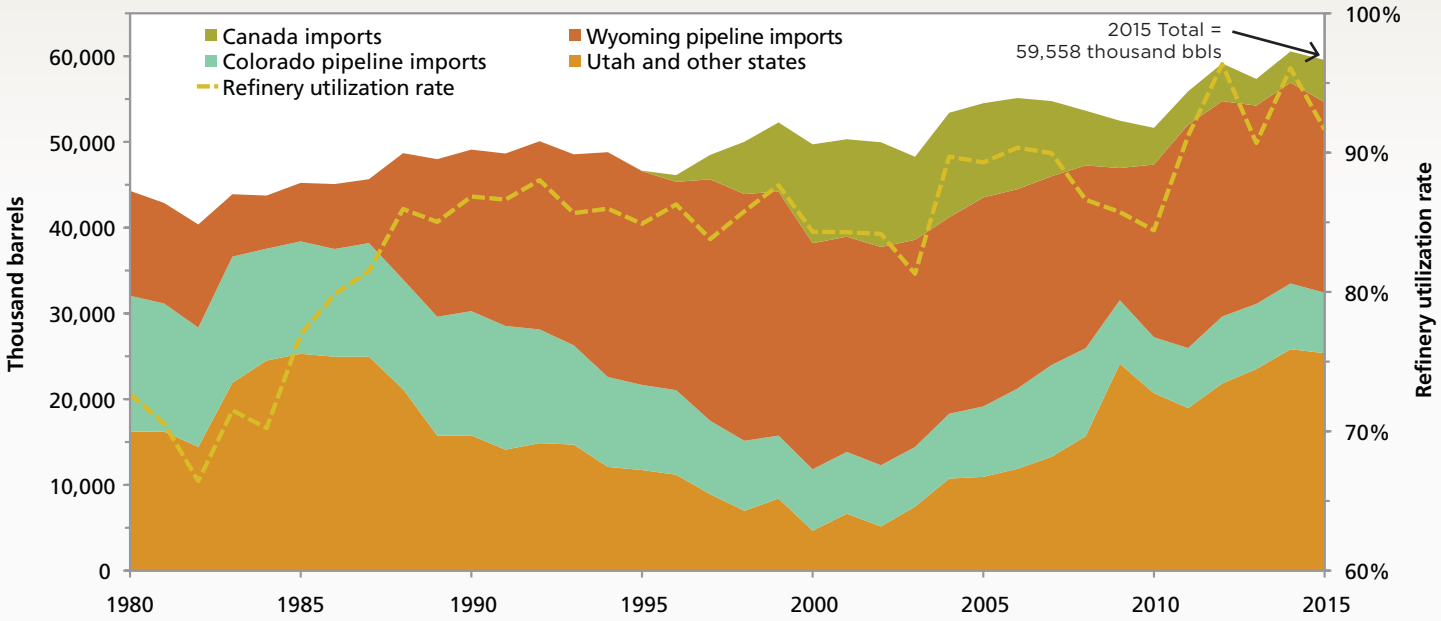
Utah Weekly Drill Rig Count, January 1968–March 2016



Source: Baker Hughes

In 2015, Utah refineries received 59,558 thousand barrels of crude oil (second highest year) from four main sources: Utah, Colorado, Wyoming, and Canada. In 2004, 23% of refinery receipts came from Canada, but with the recent increase in Utah crude oil production, the percentage from Canada has dropped to 8%. Utah's refinery utilization rate, the average ratio of crude oil inputs to total refinery capacity, has averaged 88% over the past 20 years. In 2015, the utilization rate was about 92%, but recently spiked to 96% in 2012 and 2014.

Origin of Crude Oil Shipped to Utah Refineries, 1980–2015

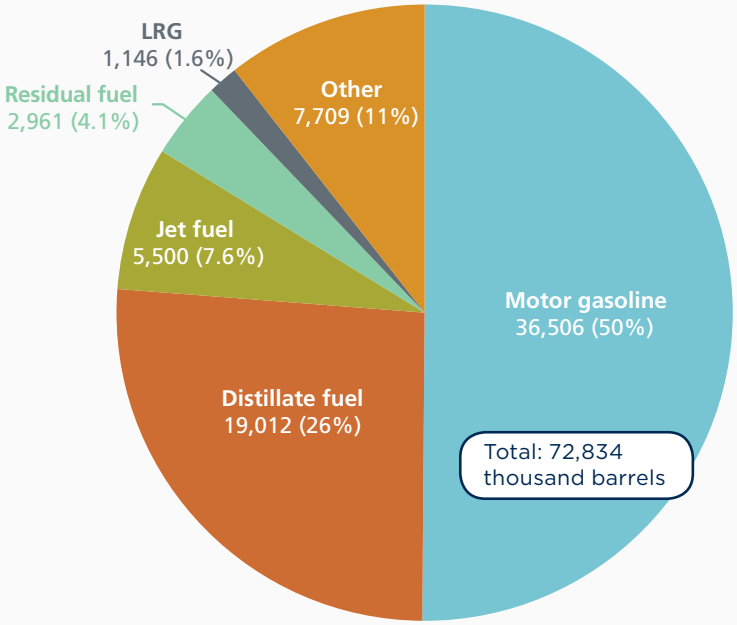


UEMS website table: Table 3.14 and Table 3.16 | Source: EIA, UGS

Note: Pipeline imports are known; however, deliveries via truck are difficult to track.

Utah Refinery Production by Product, 2015

Thousand barrels (Percent of total)

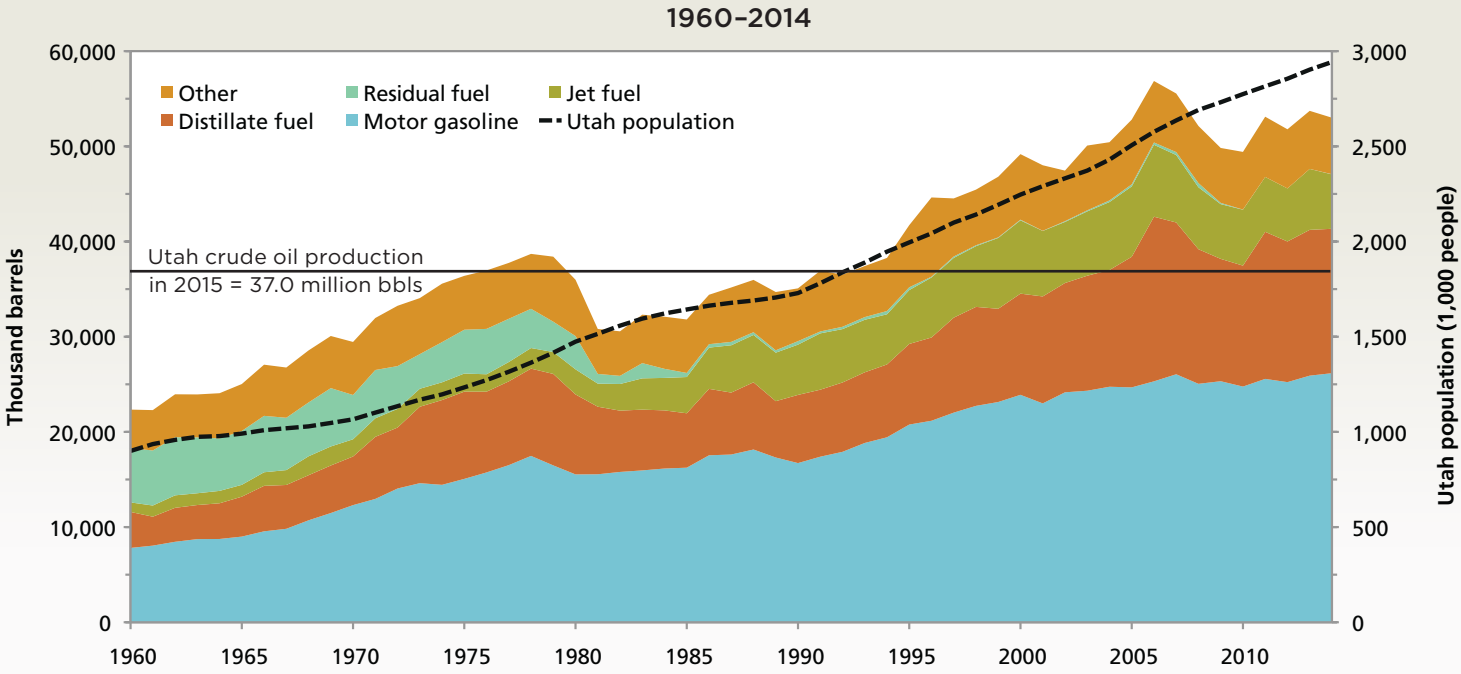


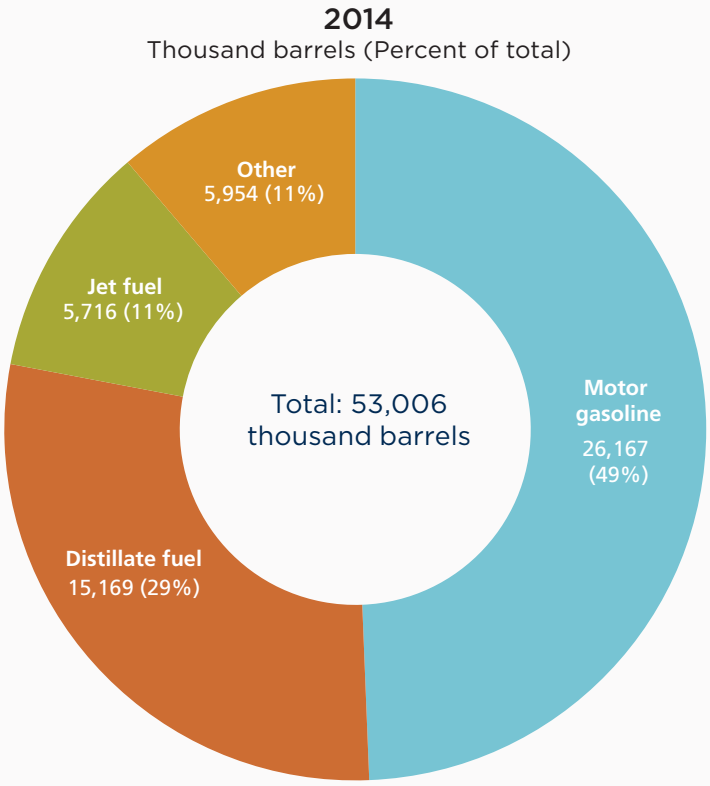
Utah refineries produced over 36 million barrels (1.5 billion gallons) of motor gasoline in 2015 and over 19 million barrels (798 million gallons) of distillate fuel (diesel).

UEMS website table: Table 3.15 | Source: EIA

Note: LRG = liquefied refinery gases

Consumption of Petroleum Products in Utah





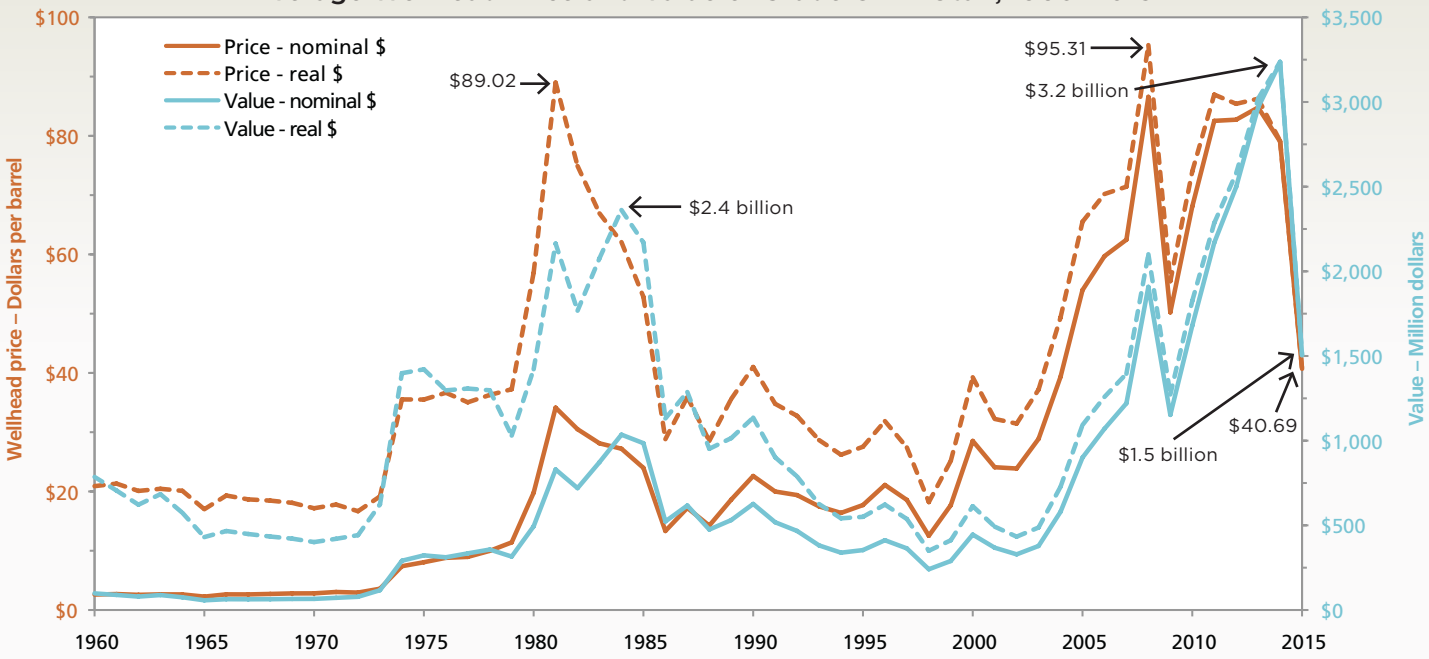
Motor gasoline was the most used petroleum product in 2014, accounting for 49% of all consumption. Distillate fuel ranked second at 29%, followed by jet fuel at 11%. Residual fuel use has declined greatly since the mid-1980s since it is no longer used as a fuel in power plants. Petroleum product consumption peaked in 2006 and has stayed in the low 50-million-barrel a year range for the past several years, rebounding in 2011 as the state recovered from the 2009 recession. Overall petroleum product consumption tracks well with Utah's population growth.

UEMS website table: Table 3.17 | Source: EIA

Note: "Other" includes asphalt and road oil, aviation gasoline, kerosene, liquefied petroleum gases, lubricants, among others.
Note: 2015 data are not yet available.

Utah's crude oil wellhead price hit an all-time, inflation-adjusted high of $95.31 per barrel in 2008. After a recession-related drop in 2009 and 2010, prices rebounded back into the low-$80s between 2011 and 2014 before plunging 49% to $40.69 per barrel in 2015. The value of Utah's crude oil reached a peak of $3.2 billion in 2014 as a result of high prices and near record production, but retreated to $1.5 billion in 2015.

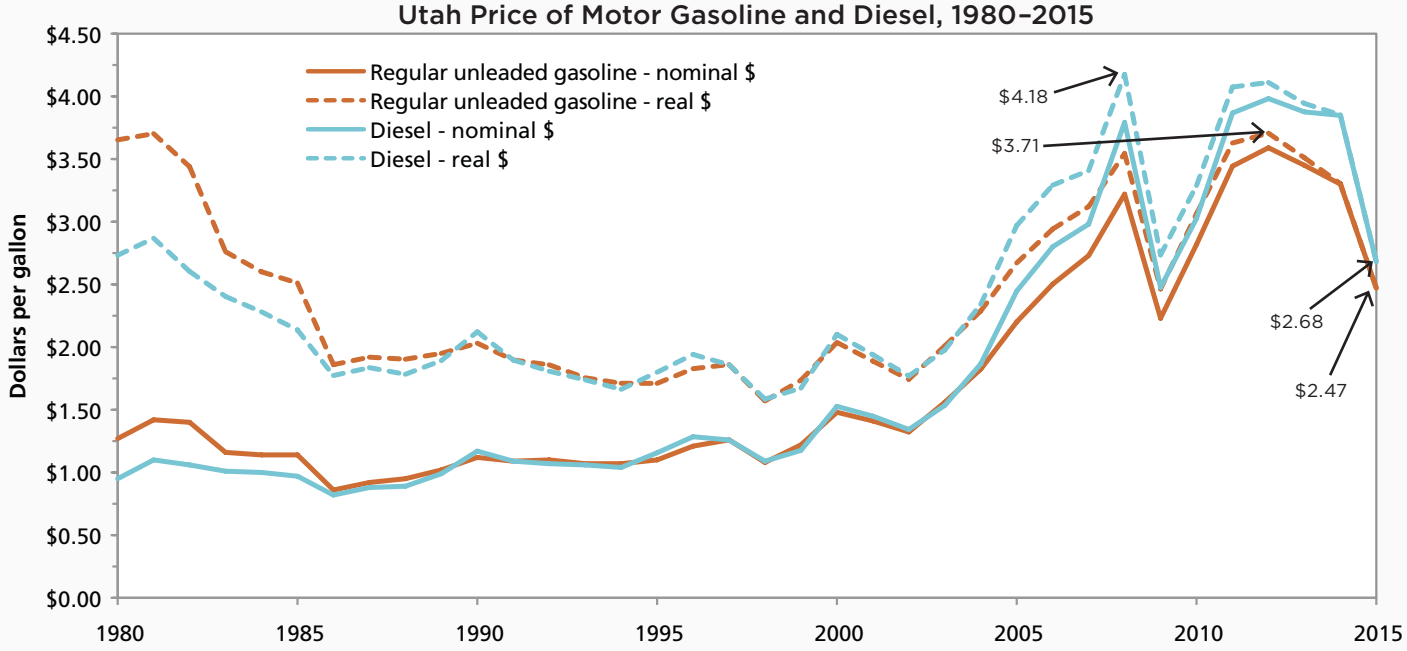
Average Wellhead Price and Value of Crude Oil in Utah, 1960–2015



UEMS website table: Table 3.19 | Source: EIA

Regular unleaded gasoline and diesel prices dropped in 2015 commensurate with crude oil prices, averaging $2.47 and $2.68 per gallon, respectively. In early 2016, gasoline prices continued to drop to a low of about $1.60 per gallon before rebounding slightly in March 2016.

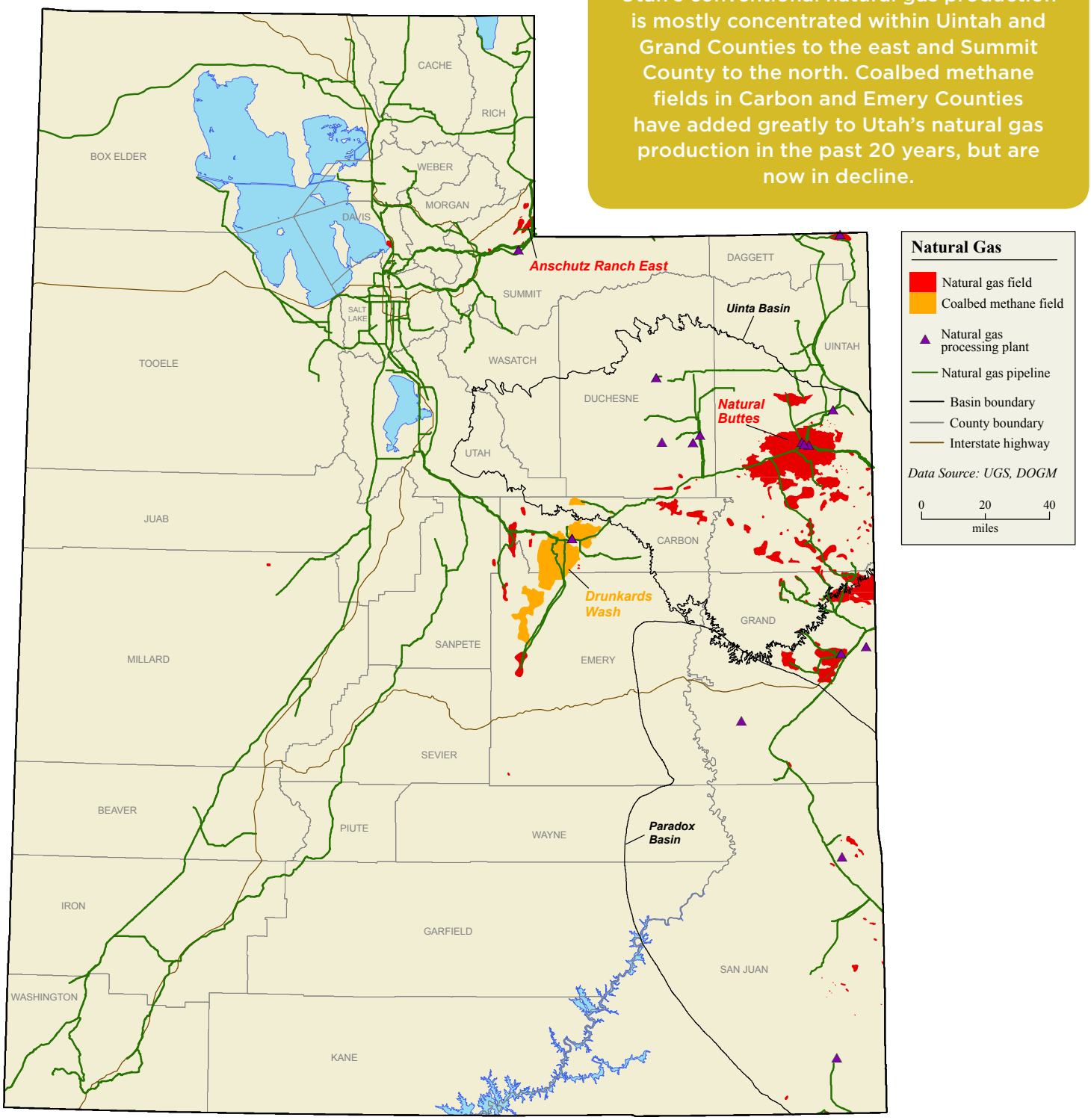
Utah Price of Motor Gasoline and Diesel, 1980–2015



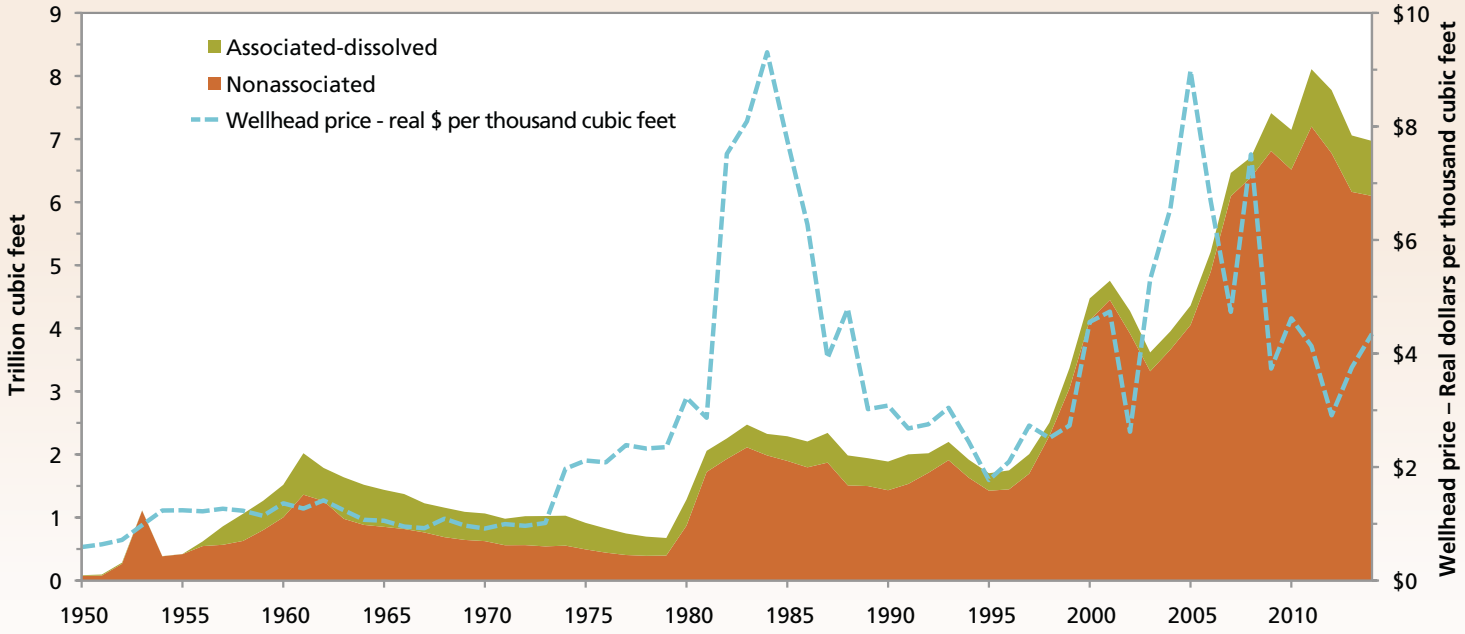
Source: EIA

natural gas

Utah's conventional natural gas production is mostly concentrated within Uintah and Grand Counties to the east and Summit County to the north. Coalbed methane fields in Carbon and Emery Counties have added greatly to Utah's natural gas production in the past 20 years, but are now in decline.



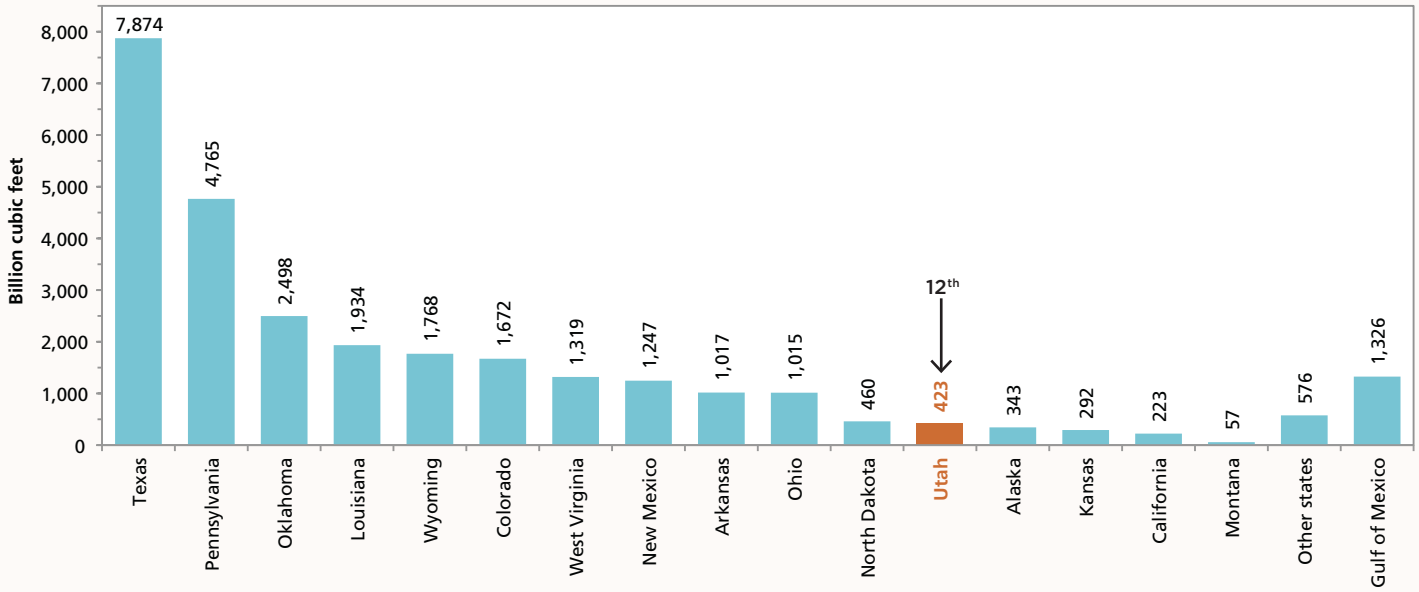
Natural Gas Reserves in Utah, 1950–2014



UEMS website table: Table 4.2 and Table 4.15 | Source: EIA, UGS
Note: 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). 2015 data are not yet available.

Natural gas reserves surged in 1980 and 1981, coinciding with an increase in wellhead prices, and a second reserve surge occurred in the late-1990s, coinciding with new development of coalbed methane fields. The recent peak in reserves is again the result of high prices recorded in the mid-2000s.

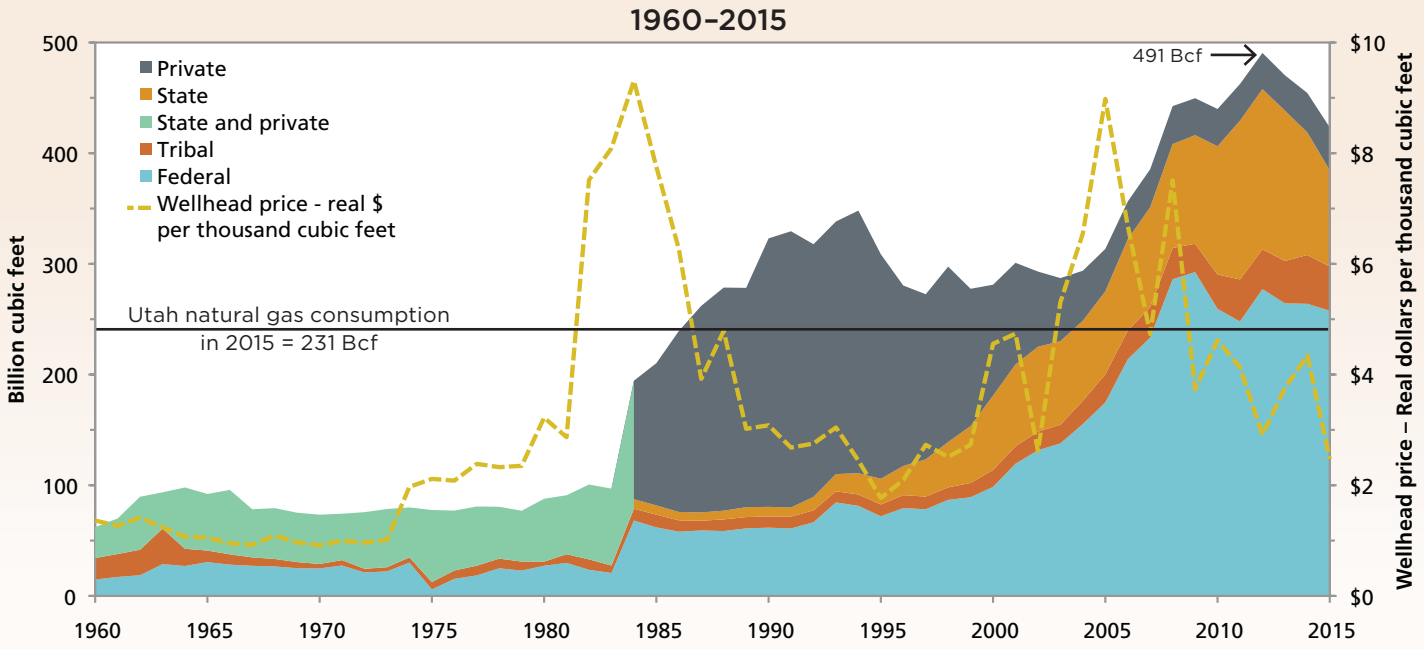
U.S. Natural Gas Production (Marketed) by State, 2015



UEMS website table: Table 4.3
Source: EIA, DOGM

In 2015, Utah ranked as the 12th largest producer of natural gas (marketed) in the United States (not including production in the Gulf of Mexico).

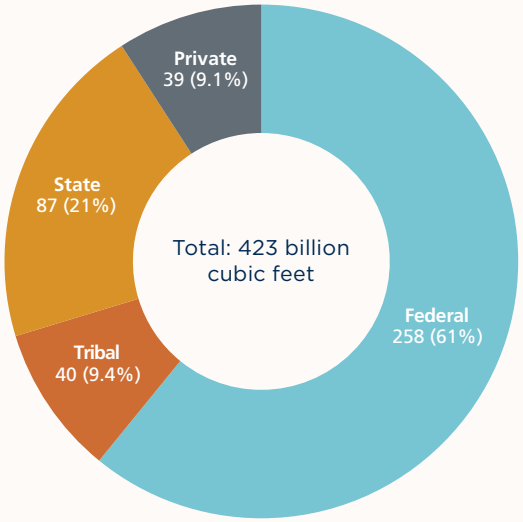
Utah Natural Gas Production (Gross) by Landownership



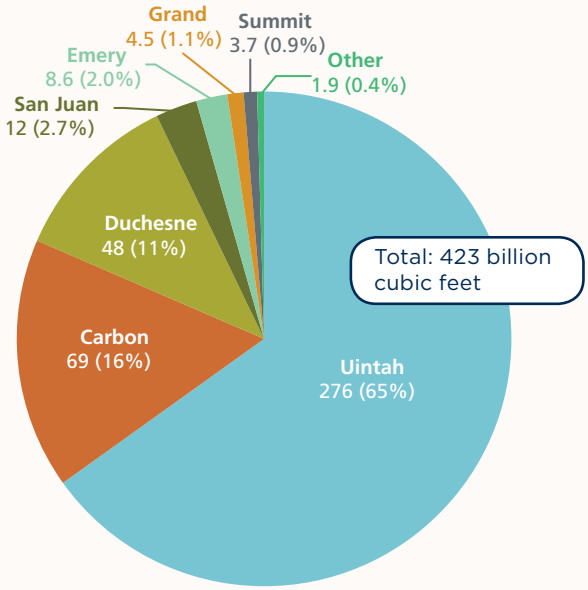
UEMS website table: Table 4.8 and Table 4.15
Source: DOGM, EIA, UGS

The first major increase in natural gas production occurred in the mid-1980s, coinciding with a large spike in prices and the discovery of fields in the Utah-Wyoming thrust belt (Anschutz Ranch East, mostly on private land). The mid-2000s surge in production was also price related, with production increasing on federal land mostly in Uintah County. As prices have fallen in 2015, down over 43%, production has also declined from peak production of 491 billion cubic feet in 2012 to 421 billion cubic feet in 2015, a 14% reduction.

2015
Billion cubic feet (Percent of total)



Utah Natural Gas Production (Gross) by County, 2015
Billion cubic feet (Percent of total)



Utah's largest portion (65%) of gross natural gas production occurs in Uintah County, which contains Utah's largest natural gas field, Natural Buttes. Production in Carbon County (17%) is dominated by coalbed methane fields, which are currently in decline, whereas natural gas produced in Duchesne County (11%) is associated with crude oil production.

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

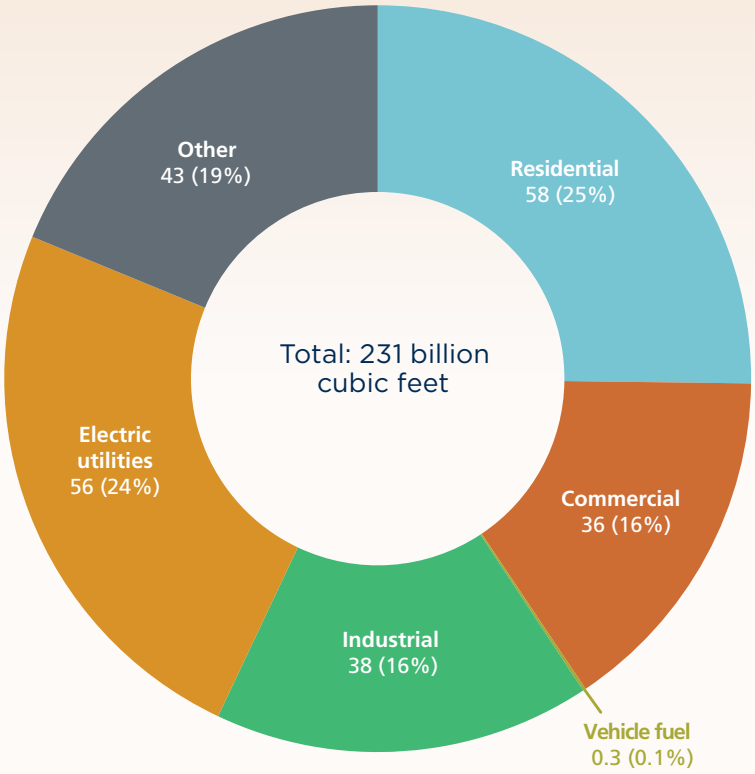
Consumption of Natural Gas in Utah

Natural gas is mostly used for home heating (residential, 25%), but starting in mid-2004, 2151 MW of new natural-gas-fired electric generating capacity has come online, greatly increasing the amount used by the electric utility sector (from 8% in 2005 to 24% in 2015). Consumption of natural gas in Utah has decreased from the high reached in 2013 of 247 billion cubic feet down to 231 billion cubic feet in 2015.

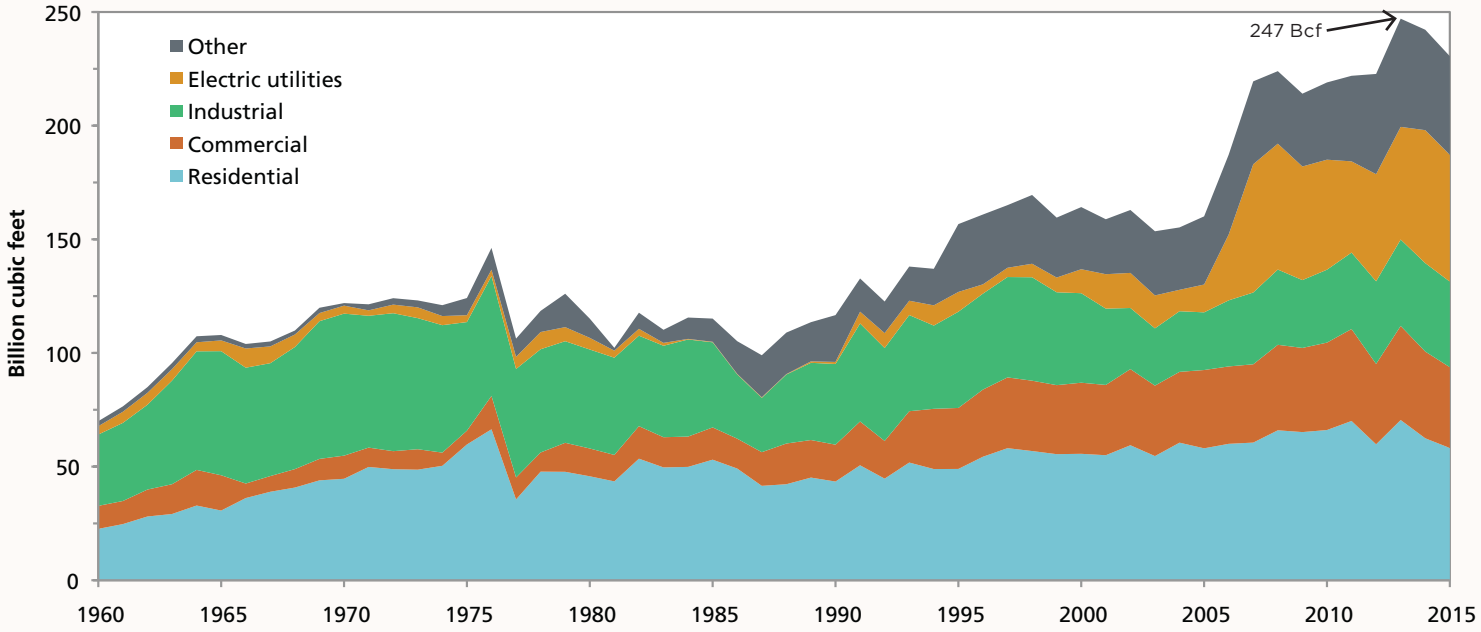
UEMS website table: Table 4.14 | Source: EIA
Note: "Other" includes lease use, plant use, pipeline fuel, and vehicle fuel (in historic graph only). 2015 data are preliminary.

Natural gas wellhead at the Lisbon field, southeast Utah

2015
Billion cubic feet (Percent of total)

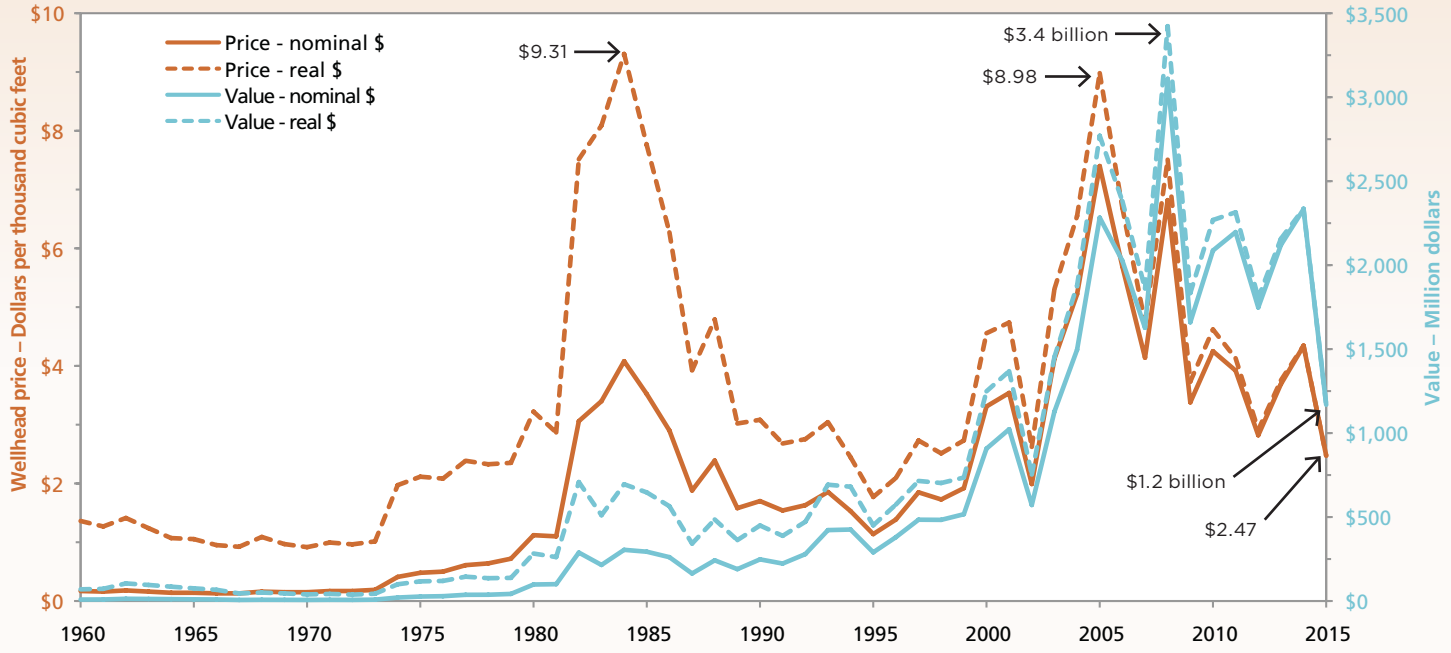


1960–2015



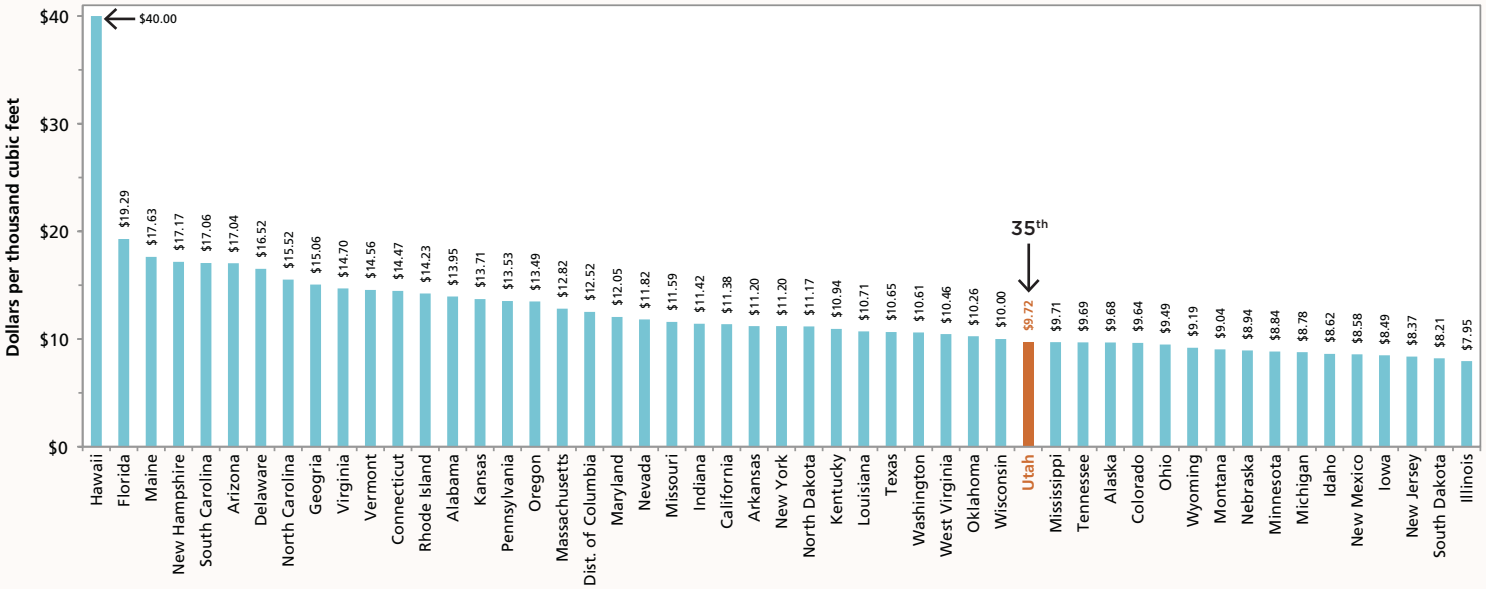
The price and value of natural gas produced in Utah in the past ten years have fluctuated dramatically, peaking in 2005 (due to high prices related to Hurricane Katrina) and again in 2008, before settling down to $2.47 per thousand cubic feet in 2015, translating to a value of $1.2 billion. Natural gas prices in early 2016 continued to slide down below $1.50 per thousand cubic feet, but are expected to rebound back above $2.00.

Average Wellhead Price and Value of Natural Gas in Utah, 1960–2015



UEMS website table: Table 4.15 | Source: EIA, UGS

Average Price of Residential Natural Gas by State, 2015



In 2015, Utah had the 17th-lowest price for residential natural gas in the country. From 2004 to 2011, Utah's natural gas price was one of the lowest in the nation (ranked 49th or 50th), but starting in 2012, Utah's price began to climb relative to the rest of the nation due to new pipelines connecting Utah's once captive natural gas resources to other areas of the county.

UEMS website table: Table 4.17 | Source: EIA

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. Not to be confused with the headline-dominating "shale oil," which is oil produced via horizontal wells and hydraulic fracturing (e.g., the Bakken shale in North Dakota), oil shale must be heated to high temperatures to convert the organic matter (kerogen) into usable oil. The UGS oil shale 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 potential in-place 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 oil.**
- A continuous interval of oil shale that averages **35 GPT** contains an in-place resource of **76 billion barrels** of oil.
- A continuous interval of oil shale that averages **25 GPT** contains an in-place resource of **147 billion barrels** of oil (see included map).
- A continuous interval of oil shale that averages **15 GPT** contains an in-place resource of **292 billion barrels** of 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 3000 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 the potential economic oil shale resource in Utah is approximately **77 billion barrels**.

Currently, and within this low-crude-oil environment, only a few companies are pursuing oil shale development in Utah, all focusing on near surface deposits in the southeastern part of the resource.

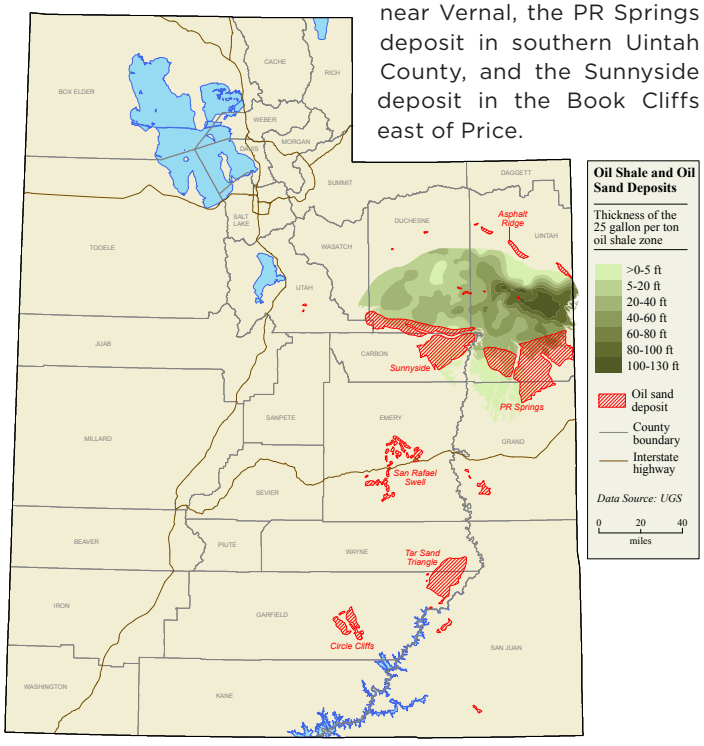
The most prospective unconventional fossil fuel resources are located in the Uinta Basin in northeastern Utah.

oil sands

North America has the greatest oil sand resources in the world, the majority of which are in Canada. Utah's oil sand resource, though small in comparison to that of Canada, is the largest in the United States. Utah's oil 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 additional 50 deposits are scattered throughout the southeastern part of the state. Utah's major oil 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.

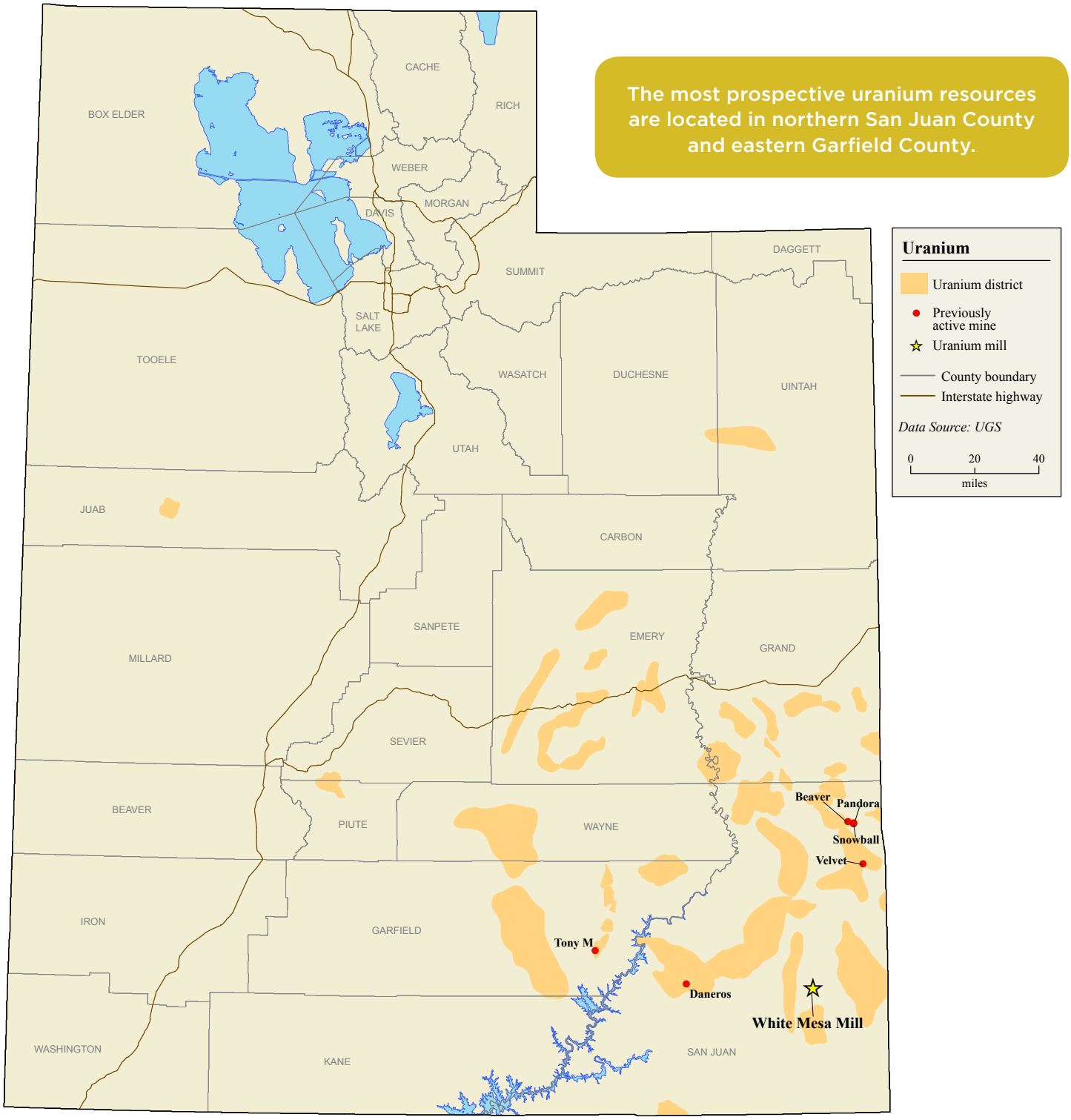
New drilling, bitumen extraction, and upgrading techniques developed in Canada may provide the necessary knowledge for successful and sustainable development of oil sand in Utah, but any new development will be dependent on a return of higher crude oil prices. In addition, factors such as site accessibility, 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 oil sand development can become a reality in Utah.

Currently, a few oil sands companies are in various stages of commercial development within the Asphalt Ridge deposit near Vernal, the PR Springs deposit in southern Uintah County, and the Sunnyside deposit in the Book Cliffs east of Price.



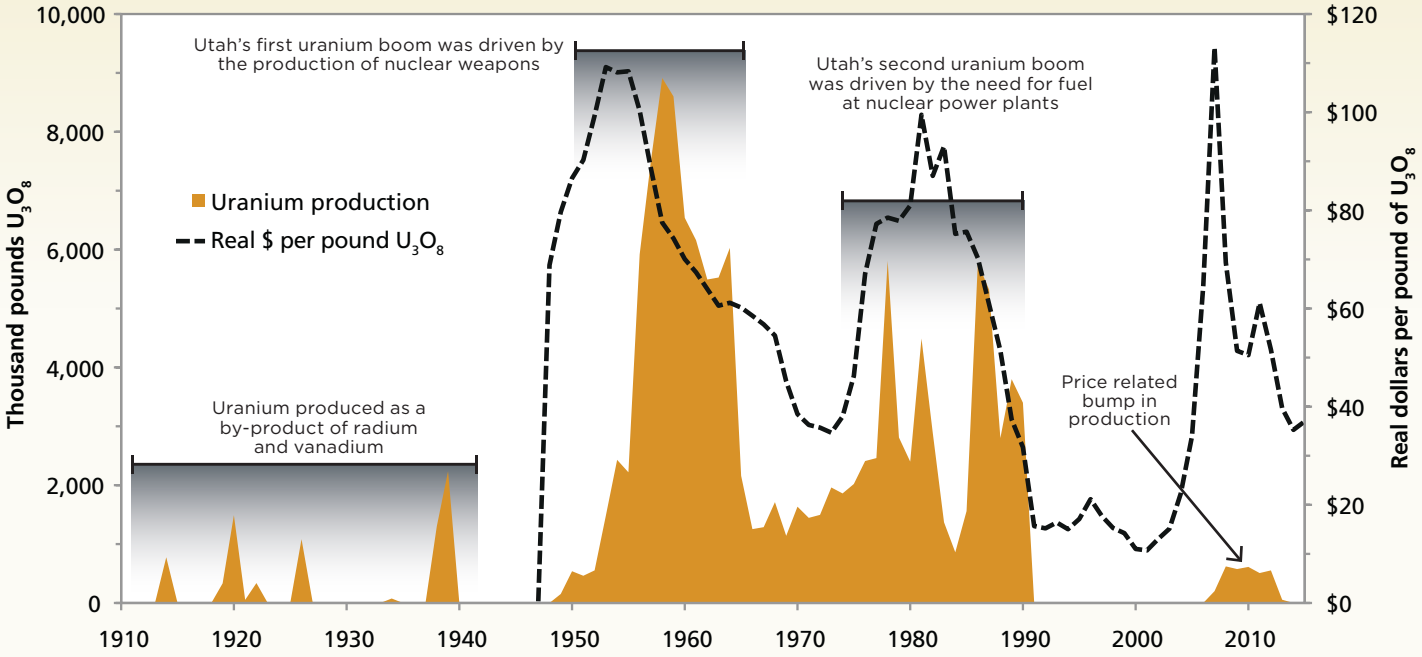
uranium

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



From 1910 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_3O_8 before declining in the mid-1960s. During this time, production occurred at over 500 individual mines.

Uranium Production in Utah, 1910–2015



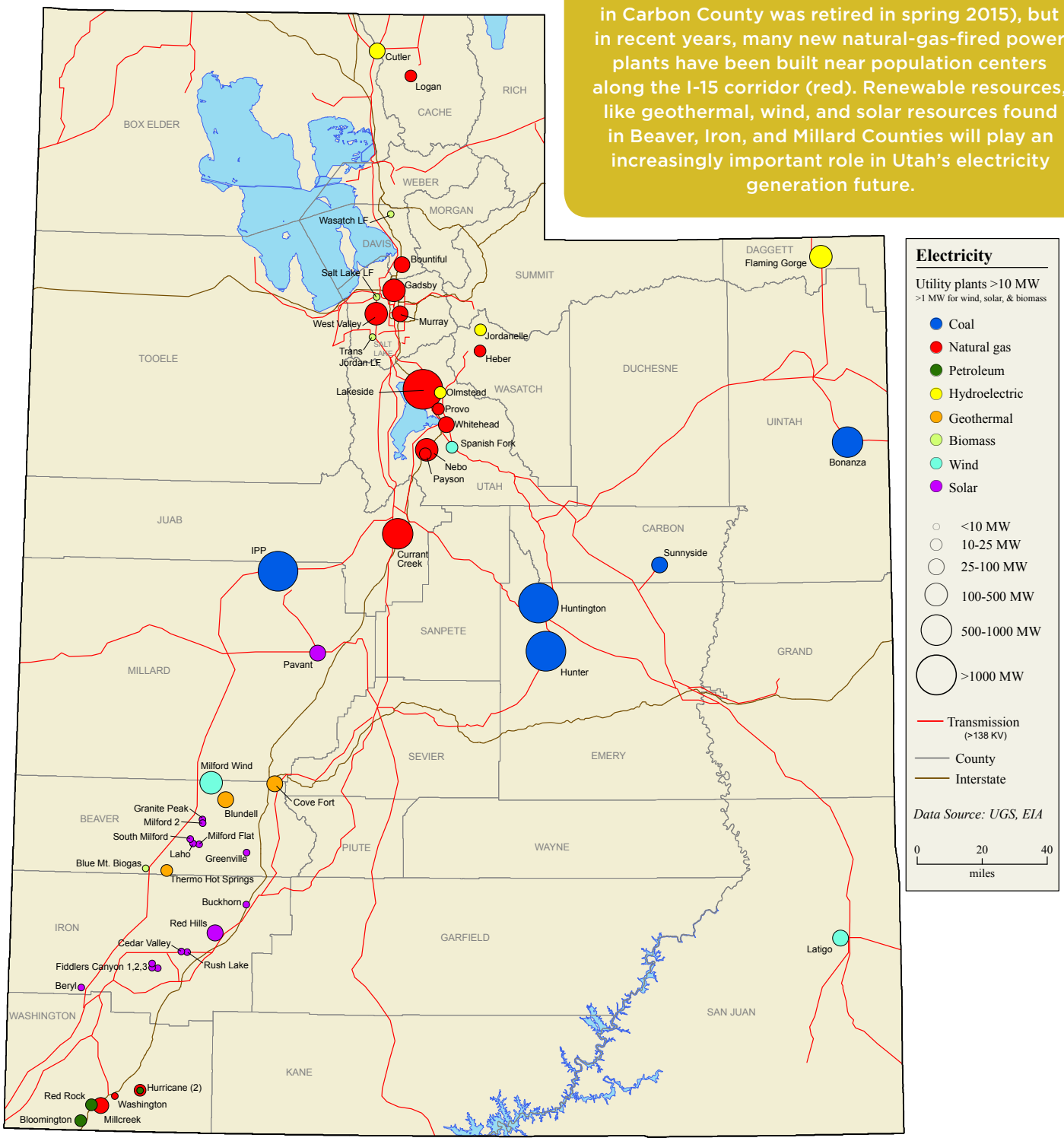
UEMS website table: Table 9.1 | Source: EIA, UGS

A second period of increasing uranium production began in the early-1970s with the development of the U.S. nuclear power industry, peaking in 1978 at 5.8 million pounds U_3O_8. Since the mid-1980s, Utah's underground ores have 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 $113 per pound in 2007. This resurgence in uranium price resulted in the reopening of several Utah uranium mines which produced 3.1 million pounds between 2007 and 2013. In addition, the White Mesa uranium mill, located outside of Blanding, Utah, once again began processing uranium ore (and currently only processes ore from Arizona). However, as prices dropped to around $35 per pound in 2014, uranium mining in Utah has once again come to a stop.

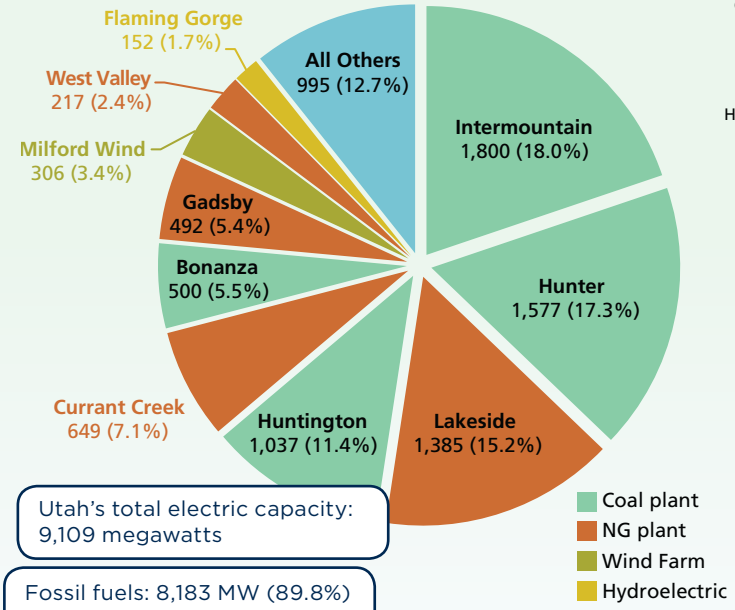
electricity

Utah's electric generation is dominated by five large coal-fired power plants (blue; the Carbon coal-fired power plant [not shown on map] located in Carbon County was retired in spring 2015), 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 geothermal, wind, and solar resources found in Beaver, Iron, and Millard Counties will play an increasingly important role in Utah's electricity generation future.



Utah's 10 Largest Power Plants

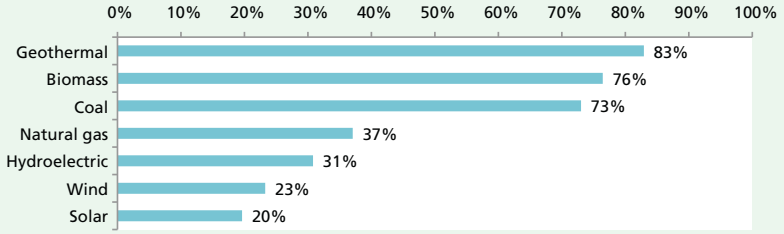
Capacity in megawatts (Percent of total)



Utah's total electric capacity: 9,109 megawatts

Fossil fuels: 8,183 MW (89.8%)
Renewables: 927 MW (10.2%)

Annual Net Capacity Factor for Utah Power Plants (2014)

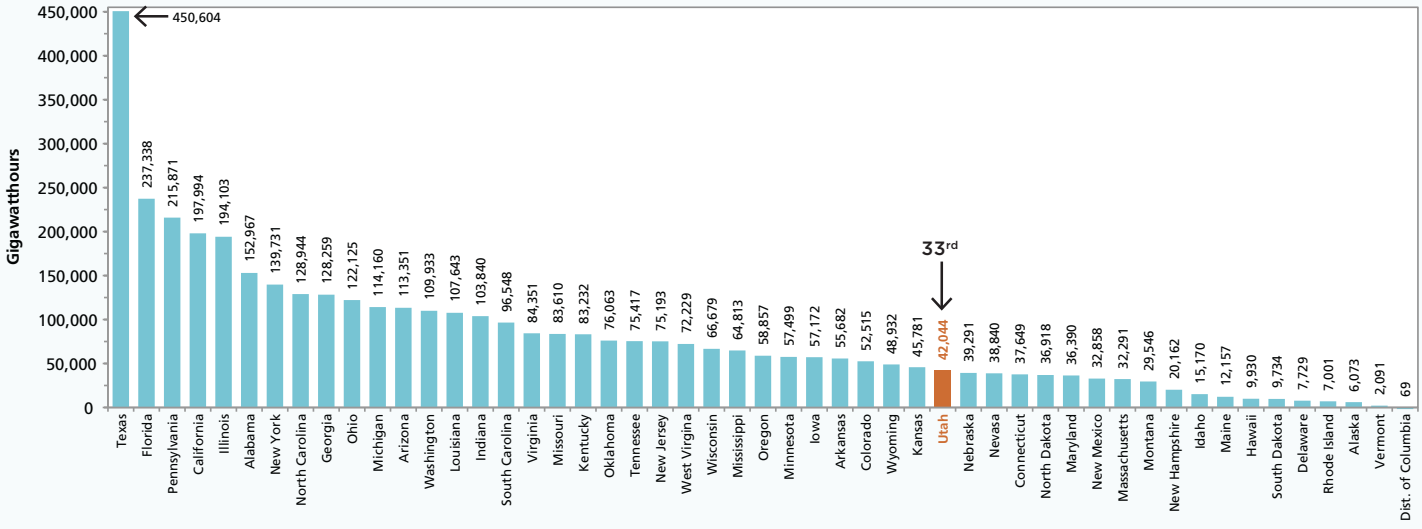


Utah's electricity portfolio is dominated by coal-fired power plants. However, several natural gas plants have been built in the past 15 years (Lakeside – 2007, 2014; Currant Creek – 2005–2006; West Valley – 2002; and three new units at Gadsby – 2002) decreasing Utah's reliance on coal generation. The largest renewable facilities are the Milford wind farm, which added 306 MW of capacity in 2009/2011, and the venerable Flaming Gorge hydroelectric plant, which came online in 1963–1964. However, not all electric plants utilize their total capacity. For example, plants with higher capacity factors run as base load operations (coal, geothermal, and biomass), whereas natural gas and hydroelectric plants operate as "peaker" plants, supplying electricity only when demand is high. Wind and solar facilities only produce electricity when the wind is blowing and the sun is shining, resulting in a capacity factor of only about 20%.

UEMS website table: Table 5.1 | Source: EIA

Note: Only includes utility plants. The net capacity factor of a power plant is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity continuously over the same period of time. Capacity factors in the graph above were calculated from 2014 Utah-specific data. The solar capacity factor is based on very limited data, but is roughly equivalent to other solar facilities in surrounding states.

U.S. Electricity Generation by State, 2015



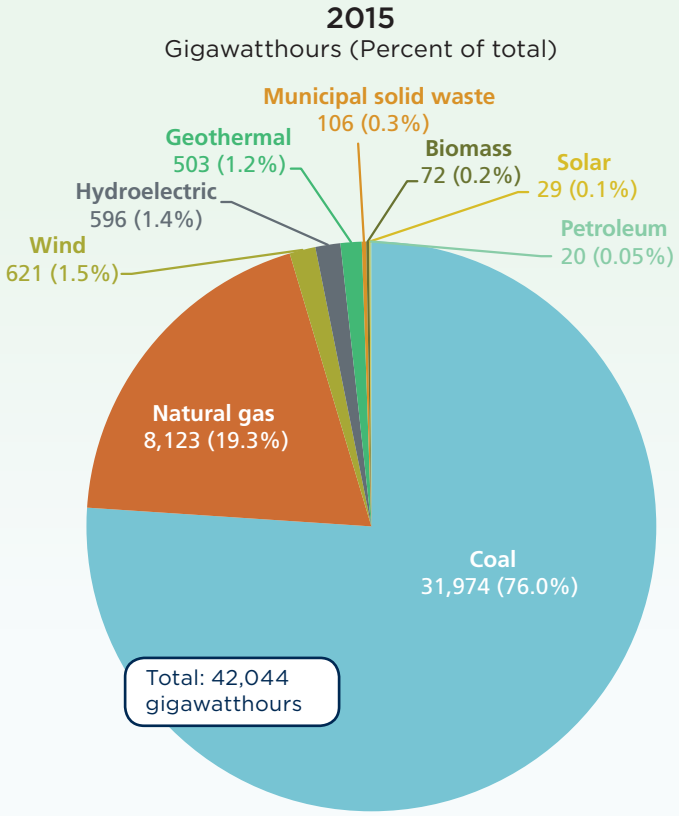
Utah's total net generation of electricity ranked 33rd in the nation in 2015.

UEMS website table: Table 5.9 | Source: EIA

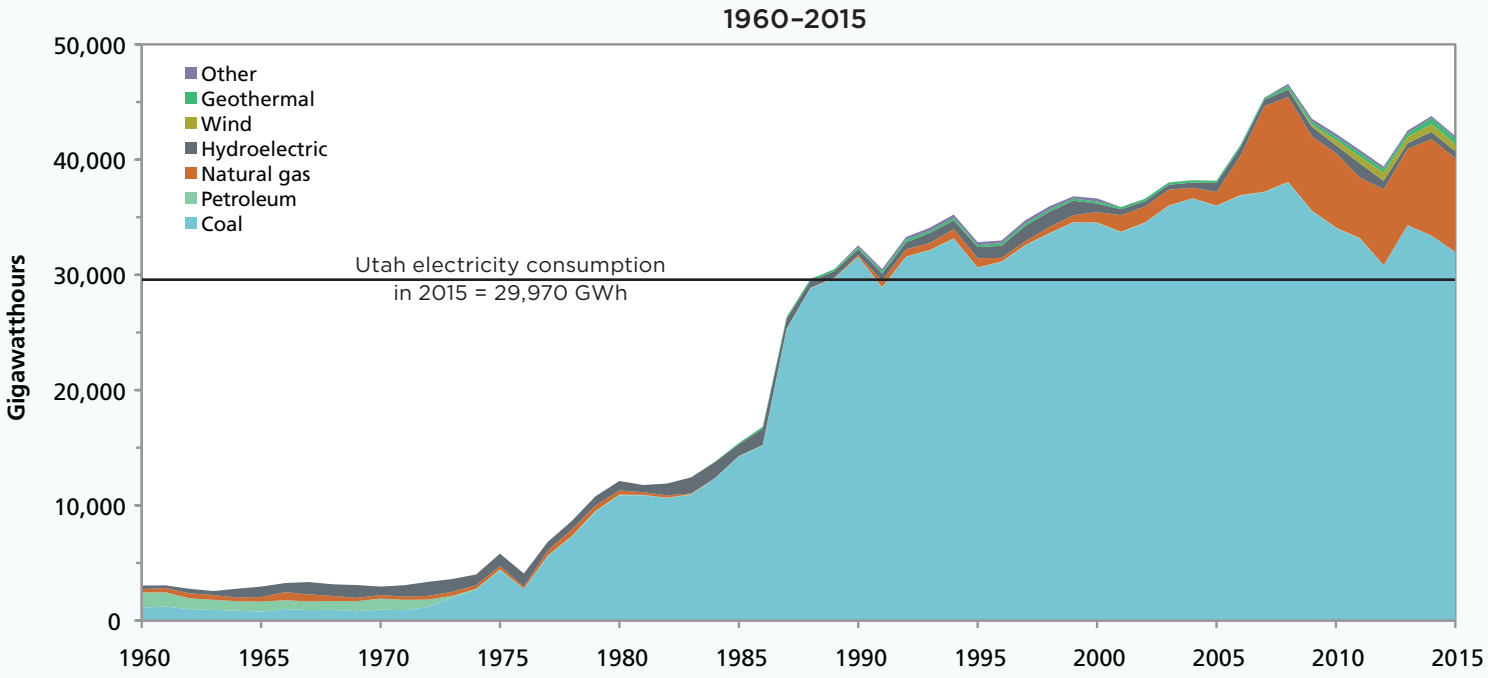
Note: 2015 data are preliminary

Net Generation of Electricity in Utah by Energy Source

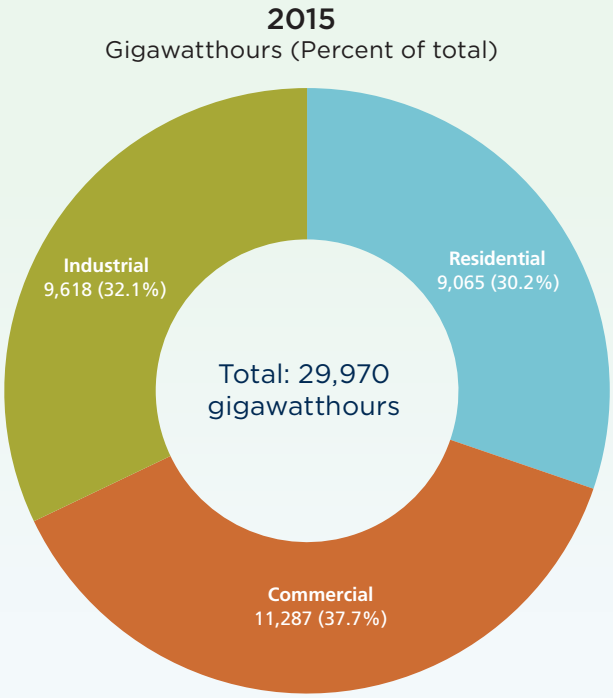
Coal has dominated Utah's electricity generation portfolio, accounting for 94% of Utah's total net generation in 2005. However, since 2004, 2,151 megawatts of new natural-gas-fired electric capacity were built, decreasing coal's overall share to 76% in 2015 and increasing natural gas's share to 19%. Utah's share of electricity generated from renewable resources has jumped to 4.3% with the addition of the 306-megawatt Milford wind farm and should jump even further in 2016 with the addition of nearly 850 MW of solar capacity. Electric generation peaked in 2008 at 38,020 GWh, but quickly declined during the recession that followed (the 2012 low was the result of an unexpected 6-month maintenance shut-down on one of two units at the Intermountain Power Plant). Electricity generation rebounded in 2013, but dropped again in 2014 and 2015 mostly due to mild winter and summer temperatures.



UEMS website table: Table 5.10 | Source: EIA
Note: "Other" includes municipal solid waste, landfill gas, solar, and other gases derived from fossil fuels. 2015 data are preliminary.

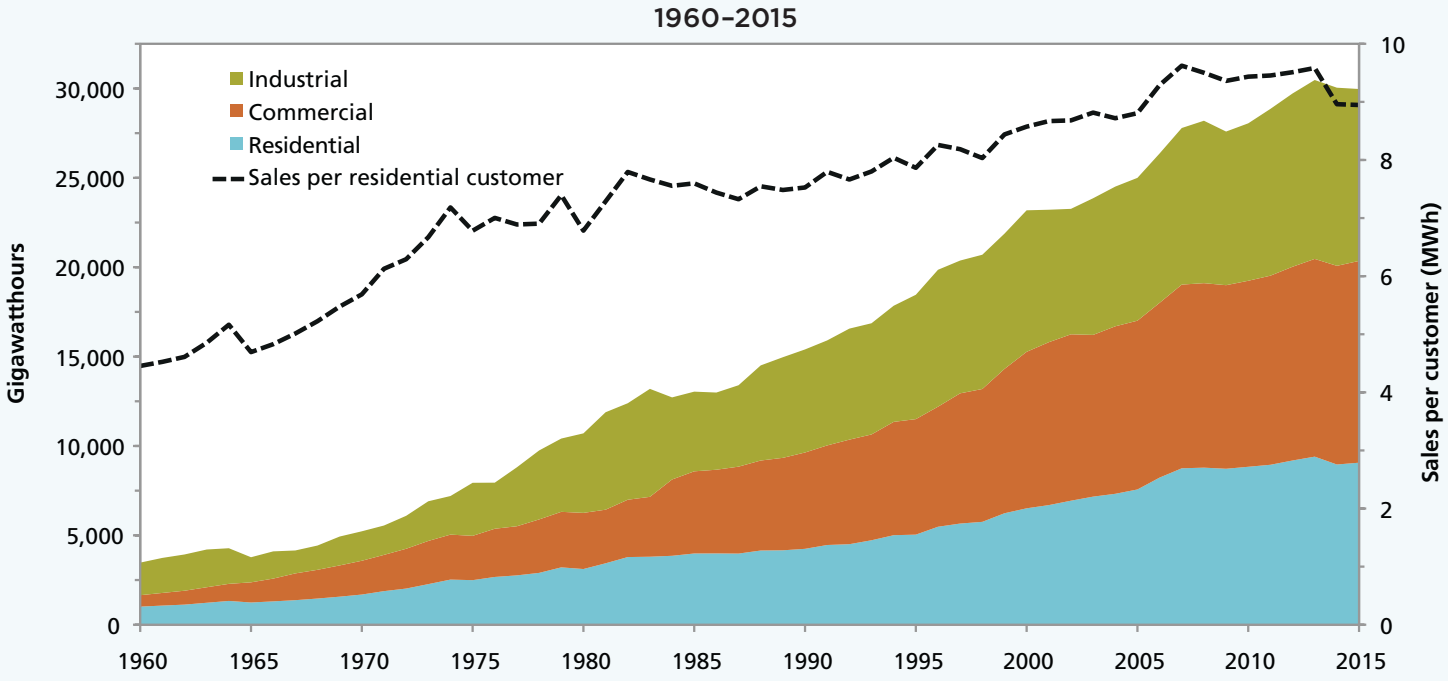


Sales of Electricity in Utah by Sector

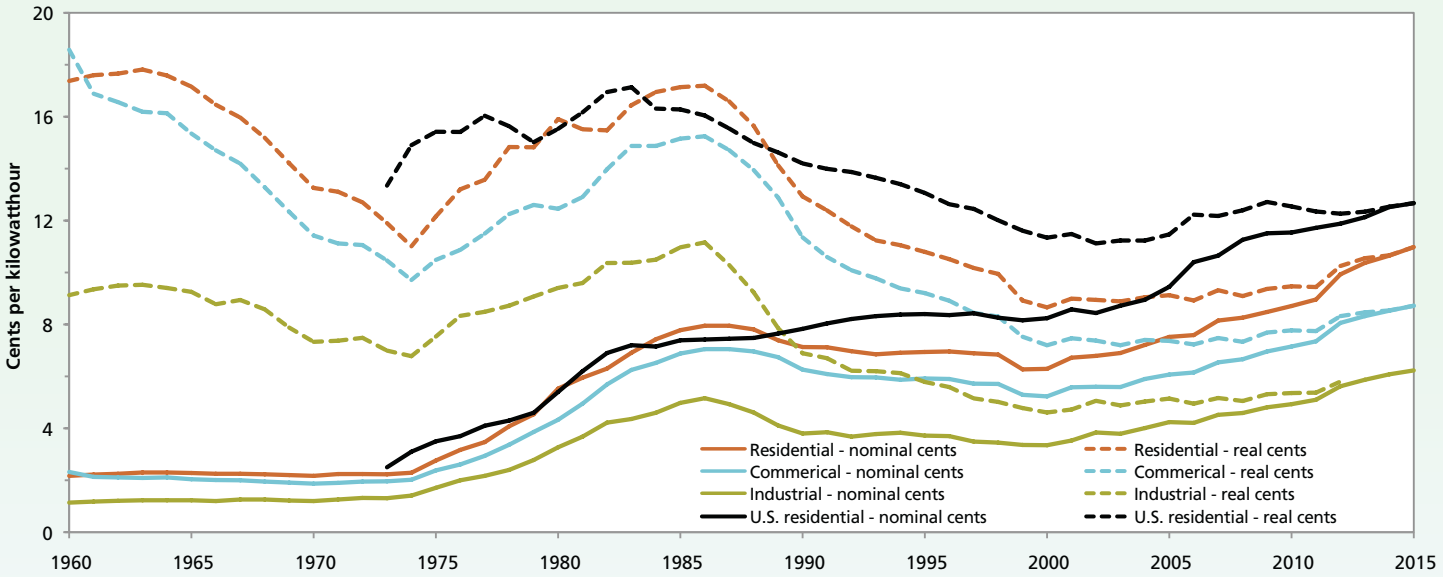


Since 1960, electricity sales in Utah increased at an average annual rate of 4.1%, roughly following increases in population (an average increase of 2.1% per year) and increases in per customer electricity use (an average increase of 1.3% per year). In 1960, each residential customer in Utah used about 4.5 MWh annually. Currently, the average residential customer usage has more than doubled to 8.9 MWh per year. As with electric generation, electricity sales dropped in 2014 and 2015 due to mild winter and summer temperatures.

UEMS website table: Table 5.19 | Source: EIA
Note: Electricity used by the transportation sector (UTA transit) is very small (56 GWh in 2015) and is included in commercial on the graphs on this page. 2015 data are preliminary.



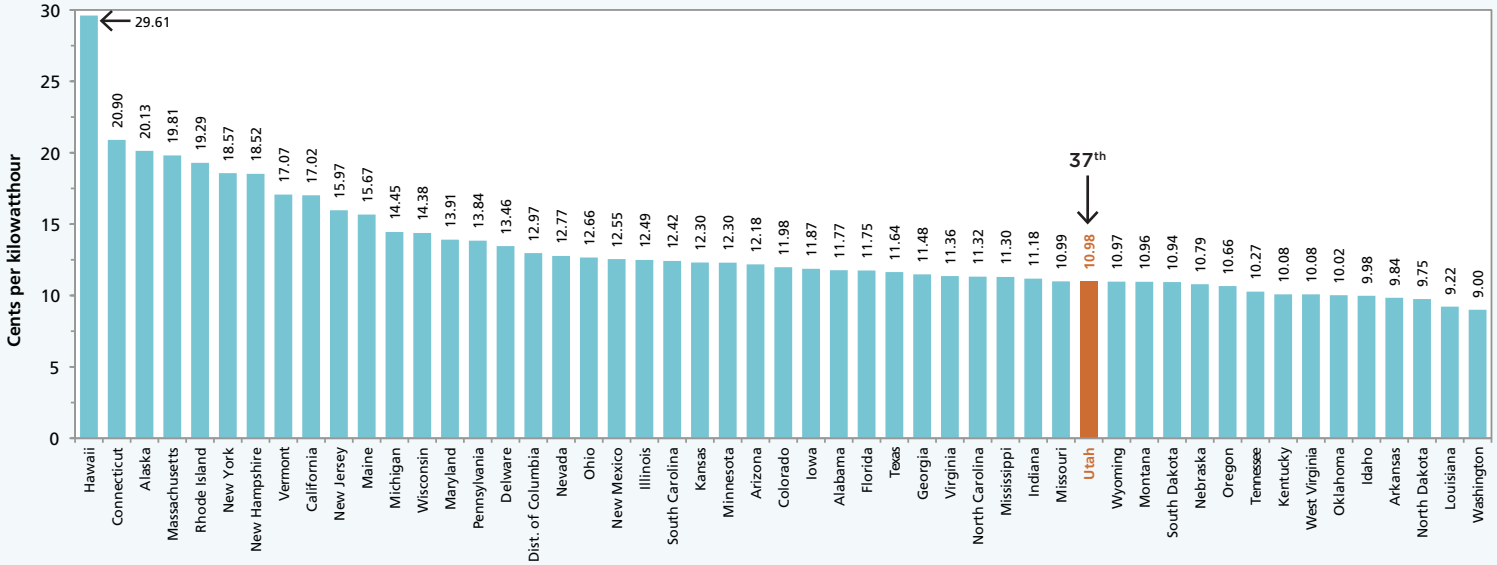
Price of Electricity in Utah by Sector, 1960–2015



The price of electricity in Utah has been on a gradual upward trend since 2000, but is still well below the national average. Utah's price for residential electricity averaged 11 cents per kilowatthour in 2015, 15% lower than the average residential price in the U.S. of 12.7 cents per kilowatthour.

UEMS website table: Table 5.20 | Source: EIA
Note: 2015 data are preliminary.

Average Residential Price of Electricity by State, 2015



Utah's average price of residential electricity ranked 15th lowest in the nation in 2015; lower prices in Utah are attributed to the state's fully amortized coal-fired generation.

UEMS website table: Table 5.21 | Source: EIA
Note: 2015 data are preliminary.

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