Economic Impacts of Utah's Energy Industry, 2017

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THE UNIVERSITY OF UTAH
DAVID ECCLES SCHOOL OF BUSINESS

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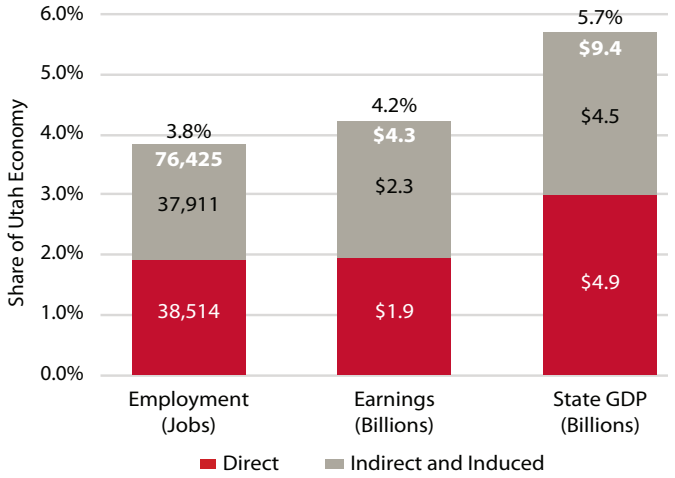
Analysis in Brief

Utah's diverse energy industry plays a significant role in the state's economy. It encompasses traditional fossil fuels and renewable resources. The mining sector produces crude oil, natural gas, and coal. Power producers generate electricity from hydropower, geothermal, solar, wind, and biomass resources and distribute it within the state and across the western U.S. Five refineries process crude oil from Utah, Colorado, Wyoming, and Canada, and Utah has the only licensed and operating uranium mill in the country. Dozens of firms manufacture machinery for mining and the oil and gas fields as well as turbines, generators, transformers, and other electrical equipment. There are more than 60 petroleum wholesalers and 30 fuel dealers across the state. Solar installation and energy efficiency activities support thousands of jobs.

Key Findings

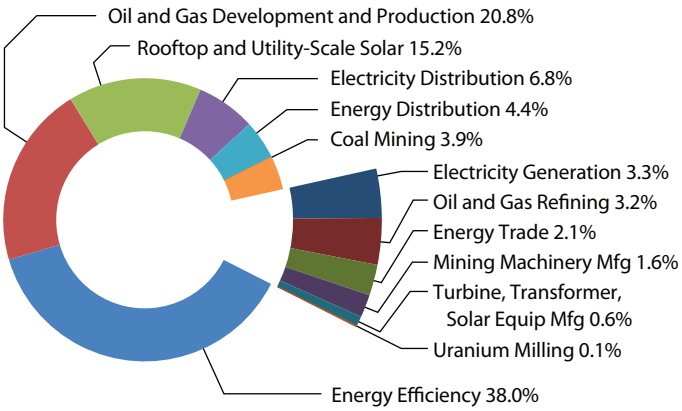
- **Share of the Economy**—In 2017, Utah's energy industry directly and indirectly supported 3.8% of the state's employment, 4.2% of its earnings, and 5.7% of its gross domestic product (GDP).
- **Jobs**—Energy activities provided an estimated 38,514 full- and part-time jobs, 1.9% of total jobs in the state.
- **Earnings**—Energy workers earned more than $1.9 billion in 2017, 1.9% of total earnings paid.[1] Average earnings (excluding energy efficiency jobs) were $81,257 per annum, 60% higher than the statewide average for all industries.
- **GDP**—Utah's energy industry directly contributed $4.9 billion to the state's GDP, 3.0% of the total.[2]
- **Multiplier Effects**—Energy industry purchases supported an additional 37,911 jobs, $2.3 billion in earnings, and almost $4.5 billion in state GDP. The energy industry's total economic impacts in Utah in 2017 included 76,425 jobs, $4.3 billion in earnings, and $9.4 billion in state GDP.
- **State and Local Fiscal Impacts**—Energy-related royalties, severance taxes, conservation fees, property taxes, and sales taxes totaled $492.1 million in 2017.
- **Low Retail Energy Prices**—Prices range from 6% to 23% below the national average for most energy users. At current consumption levels, if Utahns were paying national average prices they would pay $578.4 million more for electricity and natural gas. Because of these low prices, state GDP is about 0.4% larger than it would have been under national average prices, employment is about 0.3% higher, and earnings are about 0.7% higher.
- **Energy Production**—In 2017, Utah produced
  - 34,437,937 barrels of crude oil worth $1.6 billion, 11th in the nation
  - 315,197,367,000 cubic feet of natural gas worth $1.0 billion, 13th in the nation
  - 14,417,284 short tons of coal worth $505.1 million, 10th in the nation
  - 32,315,000 MWh of electricity from coal, natural gas, and other fossil fuels
  - 4,922,000 MWh of electricity from solar, hydro, geothermal, wind, and biomass
  - 2,211,000 MWh of utility-scale solar, fifth in the nation

Utah Energy Industry Economic Impacts, 2017



Note: Does not include direct earnings and GDP associated with energy efficiency jobs.
Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services, U.S. Bureau of Economic Analysis, Utah Geological Survey, National Association of State Energy Officials, Energy Futures Initiative, and Energy Fuels using the REMI PI+ model

Energy Industry Employment by Sector, 2017



Sector	Jobs
Energy Efficiency[1]	14,626
Oil and Gas Development and Production	7,999
Rooftop and Utility-Scale Solar [2]	5,862
Electricity Distribution	2,602
Energy Distribution	1,710
Coal Mining	1,496
Electricity Generation	1,290
Oil and Gas Refining	1,223
Energy Trade	809
Mining Machinery Manufacturing	601
Turbine, Transformer, Solar Equipment Manufacturing	250
Uranium Milling	46
Total	**38,514**

1. Includes jobs where workers spend at least half of their time on energy efficiency–related tasks.
2. Excludes jobs at solar utilities and solar equipment manufacturers, which are counted in those sectors.
Source: Utah Department of Workforce Services; Bureau of Labor Statistics, Quarterly Census of Employment and Wages; Bureau of Economic Analysis; National Association of State Energy Officials; Energy Futures Initiative; Solar Foundation; Energy Fuels

Table of Contents

Introduction 1
Terms Used 2
Economic Impacts 3
Oil and Gas Development and Production 3
Oil Refining 6
Coal 7
Electricity Generation 9
Mining and Oil and Gas Field Machinery Manufacturing .. 12
Turbine, Transformer, and Solar Equipment Manufacturing 12
Uranium 13
Other Energy Sectors 13
Electricity Distribution 13
Oil and Gas Product Distribution 13
Solar 14
Energy Efficiency 15
Fiscal Impacts 16
Energy Prices 18
Industry SWOT Analyses 20
Oil and Gas 20
Mineral Fuels 20
Wind 21
Solar 22
Geothermal 23
Methodology 23
Economic Impact Model 23
Fiscal Impact Model 23
Conclusion 24

Figures

Figure 1: Utah Energy Industry Economic Impact, 2017 1
Figure 2: Energy Industry Employment by Sector, 2017 2
Figure 3: Oil and Gas Deposits and Active Fields in Utah 3
Figure 4: Oil Shale and Oil Sands Deposits in Utah 4
Figure 5: Crude Oil Production in Utah, 2008–2017 4
Figure 6: Utah Crude Oil Production by County, 2017 4
Figure 7: Value of Crude Oil Production in Utah, 2008–2017 5
Figure 8: Natural Gas Production in Utah, 2008–2017 5
Figure 9: Utah Natural Gas Production by County, 2017 5
Figure 10: Value of Natural Gas Production in Utah, 2008–2017 5
Figure 11: Wells Spudded in Utah, 2008–2017 5
Figure 12: Wellhead Prices in Utah, 2008–2017 6
Figure 13: Oil and Gas Development and Production Employment in Utah, 2008–2017 6
Figure 14: Utah Monthly Refinery Inputs, 2008–2017 6
Figure 15: Refinery Employment in Utah, 2008–2017 7
Figure 16: Utah Coal Resources and Active Mines 7
Figure 17: Coal Production in Utah, 2008–2017 8
Figure 18: Utah Coal Production by County, 2017 8
Figure 19: Value of Coal Production in Utah, 2008–2017 8
Figure 20: Coal Mining Employment in Utah, 2008–2017 8
Figure 21: Net Utility-Scale Electricity Generation in Utah, 2008–2017 9
Figure 22: Fuel Mix of Utility-Scale Electricity Generatio in Utah, 2017 9
Figure 23: Identified Renewable Energy Resources in Utah 9
Figure 24: Net Utility-Scale Electricity Generation in Utah from Renewable Sources, 2008–2017 10
Figure 25: Retail Sales of Electricity in Utah by Sector, 2008–2017 11
Figure 26: Per Capita Retail Sales of Electricity in Utah, 2008–2017 11
Figure 27: Electric Utility Employment in Utah, 2008–2017 11
Figure 28: Mining and Oil and Gas Field Machinery Manufacturing Employment, 2008–2017 11
Figure 29: Turbine and Transformer Manufacturing Employment, 2008–2017 12
Figure 30: U_3O_8 Production and Uranium Mining Establishments in Utah, 2008–2017 12
Figure 31: Electricity Distribution Employment, 2008–2017 13
Figure 32: Oil and Gas Product Distribution Employment, 2008–2017 13
Figure 33: Energy Trade Employment and Establishments, 2008–2017 14
Figure 34: Estimated Small-Scale Solar Photovoltaic Capacity in Utah, 2014–2017 14
Figure 35: Estimated Small-Scale Solar Photovoltaic Generation in Utah, 2014–2017 14
Figure 36: Solar Jobs in Utah, 2015–2017 14
Figure 37: Total State and Local Energy-Related Revenues and Average Crude Oil Wellhead Prices, 2008–2017 16
Figure 38: Annual Change in Nominal Crude Oil Wellhead Price and Oil and Gas Jobs, 1991–2017 18
Figure 39: Effects of Utah's Low Energy Prices 18
Figure 40: Changes in Value Added by Industry Due to Lower Energy Prices 19
Figure 41: Economic SWOT Analysis of Utah's Oil and Gas Sector 20
Figure 42: Economic SWOT Analysis of Utah's Mineral Fuels Sector 21

Figure 43: Economic SWOT Analysis of Utah's Wind Sector 21
Figure 44: Economic SWOT Analysis of Utah's Solar Sector 22
Figure 45: Economic SWOT Analysis of Utah's Geothermal Energy Sector 22

Tables

Table 1: Components of Utah's Energy Industry 1
Table 2: Economic Impacts of Utah's Oil and Gas Development and Production Industry, 2017 6
Table 3: Economic Impacts of Utah's Oil Refining Industry, 2017 7
Table 4: Economic Impacts of Utah's Coal Mining Industry, 2017 8
Table 5: Economic Impacts of Utah's Fossil Fuel Electricity Generation, 2017 11
Table 6: Economic Impacts of Utah's Renewable Electricity Generation, 2017 11
Table 7: Economic Impacts of Utah's Mining and Oil and Gas Field Machinery Manufacturing Industry, 2017 ... 11
Table 8: Economic Impacts of Utah's Turbine, Transformer, and Solar Equipment Manufacturing Industry, 2017 .. 12
Table 9: Economic Impacts of Utah's Uranium Milling Industry, 2017 12
Table 10: Incremental Energy Efficiency Savings, 2017 ... 15
Table 11: Direct Energy-Related State and County Revenues, 2017 16
Table 12: Direct Energy-Related State and County Revenues, 2008–2017 17
Table 13: Additional Energy Industry Estimated State and Local Fiscal Impacts, 2017 17
Table 14: Five-Year Average Energy Prices, U.S. vs. Utah .. 18

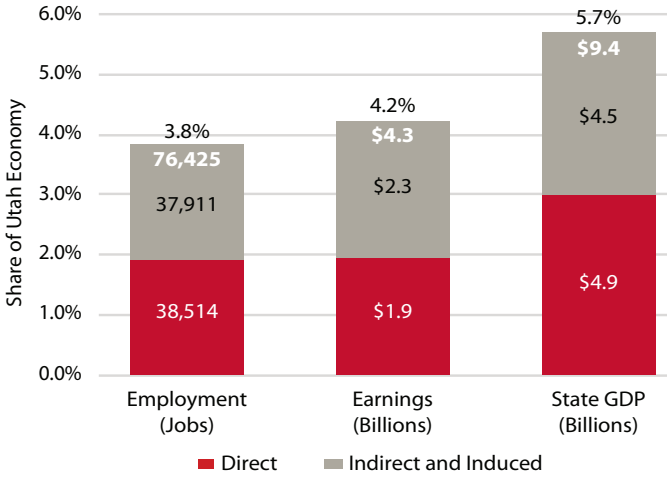
Introduction

Energy is fundamental to the functioning of a modern economy. It enables every production process, whether of goods or services, and facilitates practically every human endeavor.

Utah's diverse energy industry made significant economic impacts in the state in 2017. The industry directly and indirectly supported 3.8% of the state's employment, 4.2% of its earnings, and 5.7% of its gross domestic product (GDP) (see Figure 1). In 2017, energy activities provided an estimated 38,514 full- and part-time jobs. This represents 1.9% of total jobs in the state and is similar to the number of jobs at Utah's hospitals. Earnings paid to energy workers totaled more than $1.9 billion, 1.9% of total earnings paid.[3] Average earnings in 2017 (excluding energy efficiency jobs) were $81,257 per annum, 60% higher than the statewide average for all industries. Utah's energy industry contributed $4.9 billion to the state's GDP, 3.0% of the total.[4] In addition to this direct economic activity, energy industry purchases supported 37,911 jobs, $2.3 billion in earnings, and almost $4.5 billion in state GDP. The energy industry's total economic impacts in Utah in 2017 included 76,425 jobs, $4.3 billion in earnings, and $9.4 billion in state GDP.

Utah's energy industry comprises oil and gas development and production; oil refining; coal mining; electricity generation from both fossil fuels and renewable sources; mining and oil and gas field machinery manufacturing; electric turbine, transformer, and solar equipment manufacturing; uranium milling; electricity distribution; oil and gas product distribution; wholesale and retail energy trade; rooftop and utility-scale solar installation; and energy efficiency. Table 1 provides the specific industries that make up most of these sectors, based

Figure 1: Utah Energy Industry Economic Impact, 2017



Note: Does not include direct earnings and GDP associated with energy efficiency jobs.
Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services, U.S. Bureau of Economic Analysis, Utah Geological Survey, National Association of State Energy Officials, Energy Futures Initiative, and Energy Fuels using the REMI PI+ model

Table 1: Components of Utah's Energy Industry

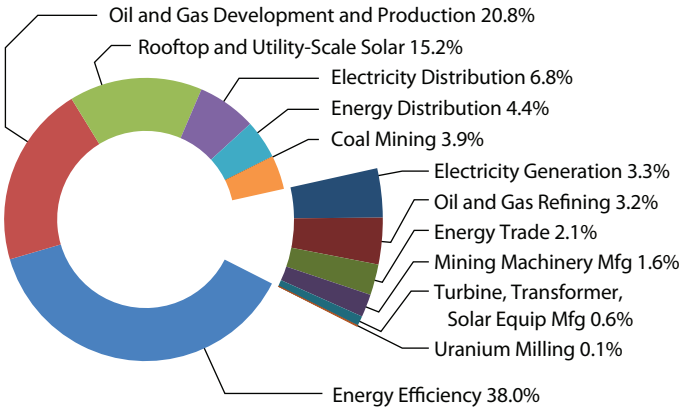
NAICS	Energy Sector
Oil and Gas Development and Production	
211000	Oil and Gas Extraction
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations
541360	Geophysical Surveying and Mapping Services
324110	**Oil and Gas Refining**
Coal Mining	
212100	Coal Mining
213113	Support Activities for Coal Mining
221112	**Fossil Fuel Electricity Generation**
Renewable Electricity Generation	
221111	Hydroelectric
221114	Solar
221115	Wind
221116	Geothermal
221118	Other
333130	**Mining and Oil and Gas Field Machinery Manufacturing**
Turbine, Transformer, and Solar Equipment Manufacturing	
332	Fabricated Metal Product Manufacturing
333611	Turbine and Turbine Generator Set Units Manufacturing
335	Electrical Equipment and Component Manufacturing
335311	Electric Power and Specialty Transformer Manufacturing
Electricity Distribution	
221120	Electric Power Transmission and Distribution
237130	Power and Communication System Construction
Energy Distribution	
221200	Natural Gas Distribution
237120	Oil and Gas Pipeline Construction
486	Pipeline Distribution
488999	Watco Trans Loading/Price River Terminal
Energy Trade, Wholesale and Retail	
424710	Petroleum Bulk Stations and Terminals
424720	Petroleum Wholesalers
454310	Fuel Dealers
Uranium Milling	
212291	Uranium-Radium-Vanadium Mining
Rooftop and Utility-Scale Solar*	
238	Specialty Trade Contractors
42	Wholesale Trade
54	Professional, Scientific, and Technical Services
Energy Efficiency	
23	Construction
31–33	Manufacturing
42	Wholesale Trade
54	Professional, Scientific, and Technical Services
81	Other Services

* Excludes jobs at solar utilities and solar equipment manufacturers, which are counted in those sectors.

on the North American Industry Classification System (NAICS).[5] The solar installation and energy efficiency sectors do not align neatly with specific NAICS industries, but instead consist of specific firms and occupations drawn from construction, manufacturing, wholesale trade, professional, scientific, and technical services, and other services like maintenance and nonprofit organizations.

Figure 2 shows the distribution of Utah's energy industry employment across its component sectors. Three sectors accounted for three-quarters of energy jobs. The largest by far was energy efficiency, with 14,626 jobs, nearly 40% of direct energy jobs.[6] Oil and gas development and production provided 7,999 jobs in 2017, representing one-fifth of the industry. There were an estimated 5,862 solar jobs, excluding those at solar utilities and solar equipment manufacturers, accounting for 15% of the total.[7] The remaining nine sectors provided approximately 10,000 jobs.

Figure 2: Energy Industry Employment by Sector, 2017



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Source: Utah Department of Workforce Services; Bureau of Labor Statistics, Quarterly Census of Employment and Wages; Bureau of Economic Analysis; National Association of State Energy Officials; Energy Futures Initiative; Solar Foundation; Energy Fuels

In addition to jobs, earnings, and GDP, Utah's energy industry generates a significant amount of revenue for state and local governments. Energy-related royalties, severance taxes, conservation fees, property taxes, and sales taxes totaled $492.1 million in 2017. The total economic activity created by the energy industry also led to net revenues of $230.4 million in state income taxes, state and local sales taxes, and local property taxes. Total combined state and local revenues attributable to the energy industry were $722.5 million in 2017.

The Gardner Institute used the REMI PI+ model to estimate economic impacts. PI+ is a dynamic simulation model that estimates the economic and demographic effects of changes to input variables. In addition to the input-output/supply chain relationships captured by traditional multiplier models like IMPLAN or RIMS II, PI+ also calculates general equilibrium effects, econometric relationships, and economic geography effects. In most cases the inputs used were industry employment and wages provided by the Utah Department of Workforce Services, the U.S. Bureau of Labor Statistics, and the U.S. Bureau of Economic Analysis. In some cases, detailed industry-level employment numbers from DWS or BLS were adjusted to include the jobs of the self-employed ("proprietors"), which are not included in data from these agencies but are included in less detailed data from BEA. Energy efficiency and solar jobs were produced by BW Research for the 2018 U.S. Energy and Employment Report and the Solar Jobs Census.

Terms Used

Economic impacts are the changes in the size and structure of a region's economy that occur when goods and services are purchased from vendors within the region with money generated outside the region. In the strictest interpretation, economic impacts occur only when "new" money enters the regional economy and is then spent locally. Such an inflow has the potential to expand the size and strength of the region's economy. Economic impacts can also be said to occur if residents would have to import goods or services if a particular industry did not exist locally. This "import substitution" argument can be applied to, for example, oil and gas that is produced *and* consumed in the state. In the absence of an import substitution rationale, purchases of goods and services by local residents from local vendors do not increase the economic base of the region; they simply reshuffle existing resources.

Direct impacts are the first round of changes in economic activity within a region. In this study they are the jobs, earnings, and output at the exporting, or import-substituting, industries.

Indirect impacts are the changes in production, earnings, and employment within the region in backward-linked industries that supply goods and services to the industry under study.

Induced impacts are the increased sales within the region from household spending of the income earned at both the business or industry under study and local supplying businesses.

Employment is a measure of jobs, not workers. Full- and part-time jobs are counted equally, and both wage and salary positions and the self-employed are included. Employment is reported by place of work, rather than place of residence.

Earnings are the sum of wage and salary disbursements, employer contributions for pension and insurance funds and for government social insurance, and the income of the self-employed. Earnings are reported by place of work.

State gross domestic product (GDP) is the most commonly used measure of total economic activity in a region. GDP avoids double counting of intermediate sales and captures only the "value added" to final products by capital and labor. From an accounting perspective, value added is the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus, a measure of profit. Alternatively, it can be thought of as total output or sales less the value of intermediate inputs purchased to produce that output. Value added is equivalent to the state gross domestic product measure.

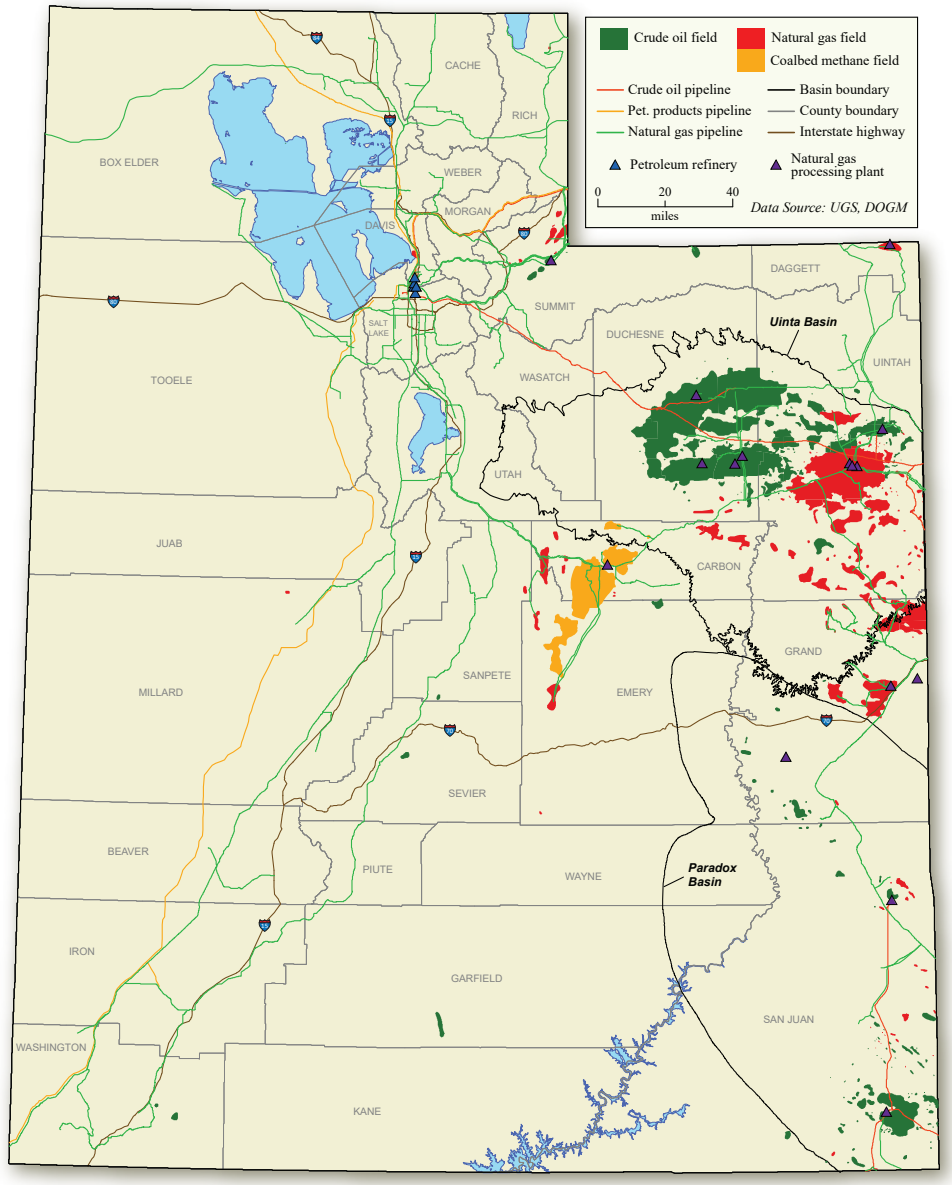
Economic Impacts

Oil and Gas Development and Production

The oil and gas development and production industry consists of geophysical surveying and mapping, drilling oil and gas wells, oil and gas extraction, and support activities for oil and gas operations.[8] As of 2017, Utah had an estimated 285 million barrels of crude oil reserves, 134 million barrels of natural gas liquids reserves (101 million barrels of natural gas liquids plus 33 million barrels of lease condensate), and 3.9 trillion cubic feet of natural gas reserves (nonassociated, including coalbed methane, and associated-dissolved). Figure 3 shows the geographical distribution of the state's oil and gas fields, as well as pipelines and refineries. In addition, there are an estimated potential economic resource of 77 billion barrels of oil in oil shale and 14 to 15 billion barrels of measured in-place oil in oil sands (see Figure 4).

Utah was the nation's 11th largest producer of crude oil in 2017, with 34.4 million barrels. This was 16% below production in 2014, which was the highest since 1985 (see Figure 5). Oil is regularly produced in 11 of the state's 29 counties. Nearly half of the state's production is in Duchesne County, about one-third comes from Uintah,

Figure 3: Oil and Gas Deposits and Active Fields in Utah



Source: Utah Geological Survey; State of Utah, SGID.

and San Juan accounts for a little over one-tenth. The remainder is produced in Sevier, Grand, Summit, Garfield, Sanpete, Carbon, Daggett, and Emery counties (see Figure 6).

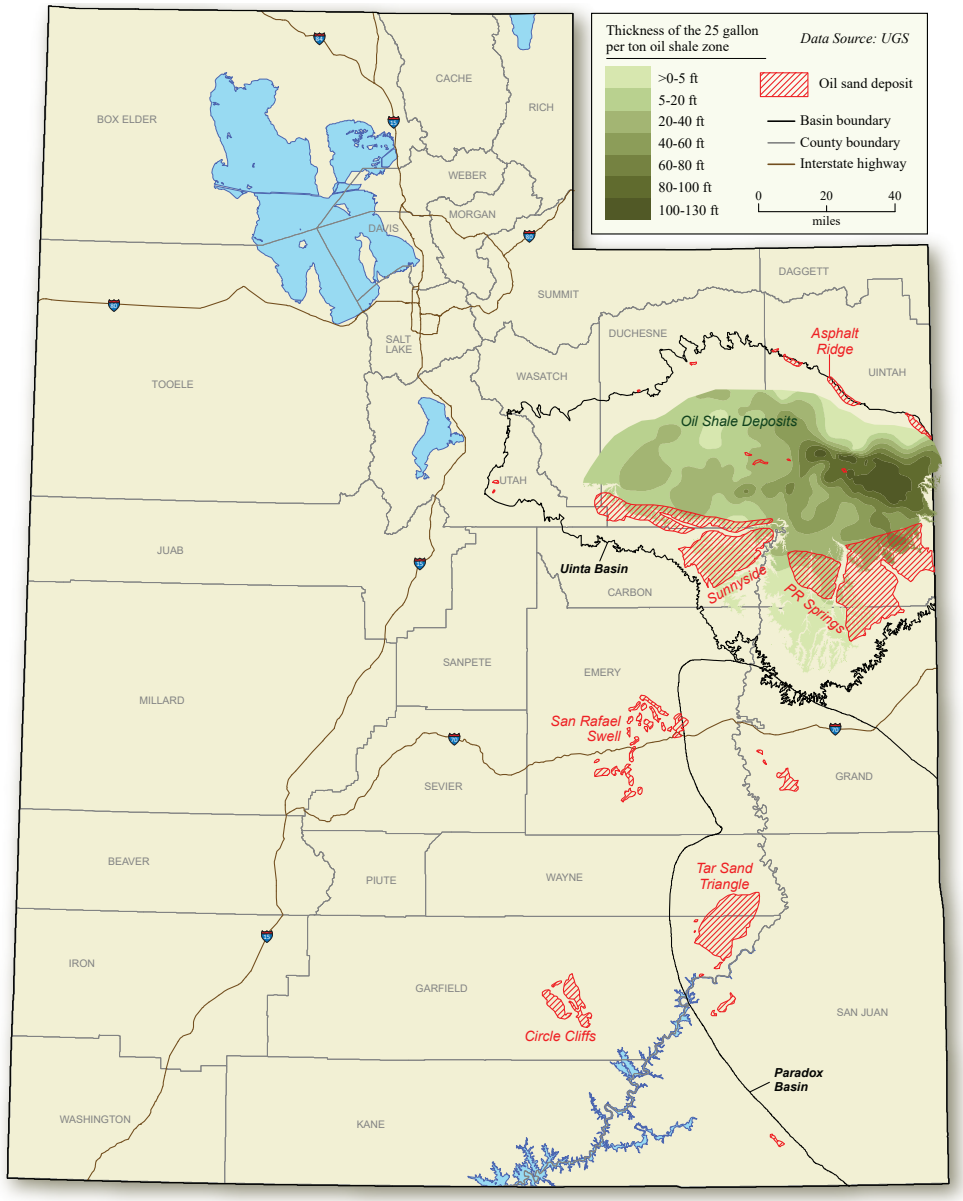
The value of crude oil produced in Utah peaked in 2014 at $3.4 billion, in inflation-adjusted 2018 dollars. Under falling prices and shrinking output, the state's oil production was worth less than $1.2 billion in 2016. Production began to recover in 2017, reaching almost $1.6 billion (see Figure 7).

With 315 billion cubic feet (bcf) of gross production in 2017, Utah was the 13th largest natural gas producer in the U.S. However, output was about one-third lower than an all-time high of over 490 bcf in 2012 (see Figure 8). About 10% of Utah's annual natural gas production is from coalbed methane fields.

Natural gas is produced in 10 of Utah's counties. Almost two-thirds is produced in Uintah County. Duchesne and Carbon each account for about one-seventh of the state's production. The remainder comes from San Juan, Emery, Grand, Summit, Daggett, Sanpete, and Garfield (see Figure 9).

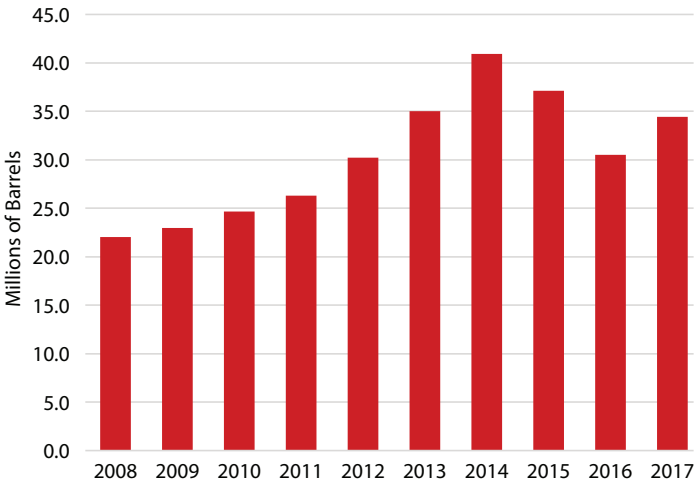
The value of natural gas and natural gas liquids produced in Utah reached an all-time high of over $3.6 billion in 2008, in inflation-adjusted 2018 dollars.

Figure 4: Oil Shale and Oil Sands Deposits in Utah



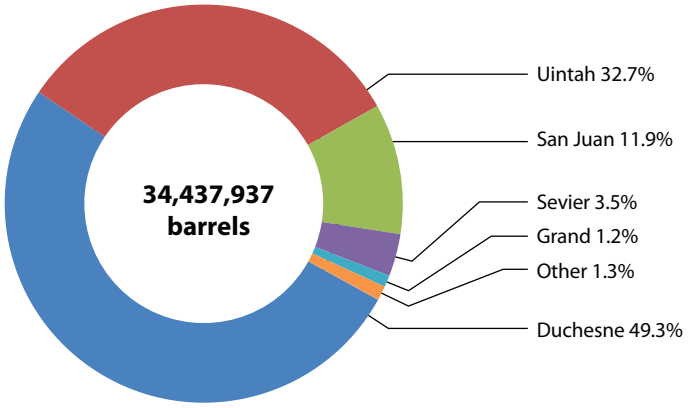
Source: Utah Geological Survey; State of Utah, SGID.

Figure 5: Crude Oil Production in Utah, 2008–2017



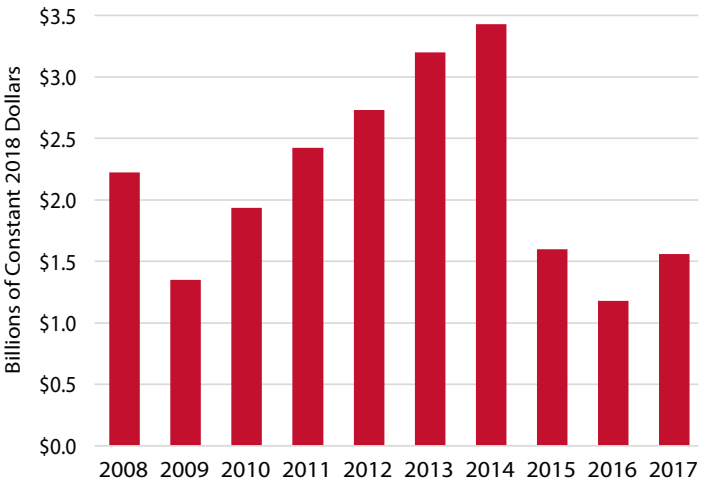
Source: Utah Division of Oil, Gas and Mining

Figure 6: Utah Crude Oil Production by County, 2017



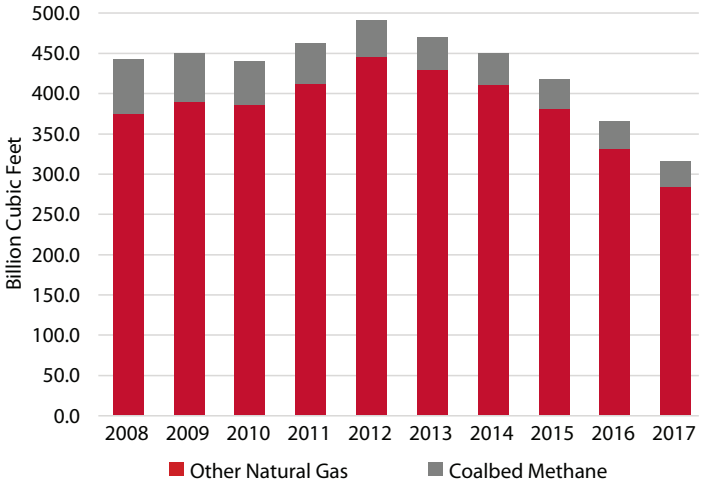
Note: "Other" consists of Summit, Garfield, Sanpete, Carbon, Daggett, Emery, and Juab counties.
Source: Utah Division of Oil, Gas and Mining

Figure 7: Value of Crude Oil Production in Utah, 2008–2017



Source: Utah Geological Survey

Figure 8: Natural Gas Production in Utah, 2008–2017

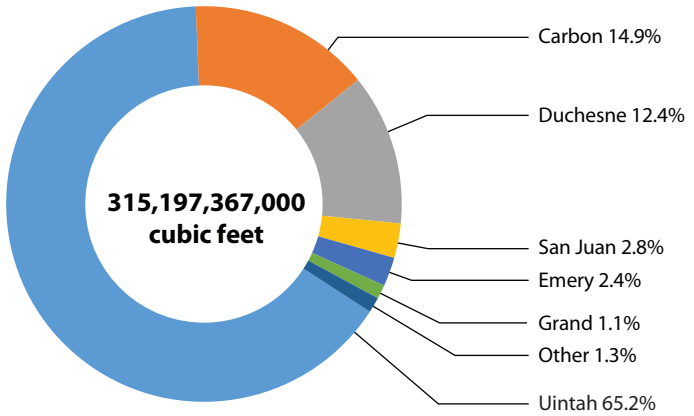


Source: Utah Division of Oil, Gas and Mining

By 2017, under falling prices and shrinking output, the state's natural gas and natural gas liquids production was worth $1.0 billion (see Figure 10).

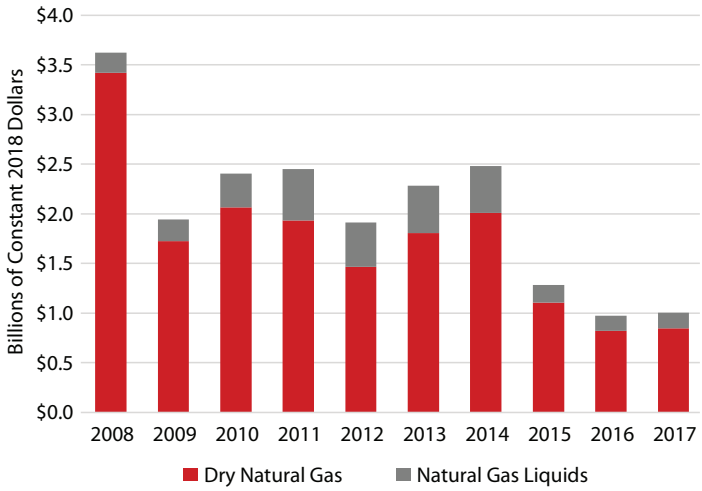
Both oil and gas drilling crashed in 2009 with the recession. While oil exploration immediately rebounded in 2010 (along with oil prices), natural gas exploration has remained low due to continuing low gas prices. Oil exploration activity in Utah began to slow after a post-recession peak in 2012, then crashed again in 2015 when oil prices nearly halved (see Figures 11 and 12). At just 84, the number of wells commenced ("spudded") in 2016 was the lowest level in modern history, 93% below the peak of 1,144 spudded in 2008. From 2008 to 2009, the average nominal wellhead price for crude oil fell by 42%, from $86.58 per barrel to $50.22, while natural gas wellhead prices fell by 50%, from $6.82 per mcf to $3.38. Oil prices quickly recovered, reaching

Figure 9: Utah Natural Gas Production by County, 2017



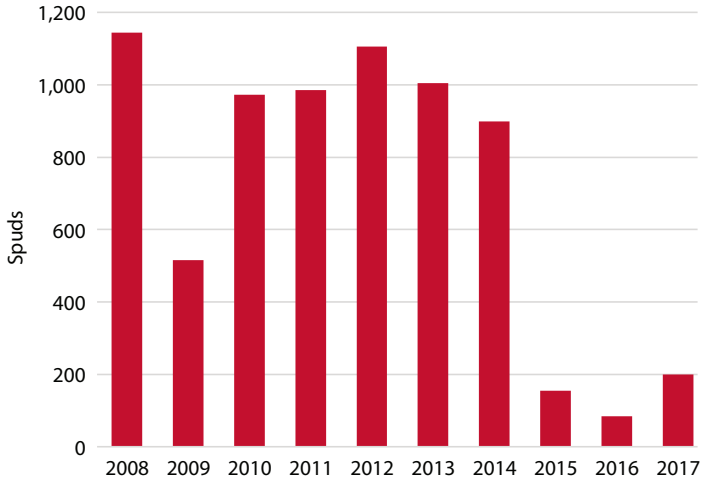
Source: Utah Division of Oil, Gas and Mining

Figure 10: Value of Natural Gas Production in Utah, 2008–2017



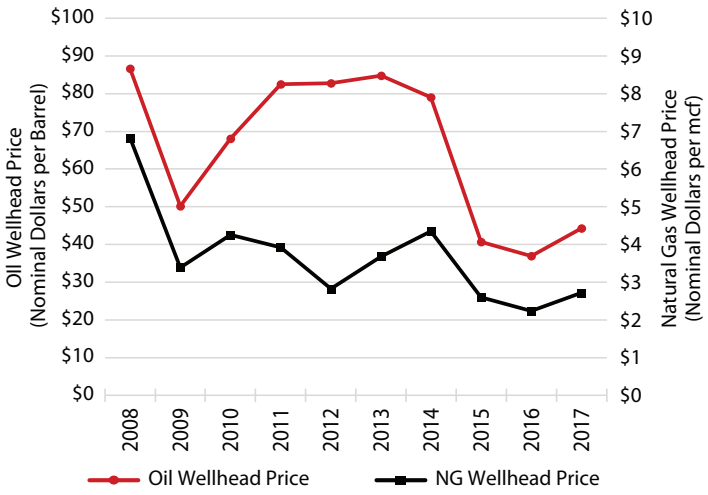
Source: Utah Geological Survey

Figure 11: Wells Spudded in Utah, 2008–2017



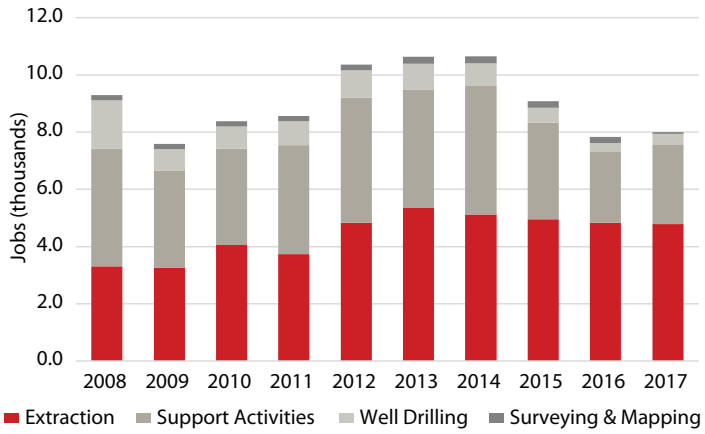
Source: Utah Division of Oil, Gas and Mining

Figure 12: Wellhead Prices in Utah, 2008–2017



Source: Utah Geological Survey

Figure 13: Oil and Gas Development and Production Employment in Utah, 2008–2017



Source: Bureau of Economic Analysis; Bureau of Labor Statistics, Quarterly Census of Employment and Wages; and Kem C. Gardner Policy Institute analysis

$84.79 in 2013. However, natural gas prices have remained low, falling as far as $2.24 in 2016 and leading to a steady decline in natural gas drilling. Oil and gas prices increased somewhat in 2017, with oil prices rising 20% to $44.24 per barrel and natural gas prices rising 22% to $2.72 per mcf. Spuds grew 137% to 199, but these were entirely new oil wells, and exploration activity is still well below pre-2015 levels.

Oil and gas development and production shed 1,700 jobs from 2008 to 2009, during the Great Recession. Most of the losses were in well drilling and other support activities. Employment then grew to a high of 10,643 jobs in 2014, when oil prices were peaking. The industry has since shed more than 2,600 jobs, again mostly in drilling and other support activities while extraction employment has remained fairly steady (see Figure 13).

In 2017 the sector provided almost 8,000 direct jobs earning $420.7 million and produced over $1.3 billion in state GDP.

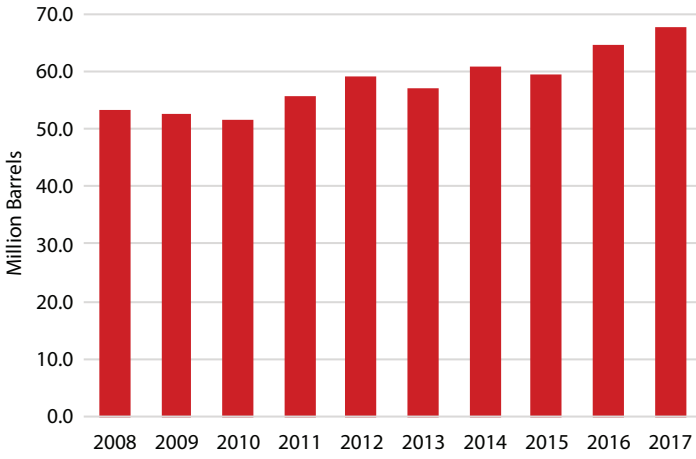
Table 2: Economic Impacts of Utah's Oil and Gas Development and Production Industry, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	7,999	24,033	32,032
Earnings	$420.7	$1,498.0	$1,918.7
State GDP	$1,346.8	$2,591.1	$3,937.9

Note: Oil and gas development and production consists of geophysical surveying and mapping services, drilling oil and gas wells, oil and gas extraction, and support activities for oil and gas operations.
Source: Kem C. Gardner Policy Institute analysis of data from the Bureau of Economic Analysis, Utah Department of Workforce Services, and Utah Geological Survey using the REMI PI+ model

Figure 14: Utah Monthly Refinery Inputs, 2008–2017



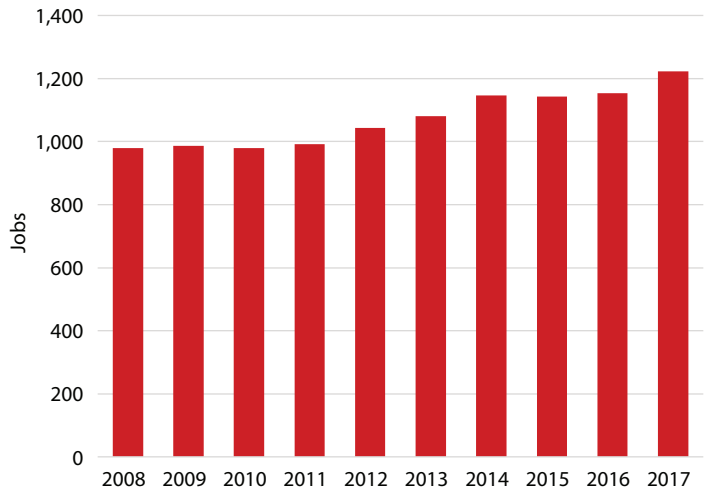
Source: Utah Geological Survey and U.S. Energy Information Administration

Average annual earnings across the oil and gas development and production sector were $52,594 in 2017, about on par with the statewide average of $50,655. Within the sector, average earnings ranged from $37,470 for oil and gas extraction workers to $75,695 for drilling and other support activity jobs. Oil and gas development and production activity generated total economic impacts in Utah of over 32,000 jobs, $1.9 billion in earnings, and $3.9 billion in state GDP (see Table 2).

Oil Refining

Most of the crude oil produced in Utah is refined in the state. There are five refineries, all located within a few miles of each other in northern Salt Lake and southern Davis counties: Marathon (formerly Andeavor, formerly Tesoro), Big West, Chevron, HollyFrontier, and Silver Eagle. They also process crude from Canada, Wyoming, and Colorado. Inputs of crude oil to Utah's refineries grew 27% between 2008 and 2017, from 53.2 million barrels to 67.5 million (see Figure 14). Refinery capacity increased 17% over the same period, from 167,700 barrels per day to 196,830. Monthly utilization rates over the period averaged 91% but ranged from a low of 61% in March

Figure 15: Refinery Employment in Utah, 2008–2017



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Table 3: Economic Impacts of Utah's Oil Refining Industry, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	1,223	17,908	19,131
Earnings	$205.7	$1,097.8	$1,303.5
State GDP	$808.6	$2,486.3	$3,294.9

Source: Kem C. Gardner Policy Institute analysis of data from the Bureau of Labor Statistics, Quarterly Census of Employment and Wages and Utah Geological Survey using the REMI PI+ model

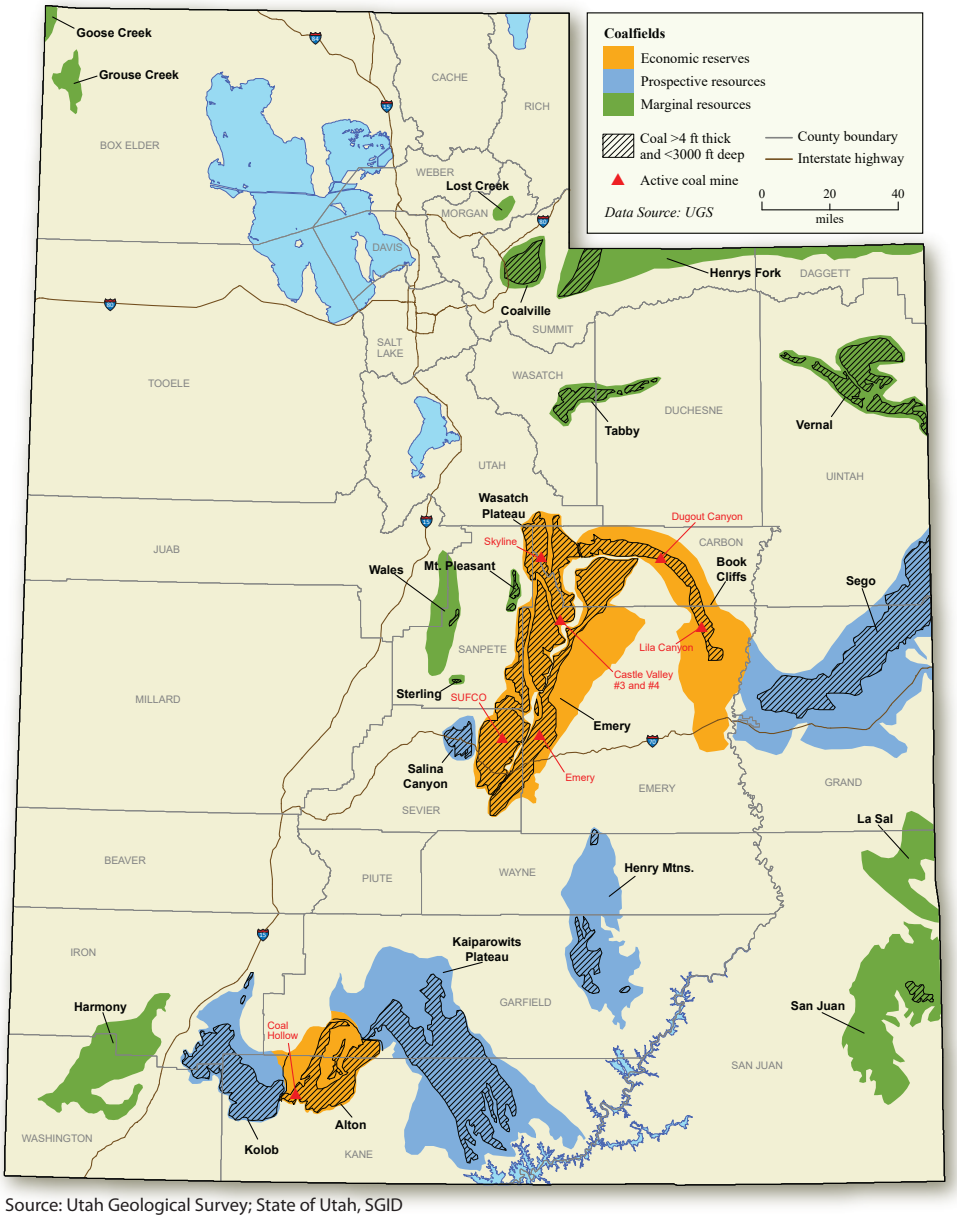
2015 to a high of 103% in July of that year. Utah's refineries were running at an average of 94% of capacity in 2017.

Increasing refinery capacity and inputs are reflected in growing employment. From 2008 through 2011, refinery employment was steady at just under 1,000 jobs. Since 2011, the industry has added 230 jobs (see Figure 15). In 2017, Utah's refineries provided 1,223 jobs with $205.7 million in earnings and contributed $808.6 million to the state's GDP. This is one of the highest-paying sectors of the energy industry, with 2017 average earnings of $168,180—more than three times the statewide average. Utah's refineries generated economic impacts of over 19,000 jobs, $1.3 billion in earnings, and $3.3 billion in state GDP (see Table 3).

Coal

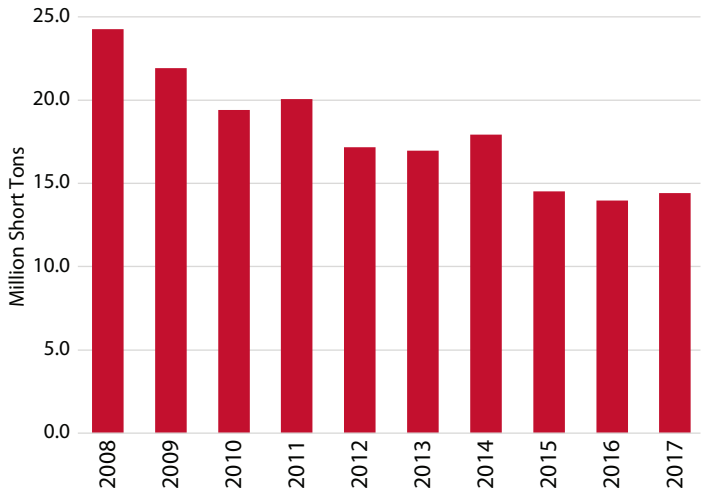
Utah has an estimated 15.5 billion short tons of recoverable coal, most of which is constrained by land use restrictions. Current economic fields are in Carbon, Emery, Sevier, and Kane counties, with prospective resources in Garfield and Grand (see Figure 16). At 14.4 million short tons in 2017, Utah was the 11th largest coal producer in the country. However, mine output was 40% lower than in 2008 and almost 47%

Figure 16: Utah Coal Resources and Active Mines



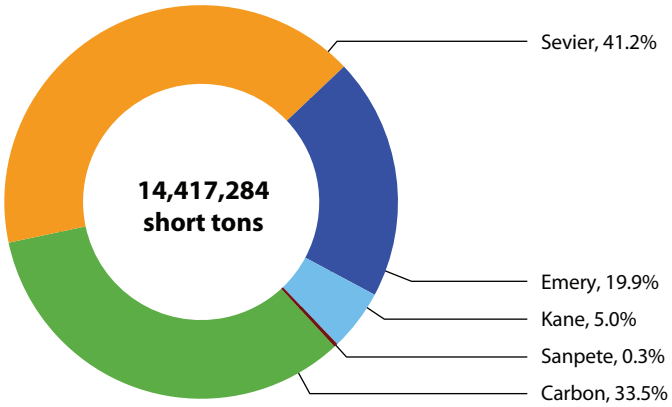
Source: Utah Geological Survey; State of Utah, SGID

Figure 17: Coal Production in Utah, 2008–2017



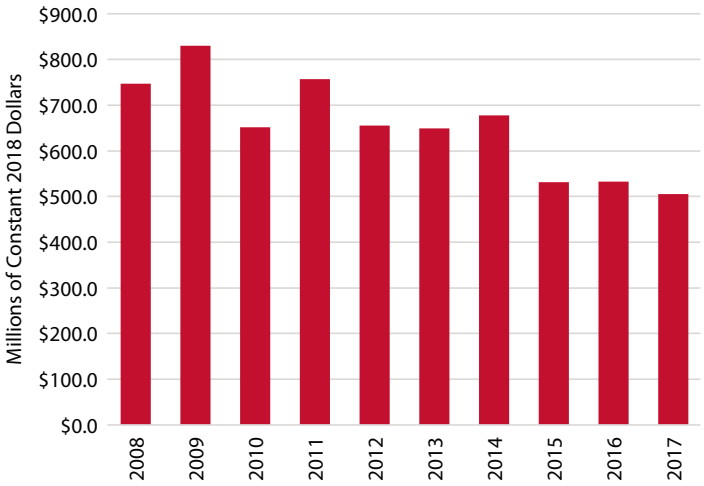
Source: Utah Geological Survey

Figure 18: Utah Coal Production by County, 2017



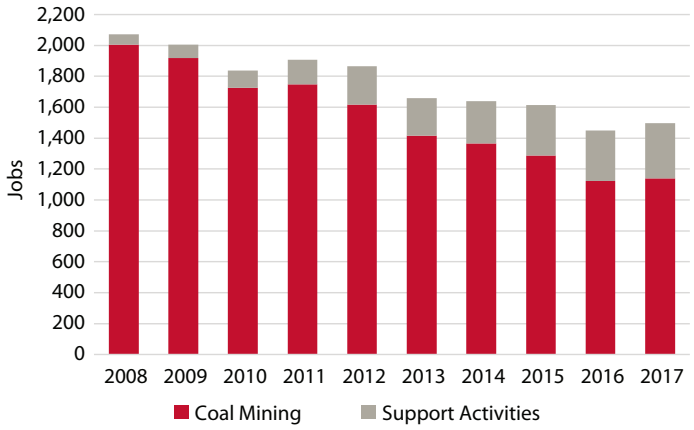
Source: Utah Geological Survey

Figure 19: Value of Coal Production in Utah, 2008–2017



Source: Utah Geological Survey

Figure 20: Coal Mining Employment in Utah, 2008–2017



Source: Kem C. Gardner Policy Institute analysis of data from the Bureau of Economic Analysis and Bureau of Labor Statistics, Quarterly Census of Employment and Wages

below the state's peak in 1996 (see Figure 17). The Sufco mine in Sevier County accounted for over 40% of the state's 2017 coal production, while those in Carbon County provided one-third of the total and Emery County mines produced one-fifth. Kane County, at 5%, and Sanpete, with 0.3%, produced the remainder (see Figure 18).

In 2017, 64% of the coal produced in Utah was consumed in Utah. One-fifth of the state's coal was exported internationally, mostly to Asia. About one-tenth went to California, and the remainder went to New Mexico, Nevada, Arizona, Idaho, and Oregon.

The value of Utah's coal production has declined by one-third since 2008, adjusting for inflation. The state's 24.3 million tons of coal in 2008 was worth $747.2 million in 2018 dollars. Production value grew to $829.5 million in 2009. However, by 2017 Utah's shrinking coal production was worth $505.1 million (see Figure 19).

Coal mining employment consists of support activities as well as the actual mining jobs. Support activities for coal mining include exploration and services such as tunneling, drilling, blasting, and draining performed on a contract basis. Reflecting the decline in output, Utah's coal sector lost over 600 jobs, 30%, from 2008 to 2016, recovering fewer than 50 in 2017. All of the losses have been in the mining industry, which shed 865 jobs between 2008 and 2017. In contrast, contracted

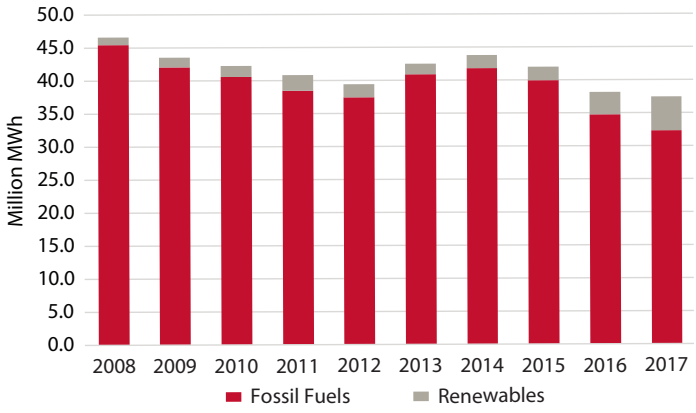
Table 4: Economic Impacts of Utah's Coal Mining Industry, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	1,496	3,731	5,228
Earnings	$157.9	$185.2	$343.0
State GDP	$309.7	$302.4	$612.1

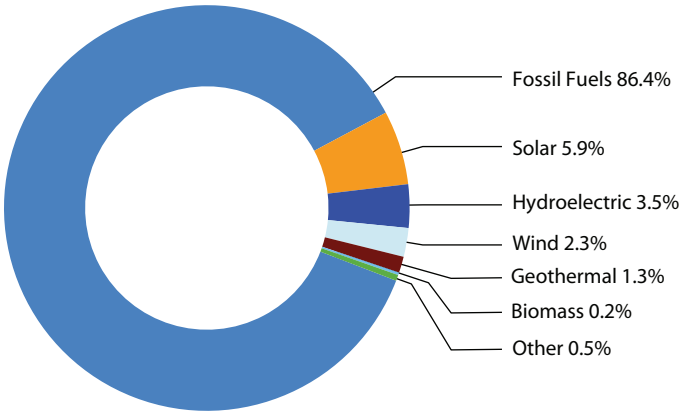
Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services and Utah Geological Survey using the REMI PI+ model

Figure 21: Net Utility-Scale Electricity Generation in Utah, 2008–2017



Note: Fossil fuels comprise coal, natural gas, petroleum liquids, and other gases. Renewables comprise utility-scale solar, hydroelectric, wind, geothermal, and most biomass. Other comprises cogeneration, waste heat, and non-biogenic municipal solid waste.
Source: U.S. Energy Information Administration

Figure 22: Fuel Mix of Utility-Scale Electricity Generation in Utah, 2017



Note: Fossil fuels consist of coal, natural gas, petroleum liquids, and other gases. Other comprises cogeneration, waste heat, and non-biogenic municipal solid waste.
Source: U.S. Energy Information Administration

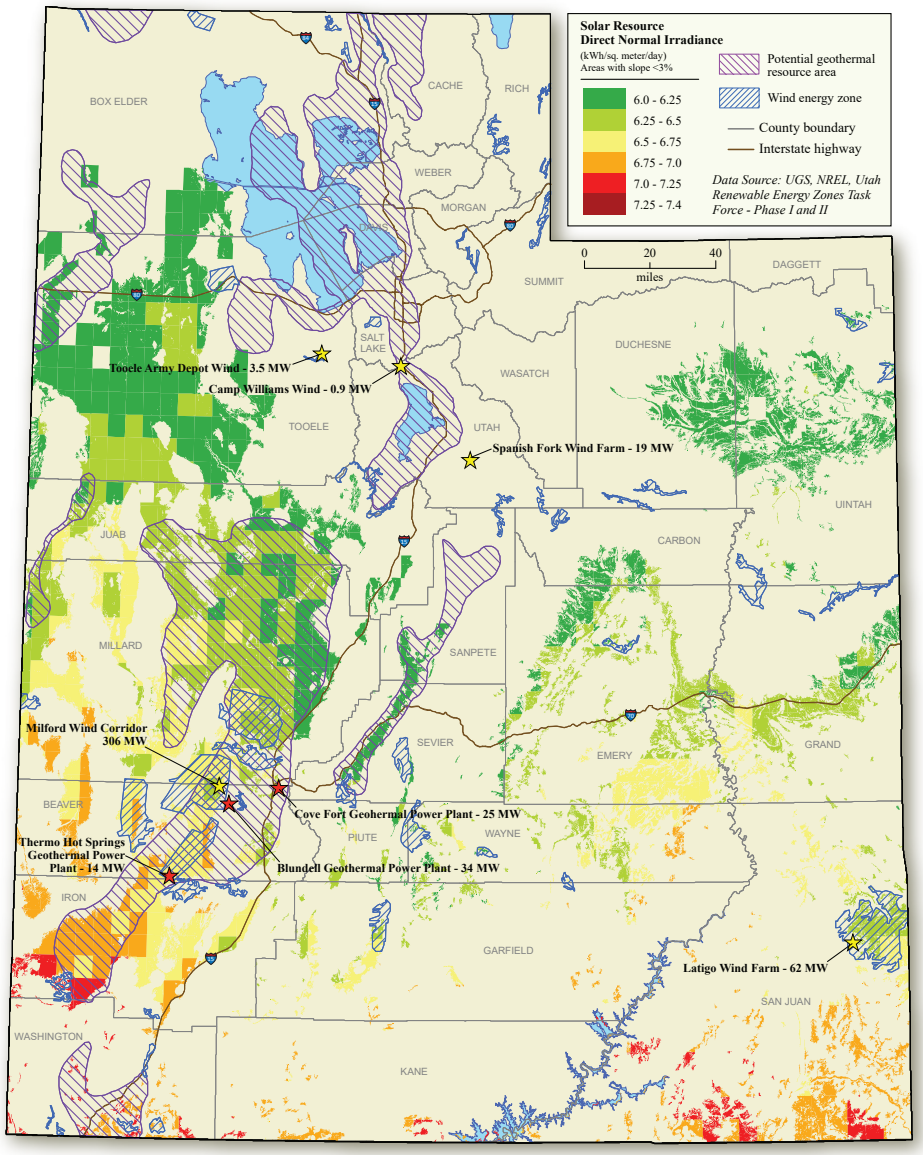
support activities for coal mining more than quadrupled, adding almost 290 jobs (see Figure 20).[9] This implies an evolution of the coal industry in the state, as larger mining firms contract out more functions to smaller support firms.

Utah mines produced $493.1 million worth of coal in 2017 (in nominal dollars), providing almost 1,500 direct jobs with $157.9 million in earnings and contributing $309.7 million to the state's GDP. Coal jobs are high paying, with 2017 average annual earnings of $105,500, double the statewide average of $50,655. Utah's 2017 coal production generated total economic impacts of 5,228 jobs, $343.0 million in earnings, and $612.1 million in state GDP (see Table 4).

Electricity Generation

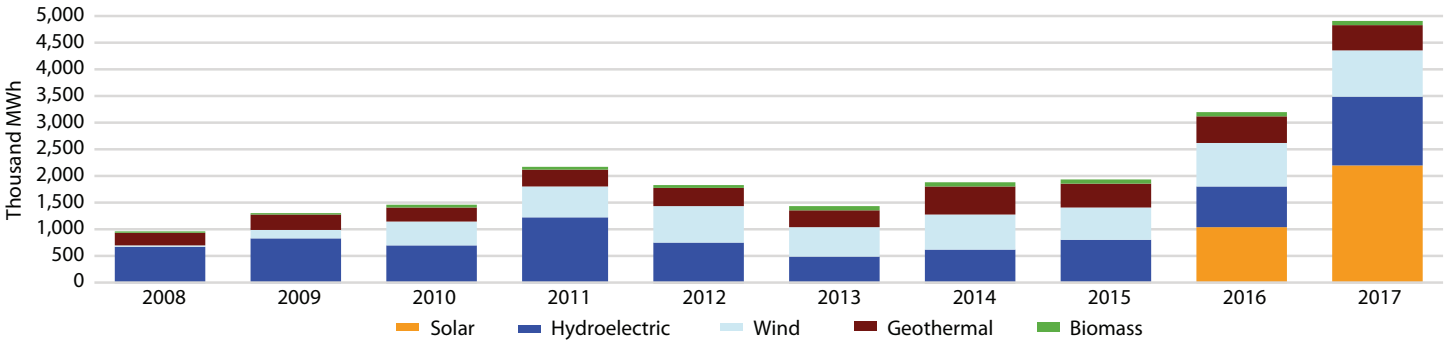
Net utility-scale electricity generation for all sectors was 20% lower in 2017 than in 2008. This was due to a 29% reduction in fossil fuel generation from 45.5 to 32.3 million megawatthours (MWh). Over the same period, electricity generated from renewable sources increased fivefold from nearly 1.0 to 4.9 million MWh. Although it's a small source, electricity from cogeneration, waste heat recovery, and non-biogenic municipal solid waste grew 23%, from 142,000 MWh in 2008 to 175,000 MWh in 2017. In 2008, fossil fuels accounted for almost 98% of total

Figure 23: Identified Renewable Energy Resources in Utah



Source: Utah Geological Survey, MP-09-1, *Utah Renewable Energy Zone Task Force Phase I Report: Renewable Energy Zone Resource Identification*

Figure 24: Net Utility-Scale Electricity Generation in Utah from Renewable Sources, 2008–2017



Fuel	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Solar	–	–	–	–	2	2	2	32	1,054	2,211
Hydroelectric	668	835	696	1,230	748	505	633	769	760	1,294
Wind	24	160	448	573	704	540	660	626	822	858
Geothermal	254	279	277	330	335	319	522	430	485	481
Biomass*	25	44	52	53	55	66	69	81	79	78

* Excludes non-biogenic municipal solid waste.
Source: U.S. Energy Information Administration.

electricity generation in Utah; by 2017 their share had shrunk to 86% (see Figures 21 and 22). At 26.4 million MWh, Utah ranked 20th of 48 states for electricity generated from coal in 2017, accounting for 2.2% of total coal-fired electricity in the country. The state ranked 35th out of 49 states and the District of Columbia (all but Hawaii) for electricity generated from natural gas, with 5.9 million MWh. Utah also has significant renewable resources. Figure 23 shows wind zones, potential geothermal resource areas, and areas with solar direct normal irradiance of at least 6.0 kWh/m^2/day and terrain with less than a 3-degree slope.

Utility-scale solar has seen the fastest growth, jumping from just 1,619 MWh in 2012 to 2.2 million MWh in 2017, and growing to 5.9% of total utility-scale electricity generation. In 2017, Utah was the fifth-largest producer of utility-scale solar electricity, accounting for 4.1% of U.S. solar generation. Wind-generated electricity grew more than 35-fold from 23,900 MWh in 2008 to 858,000 MWh in 2017, representing 2.3% of total generation. Hydroelectric and geothermal electricity generation both nearly doubled between 2008 and 2017, but for different reasons. Hydro increased from generating 668,000 MWh to nearly 1.3 million MWh—3.5% of total net generation. However, hydro power is dependent on precipitation and the need for peak power, and historically has large swings in generation. In comparison, geothermal added generation, growing from 254,000 MWh in 2008 to 481,000 in 2017—1.3% of total generation (see Figure 24).

Total retail electricity sales grew by 8% between 2008 and 2013, from 28.2 million MWh to 30.5 million, and have since remained essentially flat despite continuing economic and population growth (see Figure 25). The commercial sector is the largest consumer, averaging 37% of total sales over the period. The residential and industrial sectors are similar in size, each averaging about 31% of total sales. The transportation sector is by far the smallest electricity consumer, at just 0.2% of sales. Despite the increase in total electricity sales, per capita sales (all sectors) shrank by 7% between 2008 and 2017, from 10.6 MWh to 9.8 MWh. Per capita residential sales also fell by 7%, from 3.3 MWh to 3.1 MWh (see Figure 26).

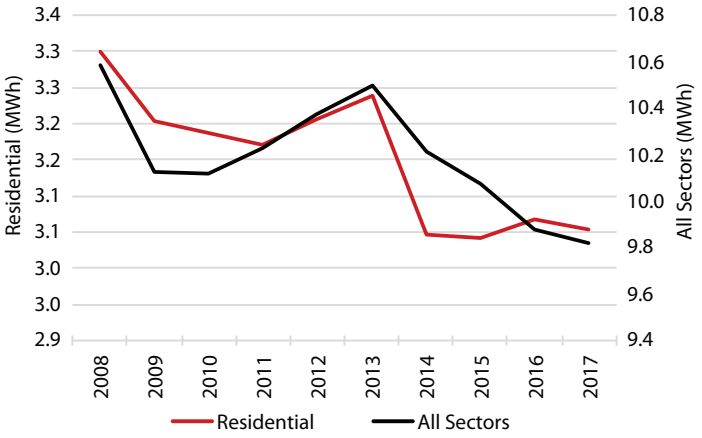
Total electric utility employment was steady between 2008 and 2016 at about 1,200 jobs, then jumped to almost 1,300 in 2017. However, over this period, fossil fuel electric utilities shed a net of 25 jobs while renewable utilities added 126 (see Figure 27).

While utilities are generally a "residential" or non-export sector serving only the local market, Utah generates more electricity than it consumes. Over the five-year period of 2013 to 2017, Utah's electric power sector exported an average of 18% of the electricity it generated. These exports generate economic impacts in the state. Since the data do not indicate the fuel source of exported electricity, we assumed 18% of both fossil fuel electricity and renewable electricity was exported.[10] Fossil fuel electricity generation provided 1,117 direct jobs with $165.6 million in earnings and contributed $474.2 million to Utah's GDP. Average annual earnings for these jobs were $148,200, almost triple the statewide average of $50,655. Exports of fossil fuel electricity produced indirect and induced impacts that led to total economic impacts of 1,828 jobs, $208.4 million in earnings, and $539.3 million in state GDP (see Table 5). Electricity generation from renewable sources (hydroelectric, solar, wind, geothermal, and biomass) provided 173 direct jobs with $27.0 million in earnings and contributed $73.5 million to the state's GDP. Average earnings were even higher for renewable electricity generation at $156,500. Exports of renewable electricity

Figure 25: Retail Sales of Electricity in Utah by Sector, 2008–2017

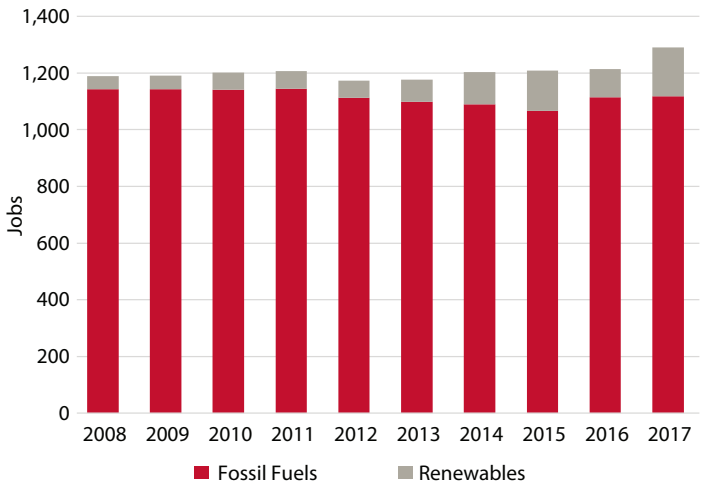
Source: U.S. Energy Information Administration

Figure 26: Per Capita Retail Sales of Electricity in Utah, 2008–2017



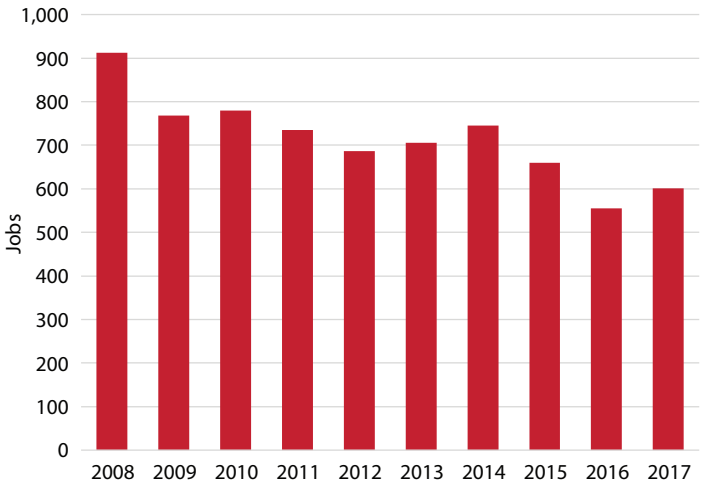
Source: Kem C. Gardner Policy Institute analysis of data from the U.S. Energy Information Administration; U.S. Census Bureau, Intercensal Population Estimates (2008–2009); Utah Population Committee, State Population Estimates (2010–2017)

Figure 27: Electric Utility Employment in Utah, 2008–2017



Source: Utah Department of Workforce Services and U.S. Bureau of Labor Statistics

Figure 28: Mining and Oil and Gas Field Machinery Manufacturing Employment, 2008–2017



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Table 5: Economic Impacts of Utah's Fossil Fuel Electricity Generation, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	1,117	711	1,828
Earnings	$165.6	$42.8	$208.4
State GDP	$474.2	$65.1	$539.3

Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services using the REMI PI+ model

Table 6: Economic Impacts of Utah's Renewable Electricity Generation, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	173	111	283
Earnings	$27.0	$6.5	$33.5
State GDP	$73.5	$10.1	$83.6

Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services using the REMI PI+ model

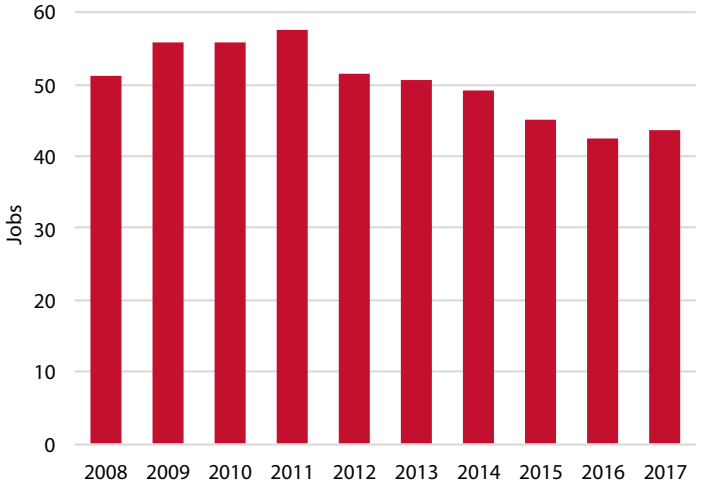
Table 7: Economic Impacts of Utah's Mining and Oil and Gas Field Machinery Manufacturing Industry, 2017

(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	601	1,303	1,904
Earnings	$51.7	$72.1	$123.8
State GDP	$59.3	$111.3	$170.6

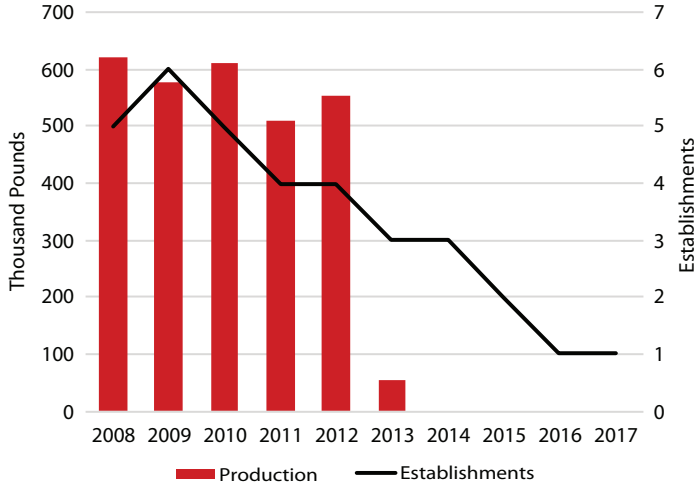
Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services using the REMI PI+ model

Figure 29: Turbine and Transformer Manufacturing Employment, 2008–2017



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Figure 30: U_3O_8 Production and Uranium Mining Establishments in Utah, 2008–2017



Source: Utah Geological Survey and U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Table 8: Economic Impacts of Utah's Turbine, Transformer, and Solar Equipment Manufacturing Industry, 2017
(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	250	517	767
Earnings	$19.3	$29.1	$48.3
State GDP	$31.5	$45.3	$76.9

Source: Kem C. Gardner Policy Institute analysis of data from the Utah Department of Workforce Services and the 2017 Solar Jobs Census using the REMI PI+ model

Table 9: Economic Impacts of Utah's Uranium Milling Industry, 2017
(Dollar amounts in millions)

Impact	Direct	Indirect and Induced	Total
Employment	46	25	71
Earnings	$3.3	$1.6	$5.0
State GDP	$3.8	$2.0	$5.8

Source: Kem C. Gardner Policy Institute analysis of data from Energy Fuels using the REMI PI+ model

produced indirect and induced impacts that led to total economic impacts of 283 jobs, $33.5 million in earnings, and $83.6 million in state GDP (see Table 6). The total impacts of the state's electricity generation sector in 2017 amounted to 2,111 jobs, $241.9 million in earnings, and $622.8 million in state GDP.

Mining and Oil and Gas Field Machinery Manufacturing

While employment at manufacturers of mining and oil and gas field machinery shrank by one-third, from 912 jobs in 2008 to 601 in 2017, the number of establishments in the state grew from 18 to 26 over the same period (see Figure 28). The largest of these are MegaDiamond, a Schlumberger company, and Boart Longyear. Average earnings in this sector were $77,646 in 2017, 53% higher than the statewide average of $50,655.

The 601 mining machinery and oil and gas field machinery manufacturing jobs in 2017 received $51.7 million in earnings. This activity produced total economic impacts of over 1,900 jobs, $123.8 million in earnings, and $170.6 million in state GDP (see Table 7).

Turbine, Transformer, and Solar Equipment Manufacturing

This sector consists of turbine and turbine generator set units manufacturing, electric power and specialty transformer manufacturing, and manufacturers of solar energy equipment. Data on turbine and transformer manufacturing employment were obtained from the Utah Department of Workforce Services. Solar equipment manufacturing employment is published by the Solar Foundation and available only for 2015 through 2018.

Turbine and transformer manufacturing is a small industry in Utah. From 2008 to 2017 between six and eight establishments were operating in the state. Employment in the industry grew from 51 in 2008 to 58 in 2011, but has since fallen to 44 as of 2017 (see Figure 29). Annual earnings across the two sectors averaged $88,377 in 2017, about 75% higher than the statewide average.

According to the Solar Foundation's Solar Jobs Census, solar-related manufacturing jobs in Utah grew from just 96 in 2015 to 226 in 2016, then dipped to 206 in 2017.[11] While there are no solar panels or wafers manufactured in the state, other components such as mounting structure hardware are produced in Utah.

Combining solar-related manufacturing with jobs building turbines, turbine generator sets, and electric power and specialty transformers, there were a total of 250 electric power–related manufacturing jobs in 2017 with $19.3 million in earnings. This activity produced total economic impacts of 767 jobs, $48.3 million in earnings, and $76.9 million in state GDP (see Table 8).

Uranium

Between 1991 and 2006 no uranium was produced in Utah. Production restarted in 2007 and grew in response to a significant increase in uranium oxide (U_3O_8) spot prices. From a low of between $15 and $20 per pound in the early 2000s, spot prices for U_3O_8 jumped to $136 in June 2007. The state's mines produced 201,000 pounds in 2007 and 621,000 pounds in 2008. The number of uranium mining establishments in Utah reached as high as six in 2009. However, since then, prices have fallen back to around $20 per pound. Mine output remained above 500,000 pounds through 2012, then plummeted to just 55,000 pounds in 2013, and all uranium mining operations have since ceased in the state (see Figure 30).[12] Energy Fuels recently started exploring again, but with emphasis on vanadium rather than uranium. The company's White Mesa mill near Blanding is the only fully licensed and operating conventional uranium mill in the U.S.[13] With no mining taking place in the state, Energy Fuels is currently only reprocessing uranium ore from its mine in Arizona. The firm reported an average of 46 jobs at the mill in 2017; at an average wage of $67,000 this yields estimated total earnings of $3.3 million. The mill produced total economic impacts of 71 jobs, $5.0 million in earnings, and $5.8 million in state GDP (see Table 9).

Other Energy Sectors

There are several other energy-related sectors in Utah which do not generate economic impacts by exporting goods or producing import substitutes. However, they do provide important services to consumers and other energy sectors in the state.

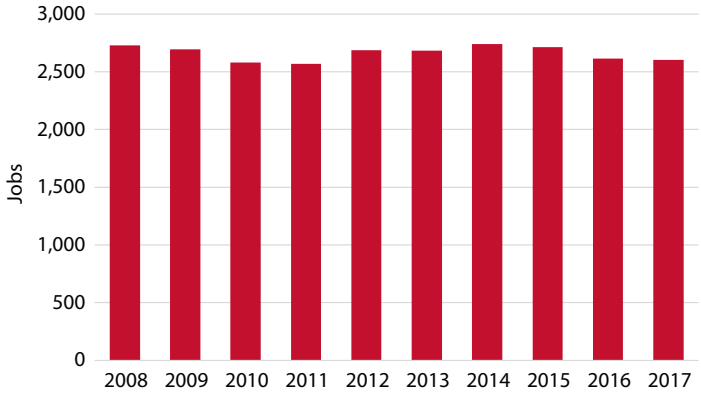
Electricity Distribution

The electricity distribution sector consists of electric power transmission and distribution and power system construction. The sector has been relatively stable over the last decade, with estimated employment fluctuating between 2,570 and 2,742 (see Figure 31).[14] In 2017, the sector provided an estimated 2,600 jobs with $292.0 million in earnings, and contributed $851.8 million to the state's GDP. Average earnings were $112,233, well over twice the statewide average of $50,655.

Oil and Gas Product Distribution

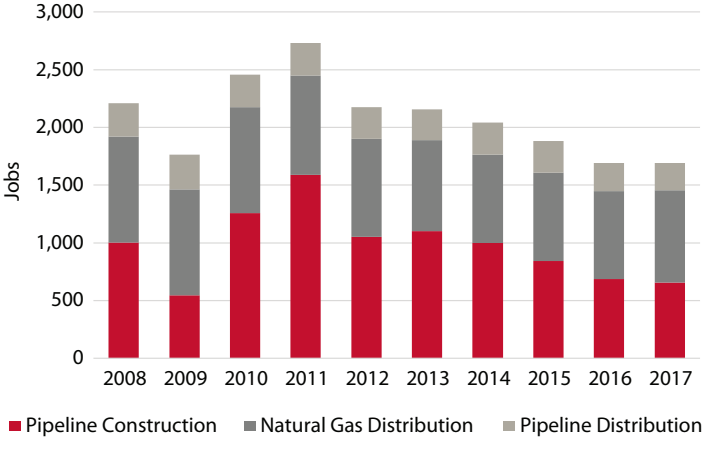
The oil and gas product distribution sector consists of utility natural gas distribution; crude oil, natural gas, and refinery products pipeline distribution; oil and gas pipeline construction; and the Watco Price River Terminal. Employment in this sector dipped from 2,210 in 2008 to 1,764 in 2009, then climbed to a high of 2,732 in 2011. It has since declined by 37%, due largely to losses in the pipeline construction industry (see Figure 32). Over the same period the number of establishments grew from 102 in 2008 to 138 in 2015. It has since shrunk to 127. In 2017 this sector provided approximately 1,710 jobs with $182.6 million in earnings and contributed an estimated $464.7 million to the state's GDP. Average earnings were $106,800, more than double the statewide average.

Figure 31: Electricity Distribution Employment, 2008–2017



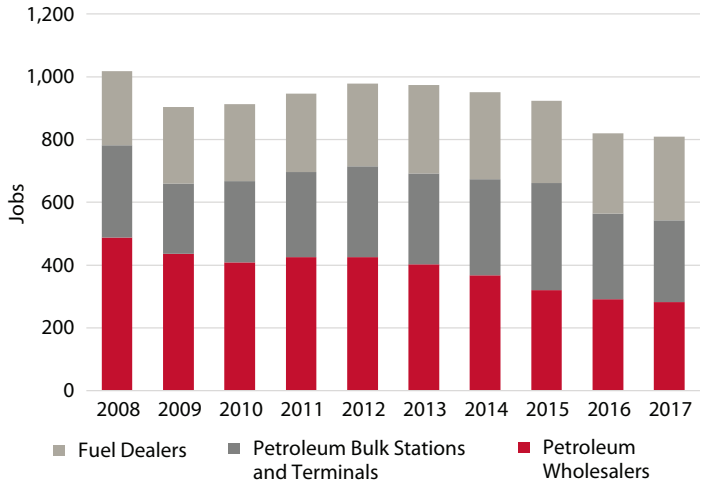
Source: Utah Department of Workforce Services

Figure 32: Oil and Gas Product Distribution Employment, 2008–2017



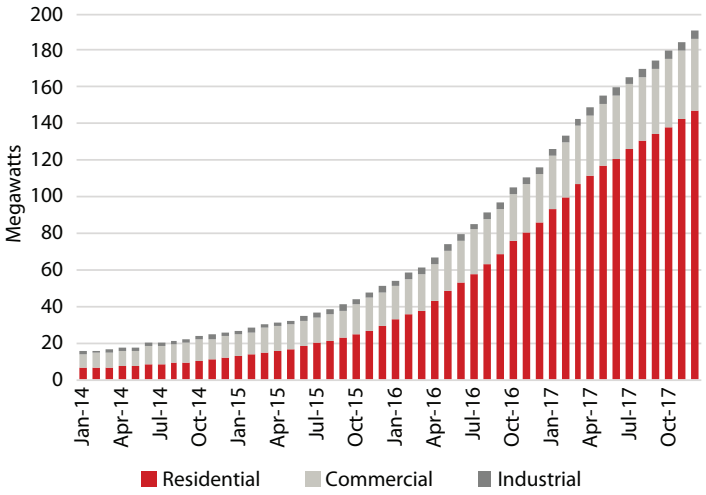
Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Figure 33: Energy Trade Employment and Establishments, 2008–2017



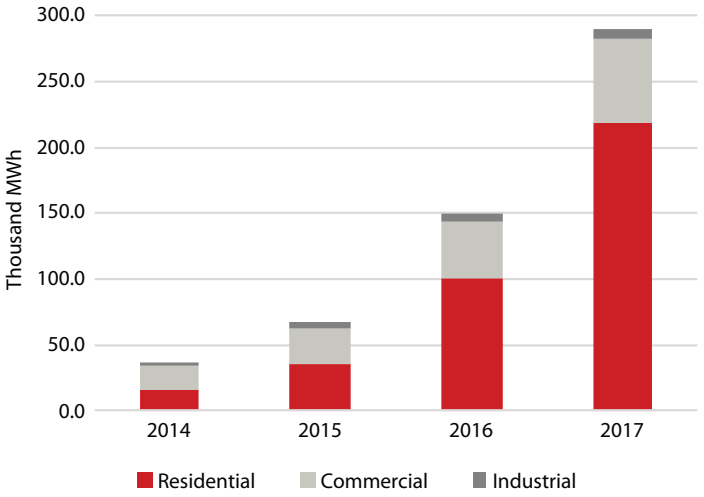
Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Figure 34: Estimated Small-Scale Solar Photovoltaic Capacity in Utah, 2014–2017



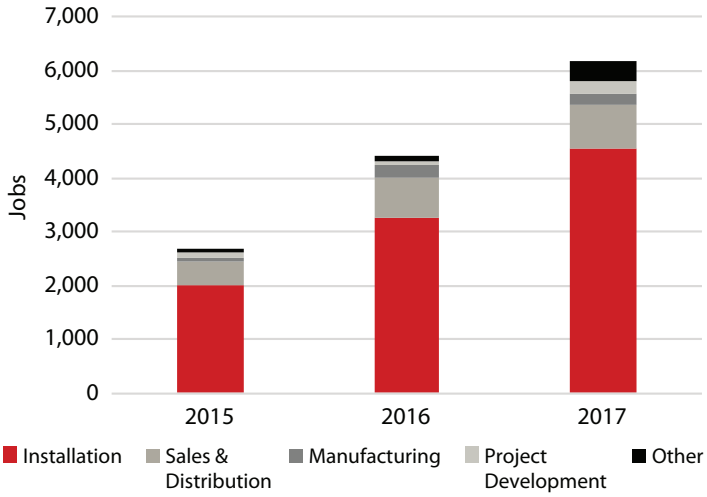
Source: U.S. Energy Information Administration, Form EIA-861M

Figure 35: Estimated Small-Scale Solar Photovoltaic Generation in Utah, 2014–2017



Source: U.S. Energy Information Administration, Form EIA-861M

Figure 36: Solar Jobs in Utah, 2015–2017



Source: The Solar Foundation, Solar Jobs Census

The energy trade sector consists of petroleum bulk stations and terminals, other petroleum wholesalers, and retail fuel dealers. Employment dropped from a pre-recession high of 1,017 jobs in 2008 to 904 in 2009, then grew to 978 in 2012. Energy trade jobs have since shrunk to just over 800. Petroleum wholesalers have seen the largest losses, shedding over 200 jobs between 2008 and 2017. Petroleum bulk stations and terminals lost 35 jobs over the same period, while fuel dealers saw a net gain of 32 jobs (see Figure 33). Together, these three subsectors provided 809 jobs in 2017 with an estimated $57.8 million in earnings and contributed $91.9 million to the state's GDP.

Solar

In 2017, Utah had the 14th largest small-scale photovoltaic solar capacity and generation in the nation. The Energy Information Administration estimates small-scale (<1 MW) photovoltaic solar capacity in Utah reached 190.6 MW as of December 2017 and generated 289,373 MWh that year (see Figures 34 and 35). This represents a 12-fold increase in capacity since 2014, the earliest available data, and an almost eightfold increase in generation.[15] Utah went from representing 0.3% of the nation's small-scale photovoltaic capacity and generation in 2014 to 1.2% of both capacity and generation in 2017. The most rapid growth was in the residential market, where capacity grew from 6.3 MW in January 2014 to 147.2 MW in December 2017, and generation grew from 15,825 MWh in

2014 to 218,494 MWh in 2017. More than three-quarters (76%) of 2017 small-scale photovoltaic generation in Utah came from residential installations, one-fifth (22%) came from commercial installations, and the remaining 3% was from industrial.

Solar jobs are present in industries ranging from engineers to electrical contractors to equipment wholesalers, but none of these sectors uniquely capture solar employees. To be included, an employee must spend at least 50% of his or her time on solar-related work. The Solar Foundation's 2017 National Solar Jobs Census reported 6,170 solar jobs in Utah, a 40% increase from 2016 (see Figure 36). This placed the state 12th for total solar jobs and fourth for the number of solar jobs per capita.[16] These represent both residential rooftop solar and utility-scale solar, each of which requires very different job skills. Nearly three-quarters of the state's solar jobs, 4,553, were in installation, which consists mostly of electricians and construction workers. The next largest component was wholesale trade and distribution, accounting for 811 jobs. There were 243 project development jobs, including design, engineering, permitting, and associated accounting, management, and administration. Manufacturing of mounting structure hardware, monitoring systems, inverters, or other components accounted for 206 jobs, which are also included in the turbine, transformer, and solar equipment sector discussed above. Finally, there were 357 "other" jobs, covering research and development, training, finance, consulting, law, communications, and nonprofit organizations. The total count includes jobs at solar electricity generation plants, some of which are included in the renewable electricity generation sector discussed above.

Energy Efficiency

Energy efficiency employment is defined as the production or installation of energy efficiency products certified by the Environmental Protection Agency's Energy Star program. BW Research, the consulting firm retained to quantify energy efficiency jobs in each state, advises that 14,626 Utah employees in 2017 spent the majority of their workday in energy efficiency activities. These activities include working with Energy Star appliances and efficient lighting; high-efficiency heating, ventilation, and air conditioning equipment, including renewable heating and cooling systems; and building materials and insulation that exceed building code standards. Conducting energy audits and building certifications and providing related software services are also included. Energy efficiency employment ranges across such industries as construction, professional services, sales and distribution, and manufacturing. Within the professional services sector, a number of Utah companies provide home automation equipment to minimize energy usage. The energy efficiency employment data do not include accompanying wages or earnings. Nor do the available data allow us to make our own estimates.

Table 10: Incremental Energy Efficiency Savings, 2017

Fuel	Energy Efficiency Savings	Average Energy Price	Value of Energy Saved
Electricity	254,907 MWh	8.6¢/kWh	$21,922,002
Natural Gas	890,000 MMBtu	$7.63/mcf	$6,519,033

Note: Savings amounts represent new energy savings from programs implemented in 2017.
Source: Kem C. Gardner Policy Institute analysis of data from the American Council for an Energy Efficient Economy, 2018 State Energy Efficiency Scorecard, and the Energy Information Administration

According to *The 2018 State Energy Efficiency Scorecard*, Utah electricity users saved 254,907 MWh of electricity in 2017 due to the implementation of new energy efficiency measures. At an average price of 8.6 cents per kWh, this amounts to savings of $21.9 million. Similarly, incremental natural gas energy efficiency savings of 890,000 MMBtu were worth an estimated $6.5 million (see Table 10).[17] Note that these savings do not represent a full cost-benefit accounting as they do not subtract the cost of achieving these savings, such as subsidies paid by utilities to customers for purchasing energy-efficient appliances or the higher cost of energy-efficient appliances and LED lighting not covered by rebates.

Fiscal Impacts

In addition to jobs, earnings, and GDP, Utah's energy industry generates a significant amount of revenue for state and local governments. Approximately half of the revenues from energy production on federal lands is disbursed to the state. Energy leases on the state's trust lands also generate royalties and other revenues. The state charges an oil and gas severance tax, an oil and gas conservation fee, and an environmental assurance fee on petroleum products. Counties levy property taxes on various energy and natural resource properties. The state and local jurisdictions collect sales taxes on taxable business investments made by energy companies. Most municipalities impose an energy sales and use tax. In calendar year 2017 these revenue sources totaled $492.1 million (see Table 11). Property taxes and sales taxes accounted for more than two-thirds of the total and federal mineral lease disbursements made up about one-seventh.

Many energy-related government revenues are based on the value of resource production. Federal oil and gas royalties are assessed at 6.9 to 19.1% of production value, depending on the product; SITLA charges 12.5% to 16-2/3% of production value for oil and gas extraction from state trust lands; the state oil and gas severance tax is 3% or 5% of production value, depending on price; and the oil and gas conservation fee is 0.2% of the value of oil or gas. As a result, a significant portion of state and local energy-related revenue is sensitive to changes in energy prices. From 2008 through 2014, federal mineral lease disbursements, SITLA revenues, and the oil and gas severance tax and conservation fee accounted for 46% to 56% of total energy-related revenues (see Table 12). Over this same period, crude oil wellhead prices averaged over $75 per barrel and natural gas wellhead prices averaged over $4 per mcf. From 2015 through 2017 these revenue sources decreased to about one-quarter of total energy revenues while oil and gas prices nearly halved. Over the last decade, total energy-related state and local revenues peaked at $711.3 million in 2014, measured in nominal dollars. Since then, revenues decreased by 30% to $492.1 million in 2017 (see Figure 37).

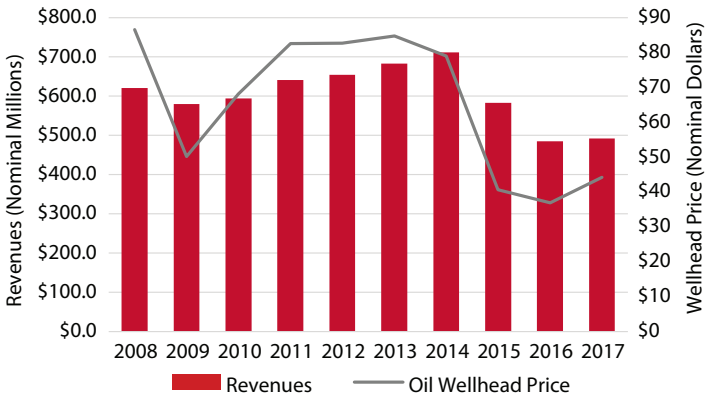
In addition to taxes, fees, royalties, and other energy-related revenues, the direct, indirect, and induced income, output and employment generated by the energy industry creates income, sales, and property taxes for the state and local jurisdictions. The total economic activity resulting from Utah's energy industry led to an estimated $236.2 million in state income and sales tax revenues and $112.7 million in county sales and property taxes (in addition to those noted above) in 2017 (see Table 13). On the expenditure side, the population supported by this activity required state public education, higher education, and non-education operating expenditures of $96.3 million, plus $22.2 million of county-level public education and non-education expenditures. The net effect amounted to $139.9 million in state revenues and $90.5 million in local revenues.

Table 11: Direct Energy-Related State and County Revenues, 2017

Source	Amount
Property Taxes	$188,680,880
Sales Taxes	$163,114,451
Federal Mineral Lease Disbursements	$74,126,035
SITLA Energy-Related Revenues	$35,159,282
Oil and Gas Severance Tax and Conservation Fee	$26,002,488
Environmental Assurance Fee	$4,988,134
Total	**$492,071,270**

Note: Sales taxes comprise estimated state and local taxes collected on energy-related business investment and municipal energy sales and use taxes. Oil and gas severance tax and conservation fee includes environmental assurance fee revenues. All data are for calendar year 2017.
Source: U.S. Department of the Interior, Office of Natural Resources Revenue; Utah State Tax Commission; State of Utah School and Institutional Trust Lands Administration

Figure 37: Total State and Local Energy-Related Revenues and Average Crude Oil Wellhead Prices, 2008–2017



Source: U.S. Department of the Interior, Office of Natural Resources Revenue; Utah State Tax Commission; State of Utah School and Institutional Trust Lands Administration; and Utah Geological Survey

Table 12: Direct Energy-Related State and County Revenues, 2008–2017

(Thousands of nominal dollars)

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Property Taxes	$119,736.8	$128,954.2	$147,040.4	$164,277.2	$185,020.2	$188,889.1	$199,002.0	$203,492.9	$190,078.2	$188,680.9
Power	$52,259.2	$59,055.3	$70,097.7	$76,285.9	$82,422.5	$88,371.1	$87,460.0	$96,775.4	$94,289.2	$93,282.9
Pipeline and Gas Utilities	$20,372.4	$22,992.3	$29,253.4	$35,031.6	$41,631.2	$43,223.9	$41,623.1	$43,747.4	$44,725.6	$44,400.4
O&G Extraction	$42,902.5	$42,582.1	$43,979.0	$48,652.3	$56,730.2	$52,604.9	$63,973.6	$57,735.0	$45,448.7	$46,821.2
Coal Mines	$4,202.8	$4,324.4	$3,710.4	$4,307.5	$4,236.4	$4,689.2	$5,945.2	$5,235.1	$5,152.7	$3,741.7
Uranium	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$462.1	$434.6
Sales Tax on Energy-Related Business Investment	$147,064.7	$136,383.3	$151,295.3	$164,314.3	$157,121.1	$168,483.1	$166,334.4	$157,750.2	$157,848.8	$156,977.8
Federal Mineral Lease Disbursements	$162,483.0	$132,151.4	$144,382.5	$153,182.0	$157,839.3	$146,256.2	$157,033.0	$104,125.3	$69,306.5	$74,126.0
SITLA	$87,881.1	$85,232.8	$72,269.7	$73,275.6	$71,033.0	$82,661.8	$82,131.0	$49,006.3	$32,027.6	$35,159.3
Oil and Gas	$73,212.0	$67,873.3	$55,958.8	$59,537.9	$62,707.0	$77,451.5	$76,905.7	$44,862.0	$28,565.3	$32,334.9
Coal	$13,661.2	$16,393.1	$14,812.9	$12,203.4	$6,475.0	$2,871.7	$3,282.7	$2,644.6	$1,873.1	$1,319.0
Oil Shale	-$92.5	-$139.3	$281.0	$281.1	$663.6	$942.5	$465.7	$93.0	$113.6	$109.0
Tar Sands	$402.9	$285.1	$399.4	$571.6	$462.8	$547.2	$666.5	$519.7	$333.6	$184.2
Uranium	$442.9	$340.8	$298.5	$331.7	$339.3	$280.1	$123.6	$158.0	$287.8	$210.2
Geothermal	$218.5	$370.2	$400.0	$257.7	$232.1	$293.7	$329.9	$333.9	$340.0	$352.7
Solar	$0.0	$0.0	$0.0	$0.0	$45.1	$81.2	$97.0	$103.6	$167.3	$296.3
Wind	$36.2	$86.1	$78.0	$57.3	$58.6	$59.3	$62.6	$66.0	$66.6	$67.4
Western Energy Hub (salt cavern storage)	$0.0	$23.6	$41.1	$35.0	$49.5	$134.7	$197.3	$225.5	$280.3	$285.7
Oil and Gas Severance Tax	$88,210.7	$83,143.0	$65,603.8	$71,102.2	$68,220.3	$80,294.1	$88,757.3	$52,990.5	$22,047.9	$22,599.7
Oil and Gas Conservation Fee	$6,122.1	$5,513.1	$4,987.8	$6,108.7	$6,151.7	$6,846.0	$7,274.7	$4,924.6	$3,229.6	$3,402.8
Environmental Assurance Fee	$4,869.8	$4,414.7	$4,527.4	$4,574.1	$4,774.5	$4,897.0	$5,241.4	$5,842.8	$5,346.0	$4,988.1
Municipal Energy Sales and Use Tax	$4,670.4	$4,456.7	$4,036.2	$3,985.1	$4,115.3	$5,065.3	$5,542.4	$5,061.1	$5,555.6	$6,136.7
Total	**$621,038.7**	**$580,249.0**	**$594,143.1**	**$640,819.3**	**$654,275.4**	**$683,392.6**	**$711,316.1**	**$583,193.8**	**$485,440.2**	**$492,071.3**

Note: Years are calendar years.
Source: U.S. Department of the Interior, Office of Natural Resources Revenue; Utah State Tax Commission; State of Utah School and Institutional Trust Lands Administration.

Table 13: Additional Energy Industry Estimated State and Local Fiscal Impacts, 2017

(Millions)

Estimated State Fiscal Impacts	Amount
Personal Income Tax Revenues	$103.8
Corporate Income Tax Revenues	$19.9
State Sales Tax Revenues[1]	$112.6
Total State Revenues	**$236.2**
State Non-Education Expenditures	$49.8
State Public Education Expenditures	$25.7
State Higher-Education Expenditures	$20.8
Total State Operating Expenditures	**$96.3**
Net State Operating Revenue	**$139.9**

Estimated Local Fiscal Impacts	Amount
Local Sales Tax Revenues[2]	$15.8
Property Tax Revenues	$96.9
Total Local Revenues	**$112.7**
County Expenditures	$12.8
Countywide Public Education Expenditures	$9.4
Total Local Operating Expenditures	**$22.2**
Net Local Operating Revenue	**$90.5**

1. Sales and gross receipts taxes.
2. Local sales tax revenues consist of total general sales and use taxes and the tourism restaurant tax.
Source: Kem C. Gardner Policy Institute analysis using the REMI PI+ model and Gardner Institute fiscal model

Energy Prices

As noted above, because many of the state energy-related revenue sources are based on the value of production, revenues are affected by swings in energy prices. Energy prices also affect the state through the prices that businesses and households pay and through changes in direct energy-sector jobs in Utah that result from changes in energy prices. In addition, our low retail energy prices may induce energy-intensive firms to locate facilities here, creating new jobs.

Oil and gas drilling jobs are the most responsive to changes in oil and gas prices (see, for example, Figures 11 and 12 above). High prices spur new exploration activity, while low prices discourage investment in new wells. Oil and gas extraction jobs exhibit almost no response to price changes because once a well is drilled and producing, ongoing operating costs are low (see Figure 38). However, this masks the fact that operators can shut in wells when prices are low, and the steep production declines of horizontal wells require companies to continually drill new wells to keep production flowing. Running simple regression analyses of the change in oil and gas drilling jobs as a function of the change in nominal wellhead oil prices, and the change in oil and gas extraction jobs as a function of changes in nominal wellhead prices supports these observations.[18] For every 10% change in the price of oil, drilling jobs change by 6% (in the same direction) but extraction jobs change by only 1%—and could even move in the opposite direction. Correlation measures the degree to which two variables move together. Correlation coefficients range from 1, when the two variables are perfectly in synch, to –1, when they are perfectly out of synch. An analysis of changes in oil prices, well-drilling jobs, and extraction jobs shows that changes in prices and drilling jobs have a correlation coefficient of 0.56, whereas the coefficient on changes in prices and extraction jobs is only 0.22.

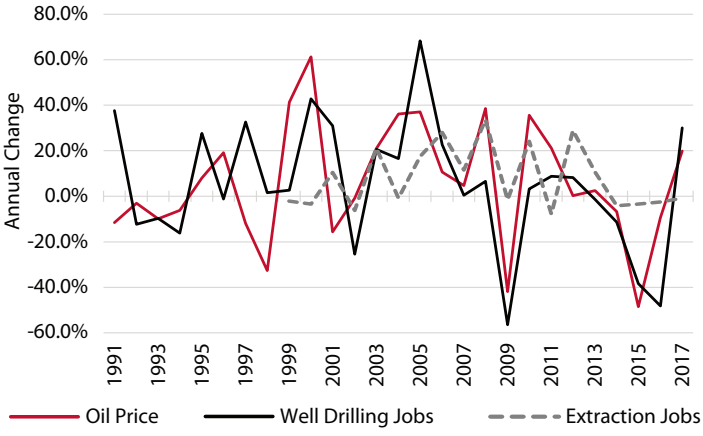
Retail energy prices for most consumers in Utah are below national averages. Prices range from 6% to 23% lower than the national average for all but industrial users of natural gas and transportation users of electricity, whose prices are 22% and just over 1% higher than average, respectively (see Table 14). At current consumption levels, if Utahns were paying national average prices they would pay, on net, $578.4 million more for electricity and natural gas.

Table 14: Five-Year Average Energy Prices, U.S. vs. Utah

Sector/Product	5-Year Average Price		Utah vs. U.S. Differential	Estimated Savings in 2017
	Utah	U.S.		
Residential				
Electricity (per kWh)	10.8¢	12.5¢	–16.5%	$184,513,400
Natural Gas (per mcf)	$9.18	$10.53	–14.6%	$124,062,000
Commercial				
Electricity (per kWh)	8.6¢	10.5¢	–23.0%	$237,127,800
Natural Gas (per mcf)	$7.53	$8.01	–6.4%	$19,806,720
Industrial				
Electricity (per kWh)	6.1¢	6.9¢	–12.9%	$69,622,500
Natural Gas (per mcf)	$5.61	$4.36	22.3%	–$56,409,870
Transportation*				
Electricity (per kWh)	10.2¢	10.1¢	1.4%	–$324,800
All Sectors/All Products				$578,397,750

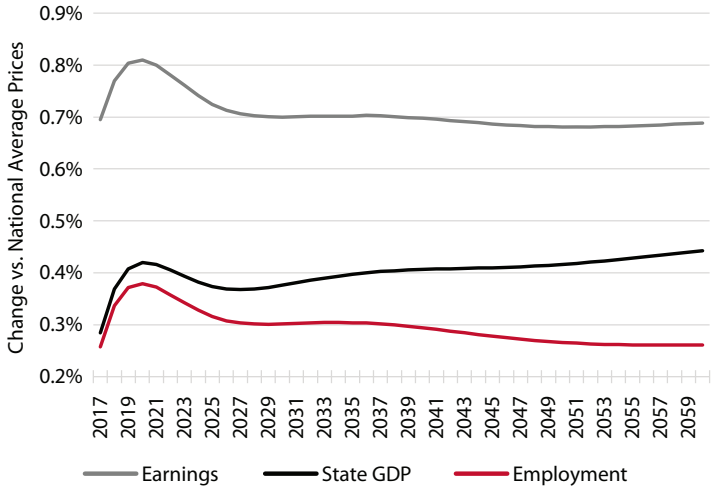
* State-level natural gas prices for the transportation sector are available only through 2012.
Source: Kem C. Gardner Policy Institute analysis of U.S. Energy Information Administration data

Figure 38: Annual Change in Nominal Crude Oil Wellhead Price and Oil and Gas Jobs, 1991–2017



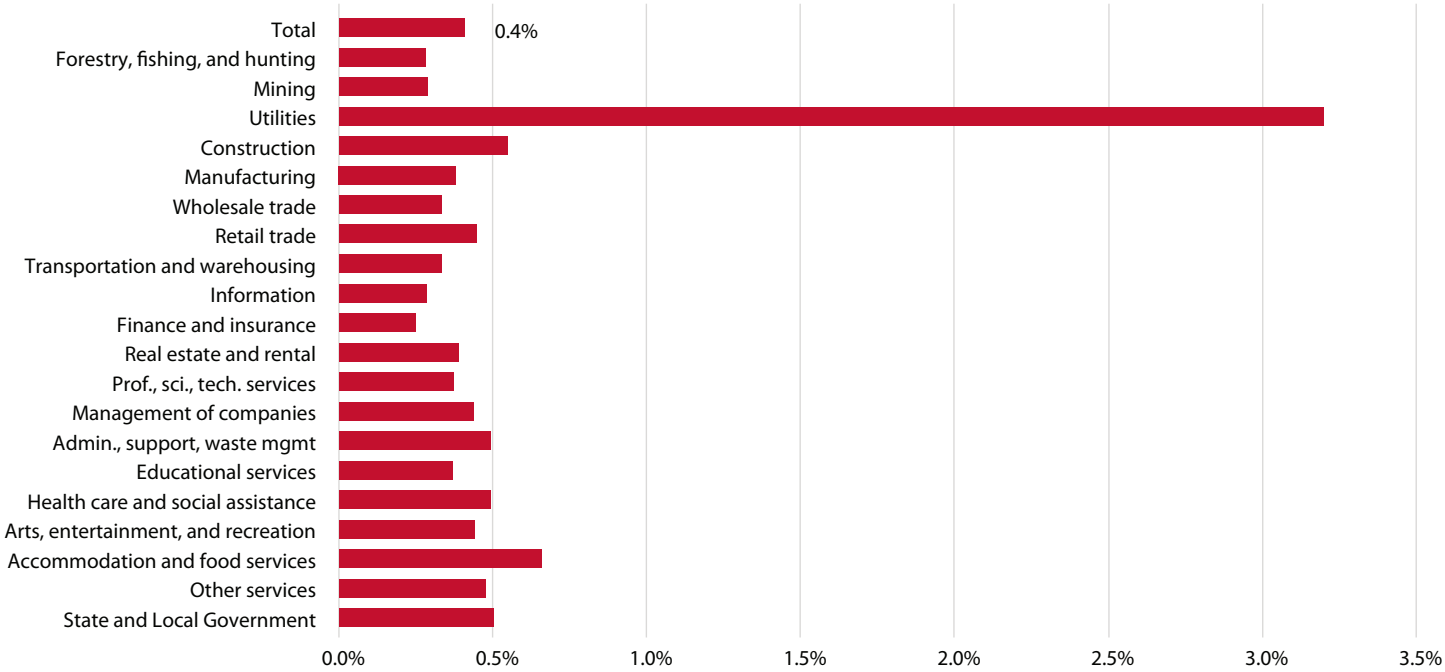
Source: Kem C. Gardner Policy Institute analysis of data from the Utah Geological Survey and the Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Figure 39: Effects of Utah's Low Energy Prices



Source: Kem C. Gardner Policy Institute analysis of U.S. Energy Information Administration data using the REMI PI+ model

Figure 40: Changes in Value Added by Industry Due to Lower Energy Prices



Source: Kem C. Gardner Policy Institute analysis of U.S. Energy Information Administration data using the REMI PI+ model

To examine the effects of energy prices on the state's economy, we entered the percentage difference between national average prices and Utah prices for each fuel (electricity and natural gas) and end user (residential, commercial, and industrial). We entered the differences for every year out to 2060 and compared the results to REMI's baseline forecast, which incorporates Utah's existing prices. After an initial adjustment period, baseline state GDP averages about 0.4% larger than it would have been under national average prices, employment is about 0.3% higher, and earnings average 0.7% higher (see Figure 39).

Comparing impacts on value added by industry, effects range from 0.2% in the finance and insurance sector to 3.2% in the utilities sector (see Figure 40). Since most utilities are regulated monopolies, their profit margins are fixed. The large advantages of lower prices to the utility sector then likely result from greater electricity and natural gas consumption compared with that under the higher national average prices. Besides utilities, other sectors with the largest effects include accommodation and food services (0.66%), construction (0.55%), and state and local government (0.50%).

Industry SWOT Analyses

The Gardner Institute conducted strengths-weaknesses-opportunities-threats (SWOT) analyses of Utah's main energy sectors: oil and gas, mineral fuels, wind, solar, and geothermal. These analyses evaluated the internal strengths and weaknesses of each sector as well as external opportunities and threats.

Oil and Gas

Utah has abundant oil and gas resources to meet state demands; however, Utah faces a decision about becoming a player in the national and international markets. In parts of the Uinta Basin, hydraulic fracturing and horizontal drilling have increased well production rates to match prolific basins in Texas and North Dakota. However, delivering Uinta Basin waxy crude to national and international markets has always been difficult because the crude congeals at ambient air temperatures. Since the state's crude oil production growth has been constrained by Salt Lake City refinery capacity, Utah's crude oil sector growth is dependent on expanding rail infrastructure to export Uinta Basin crude oils to the Gulf Coast and West Coast.

Regarding natural gas, future production growth is also problematic. The United States is awash in natural gas supplies due to prolific shale gas resource in the Marcellus (Pennsylvania) and other shale basins, plus the associated gas production in the Permian Basin (Texas) and Bakken Formation (North Dakota). The resulting overhang of natural gas volumes has driven prices to levels that are uneconomic for Uinta Basin operators to expand production. At such low price levels, supplying natural gas to a West Coast liquefaction plant for deliveries to the Asian markets is attractive to stakeholders in the Western States and Tribal Nations Natural Gas Initiative. Opening a new market for sales of liquefied natural gas (LNG) could raise natural gas prices, increasing exploration and drilling activities.

Mineral Fuels

Mineral fuels consist of coal and uranium. Utah is the 11th largest coal producer in the United States; however, domestic markets have dwindled over the last decade due to environmental concerns and fuel switching by power plants to natural gas. In

Figure 41: Economic SWOT Analysis of Utah's Oil and Gas Sector

Strengths	Weaknesses
• Utah has a favorable regulatory environment that encourages oil and gas development • Utah is the 11th largest producer of oil and 13th largest producer of natural gas in the U.S. • Uinta Basin waxy crude oil has positive properties such as high API gravity, low sulfur, and low metals content • Uinta Basin waxy crude oil's high paraffin content makes it an ideal base stock for lubricants used in automobiles • Horizontal drilling in the Uinta Basin has proven very successful and has improved economics of production • Oil and gas jobs pay higher than average wages • Large unconventional oil shale and oil sands resources exist in Utah • Upside potential exists to increase production levels in the Paradox Basin.	• Uinta Basin waxy crude has a high paraffin content that solidifies at ambient temperatures making handling more difficult and expensive • The Salt Lake City refineries' aggregate fluid catalytic cracking capacity caps their receipts of Utah waxy crude at 90,000 barrels per day, although the Uinta Basin is capable of producing more waxy crude than current production levels • Truck traffic on US 40 has increased the wear and tear on the road and increased the risk of automobile accidents • The number of oil and gas jobs can be volatile due to commodity price fluctuations • Uinta Basin waxy crude sells to Utah refiners at a discount to the benchmark crude, West Texas Intermediate (WTI), although the waxy crude could be valued higher by out-of-state refiners that produce lubricants • Federal ownership of a majority of Utah's land increases the difficulty of developing oil and gas
Opportunities	**Threats**
• The production of waxy crude from the Uinta Basin could expand with the construction of rail infrastructure, allowing exports to national and international markets • With a newly constructed rail infrastructure for increased Uinta Basin waxy crude production, profits could increase to $126 million per annum, $92 million per annum more could be collected in state and local revenues, and 860 full-time-equivalent jobs per annum could be created and sustained • Abundant supplies of natural gas plus low price levels make a liquefied natural gas (LNG) terminal plant located on the West Coast economically attractive allowing exports to international markets • The Ruby Pipeline, constructed in 2010 has spare capacity to transport Uinta Basin natural gas to the West Coast • With the right training, Utah's young, agile population can fill key industry positions • New enhanced oil recovery (EOR) techniques are poised to increase crude oil production levels.	• The Williston (Bakken - North Dakota) and Permian (Texas) basins have export commissions identifying potential outlets for their crude oil exports to national and international markets • Political differences in Oregon pose resistance to building an LNG terminal in Jordan Cove • Increased pressure from climate change activists may decrease demand for fossil fuels • Increasing market share of electric vehicles (EV's) may decrease demand for motor gasoline and diesel fuel.

Source: Kem C. Gardner Policy Institute; U.S. Energy Information Administration; U.S. Geological Survey; Utah Geological Survey; HDR, *Uinta Basin Energy and Transportation Study*

Figure 42: Economic SWOT Analysis of Utah's Mineral Fuels Sector

Strengths	Weaknesses
• Utah is the 11th largest coal producer in the U.S. • Utah coal exports increased to 20% of total state production since the early 2000s • Utah's bituminous coal has a higher heat content (11,400–12,100 BTU/lb.) than the sub-bituminous coal from Wyoming, the nation's largest coal producer • The U.S. is the world's largest consumer of uranium, principally as a fuel source for nuclear power plants and the Navy's vessel fleet • Utah has the only operating uranium mill in the U.S.	• Demand for Utah coal in U.S. domestic markets has declined since the early 2000s • The use of uranium as a fuel source in the U.S. has declined in recent years • Utah's uranium ores have an average concentration of only 0.4% U_3O_8, whereas Canadian uranium ores have 20% U_3O_8 concentration
Opportunities	**Threats**
• Southeast Asia is projected to have a continued large demand for coal • The Utah Office of Energy Development has signed an agreement with the Port of Ensenada in Baja California, Mexico for transportation of Utah's natural resources • Utah has large recoverable resources of coal, one of the lowest-cost conventional fuels • With the right training, Utah's young, agile population can fill key industry positions • Associated vanadium can make Utah's uranium ore more attractive • The carbon capture sequestration and utilization (CCSU) pilot project at the coal-fired Hunter Power Plant may become commercial, eliminating the need for alternative feedstocks	• The number of coal-fired power plants in the U.S. has been decreasing. Utah's coal deliveries to other states has decreased by almost 90% in the last 15 years • The Los Angeles Department of Water and Power, the chief shareholder in the Intermountain Power Project, will cease accepting coal-fired electricity in 2025; this event will further diminish coal demand within Utah • Low natural gas prices make natural gas–fired electricity a better option • Future greenhouse gas emissions regulations may threaten Utah's existing coal-fired power plants • Opposition to allowing coal exports through California port facilities • Declining costs of renewable electricity generation • Lack of a long-term nuclear waste storage solution impedes the building of any new nuclear plants

Source: Kem C. Gardner Policy Institute; Utah Geological Survey, circular 124, *Utah Mining 2017*

Figure 43: Economic SWOT Analysis of Utah's Wind Sector

Strengths	Weaknesses
• Wind-generated electricity accounted for 2.3% of Utah's total electricity generated in 2017 • The $125 million investment in the Latigo Wind Park (62 MW) is the largest private investment in San Juan County • Beaver and Millard county property tax revenues on the 12,000-acre footprint of the Milford Wind Project (306 MW) rose from $680 to $3,100,000 after the development of the $360 million project	• Intermittent nature of wind energy • The complex topography of Utah makes wind resources in the state marginal compared with other states like Wyoming • Storage costs for intermittent resources have not been demonstrated to be cost effective in Utah's low energy cost environment • Concerns about hub height and potential hazards to wildlife have delayed wind projects from being commissioned on schedule
Opportunities	**Threats**
• As the hub heights on windmills (i.e. the height of the rotor above ground) increase from 80 meters to 140 meters the electrical generating capacity will increase • Adoption of renewable portfolio standards (RPS) by either Utah or neighboring states may improve economic viability of wind projects in Utah.	• Lack of available transmission capacity from remote sites in Utah could deter project developers • Federal and state fiscal incentives are scheduled to lapse in the early 2020s • New difficulties in securing power purchase agreements due to a large influx of renewable electricity and decreasing incentives • Difficulties siting and permitting on or near federal lands could delay or deter projects

Source: Kem C. Gardner Policy Institute; U.S. Energy Information Administration; Beaver County Economic Development Office, press release titled "Renewable Energy and Our Economy"

2025, Utah coal deliveries to the Intermountain Power Project (IPP) will cease as IPP converts to natural gas–fired electricity as mandated by IPP's chief shareholder, the Los Angeles Department of Water and Power. Utah's coal production has shrunk by 47% since 2001. Although demand for coal in Asia is projected to rise, ongoing litigation at U.S. domestic export terminals in California and Washington have forced Utah coal producers to transit coal shipments through Mexico or the Gulf of Mexico.

Low uranium commodity prices have brought Utah's uranium production activities to a standstill since 2013. The only licensed conventional uranium mill in the United States, White Mesa, near Blanding, services superior grade uranium ores from Arizona while Utah's lower grade ore remains shut in.

Wind

Although wind has the lowest levelized cost of energy among both conventional and renewable energies, wind remains relatively underdeveloped in Utah compared with neighboring states Wyoming, Colorado, and New Mexico. Smaller wind projects located close to communities such as Spanish Fork (19 MW) or Monticello (60 MW) have met with local resistance due to compromised view sheds. Larger wind projects such as Milford Project 1 and 2 in sparsely populated Beaver and Millard counties have been embraced because of the enormous jump in property tax revenues.

Figure 44: Economic SWOT Analysis of Utah's Solar Sector

Strengths	Weaknesses
• Utah has high-quality solar resources at higher altitudes, which often increases the efficiency of solar systems • Solar-generated electricity totaled almost 7% of Utah's electricity generated in 2017. Solar-generated electricity more than doubled from 2016 to 2017 • Utah is one of seven states with the best potential for solar power according to the National Renewable Energy Laboratory • Utah has over 6,100 employees working in the solar industry according to the 2017 Solar Foundation Annual Jobs Census[1]	• Intermittent nature of solar energy • Storage costs for renewable energy generated electricity have not currently demonstrated cost effectiveness in Utah's low energy rate environment
Opportunities	**Threats**
• Through technological advances, solar panel costs will likely decrease. Solar panel costs have already decreased by over 60% in the last decade • Counties in southern Utah have the highest solar potential. Beaver, Iron, and Millard currently account for almost all of the installed capacity of utility-scale solar • Advances in residential and utility-scale battery technology may enable solar to become base load energy.	• The U.S. announced Section 201 tariffs on imported solar cells and modules commencing in January 2018. U.S. project developers have announced project cancellations totaling $2.5 billion due to the announcement of Section 201 • Lack of available transmission capacity from remote sites in Utah could deter project developers • Federal and state fiscal incentives are scheduled to lapse in the early 2020s • New difficulties in securing power purchase agreements due to a large influx of renewable electricity and decreasing incentives

1. The Solar Foundation defined a solar job as one held by a worker who spends at least 50% of his or her time on solar-related work; census findings showed that 89% of solar workers spent 100% of their time on solar work.
Source: Kem C. Gardner Policy Institute; U.S. Energy Information Administration; *Deseret News*, 6 April 2018, "Salt Lake City Rises Above Many Other American Cities"

Figure 45: Economic SWOT Analysis of Utah's Geothermal Energy Sector

Strengths	Weaknesses
• Significant geothermal resources exist close to transmission • The University of Utah's Energy and Geoscience Institute (EGI) was awarded a $140 million Department of Energy (DOE) research grant to research geothermal and development of advanced geothermal extraction methods at the Frontier Observatory for Research in Geothermal Energy (FORGE) center near Milford, Utah • Geothermal energy is a base-loaded mostly carbon neutral energy source	• More expensive front-end costs of project development for both utility-scale and direct-use geothermal as compared to some alternatives • Research and development advances from FORGE will take significant time to develop into commercial deployment
Opportunities	**Threats**
• Technical breakthroughs by FORGE may reduce the costs of energy production and lower risks in project development • Less than one-tenth of U.S. geothermal resources have been developed; Utah has 22 identified geothermal systems of which only 4 have been developed • Knowledge-sharing with the oil and gas industry may lead to cost reductions in deep drilling of geothermal wells • Utility-scale geothermal is a large potential energy source with positive attributes of serving as base load power as well as dispatchable power	• Geothermal projects have costly front-end exploration and development phases before full-scale production of geothermal resources commences

Source: Kem C. Gardner Policy Institute; U.S. Department of Energy, 14 June 2018 press release, "DOE selects University of Utah Site for Research and Development"

Solar

Solar-generated electricity in Utah doubled from 2016 to 2017. Solar has replaced hydroelectric as the biggest renewable energy contributor to Utah electricity generation. Growth in solar energy is driven by decreased costs of photovoltaic panels as well as state and federal incentives. Both utility-scale solar and rooftop solar in Utah doubled year-on-year from 2016 to 2017, however utility-scale solar (2,500 thousand megawatt hours) is nearly an order of magnitude larger than rooftop solar (289 thousand megawatt hours).

The National Renewable Energy Labs named Utah one of seven states along a solar energy corridor that are most prospective in the U.S. for harnessing solar power. The 2017 National Solar Jobs Census identified 6,170 solar jobs in Utah. In both rooftop and utility-scale solar, job creation is greatest during the photovoltaic panel installation phase followed by a drop-off in job creation during the production phase. Potential barriers to continued solar growth include the scheduled phase-out of both state and federal tax incentives. Another potential barrier is tariffs levied on imports of Chinese-manufactured photovoltaic panels.

Geothermal

Utah is the third largest producer of geothermal energy in the United States, behind California and Nevada. However, within Utah's renewable energy portfolio, geothermal energy

ranks fourth, behind solar, hydroelectric, and wind. Technology advances in both solar and wind have outstripped geothermal, resulting in minimal growth in Utah's geothermal resources since 2014. The Department of Energy's $140 million grant to the University of Utah for geothermal research and development at Milford, Beaver County will create a center of excellence near the site of Utah's three existing geothermal operations, Thermo Hot Springs, Roosevelt Hot Springs, and Cove Fort. Technology advances may reduce production costs of energy from geothermal projects and lower project development risks.

Geothermal energy has a unique advantage over wind and solar as a dispatchable power source available 24 hours per day. In addition, the surface footprint of geothermal operations is small compared with utility-scale wind farms and solar panel fields.

Methodology

Economic Impact Model

The Gardner Institute estimated direct earnings by multiplying direct wages obtained from the Utah Department of Workforce Services (DWS) or the Bureau of Labor Statistics (BLS) by the appropriate industry-specific ratio of either earnings or compensation to wages, depending on the presence of self-employed proprietors in each industry. These ratios were calculated from three-digit NAICS level data for Utah, available from the Bureau of Economic Analysis (BEA). In the case of oil and gas extraction, we were able to obtain industry earnings directly from the BEA.

We estimated direct GDP by entering the direct employment for each industry into REMI PI+ and obtaining the associated direct output, or "exogenous industry sales." We then multiplied industry sales by the value-added share of output for each industry. This gives direct value added by industry, which is equivalent to GDP.

The Gardner Institute used the most recent data available at the time of research. Some values have since been revised.

To estimate the indirect and induced effects resulting from direct economic activity in the energy industry, we customized an economic impact model for Utah. REMI PI+ version 2.1, developed by Regional Economic Models, Inc., is a dynamic, multi-regional simulation model that estimates economic, population, and labor market impacts of specific economic or policy changes. The model incorporates input-output relationships, general equilibrium effects, econometric relationships, and economic geography effects.

The 70-sector model generally aggregates to two-digit or three-digit NAICS sectors, rather than fully incorporating the six-digit specificity of our data from DWS and BLS. We adjusted for the difference in wages between the aggregated NAICS sectors in REMI and our six-digit NAICS industries to regain precision lost by the model's 70-sector limitation.

In deciding which energy sectors generate economic impacts in Utah, we considered whether they export products or provide products to local consumers that would have been purchased from out of state in the absence of the industry ("import substitution"). Thus, sectors like oil and gas development and production, oil refining, coal mining, and energy-related manufacturing sectors generate impacts. Sectors that serve the local market, like electricity transmission and distribution, wholesale and retail trade, and construction, do not generate indirect and induced impacts but do contribute direct employment, earnings, and GDP. In the case of the state's electricity generation sector, we calculated indirect and induced impacts on only 18% of total generation. This is the five-year average share of electricity sector generation that was exported out of state.

To calculate the impacts of the entire energy industry, we began by modeling only the "downstream" industries to determine the amount of activity in other energy sectors the model generated as inputs. For example, the oil refining sector uses crude oil production as one of its major inputs, and fossil fuel electricity generation uses coal mining as one of its inputs. To avoid double counting, we subtracted this "intermediate demand" employment from the direct employment we modeled in the "upstream" sectors like oil and gas production and coal mining.

Fiscal Impact Model

We use the fiscal model to estimate new state and local revenues and expenditures. Inputs to the fiscal model are employment, personal income, output, and population results produced by the REMI PI+ model based on energy industry operations in Utah in 2017.

Tax revenue estimates are based on past Utah effective tax rates calculated as ratios of historical tax payments to personal income, industry output, and employment. All government expenditures reported in this memo are estimates based on Utah historical averages for spending per capita, adjusted to 2017 dollars.

Conclusion

Utah's diverse energy industry plays a significant role in the state's economy. In 2017, the industry directly and indirectly supported approximately 4.0% of the state's jobs and earnings and nearly 6.0% of GDP. Direct energy-related state and local government revenues totaled $492.1 million. Utah's low retail energy prices saved consumers $578.4 million versus national average prices, and have helped fuel the state's economic growth. The state's mix of traditional and renewable energy resources position it to enjoy continued low prices.

Endnotes

1 This does not include earnings for 14,600 energy efficiency jobs, as the data were not available and could not be estimated.
2 As with earnings, direct GDP from energy efficiency jobs could not be estimated.
3 This does not include earnings for 14,600 energy efficiency jobs, as the data were not available and could not be estimated.
4 As with earnings, direct GDP from energy efficiency jobs could not be estimated.
5 The North American Industry Classification System is used by state and federal statistical agencies as a means of classifying economic activity based on production methods. It allows for various levels of detail, but at its most aggregated divides the economy into 20 sectors such as mining, utilities, construction, manufacturing, and professional, scientific, and technical services. The full classification scheme can be found at www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2017.
6 Taken from an analysis by BW Research for the National Association of State Energy Officers and the Energy Futures Institute, these are jobs where workers spend at least half of their time on energy efficiency–related tasks. A more generous definition, counting workers who spend any time at all on energy efficiency–related tasks, gives 31,074 jobs. We use the more conservative count in our analysis.
7 As reported elsewhere in this study, the Solar Foundation's Solar Jobs Census counted 6,170 solar jobs in Utah. This includes 308 solar equipment manufacturing and electricity generation jobs that are counted in those sectors here.
8 Support activities for oil and gas operations include exploration; excavating slush pits and cellars; well surveying; running, cutting, and pulling casings, tubes, and rods; cementing wells; shooting wells; perforating well casings; acidizing and chemically treating wells; and cleaning out, bailing, and swabbing wells.
9 The number of support activities establishments does not include sole proprietors, who accounted for about 20% of total support activities employment in 2017.
10 This is probably too low for renewables. Much of the wind and geothermal electricity goes out of state through power purchase agreements with California.
11 See solarstates.org/#state/utah/counties/solar-jobs/2018.
12 Production and pricing discussion taken from Taylor Boden, Ken Krahulec, Michael Vanden Berg, and Andrew Rupke, *Utah Mining 2017*, Utah Geological Survey, Circular 125, 2018.
13 Per Energy Fuels; see www.energyfuels.com/project/white-mesa-mill/.
14 Power system construction employment is estimated. NAICS 237120 is power and communication system construction. To estimate only the power system construction jobs, the Gardner Institute used the Department of Workforce Services' FirmFind database to identify the companies in this industry that perform power system construction. We estimated employment in 2017 by taking the midpoint of the summed employment ranges reported for those companies. This gave 960 jobs. We then multiplied total power and communication system construction jobs in previous years by the ratio of power system jobs to the total in 2017 (960/1,723).
15 The change in capacity is measured from January 2014 to December 2017; the change in generation is measured from the annual total in 2014 to the annual total in 2017.
16 See https://www.thesolarfoundation.org/solar-jobs-census-factsheet-2017-ut/.
17 These are estimated net savings, which remove savings due to program participants who would have implemented or installed the energy efficiency measures without an incentive. They are incremental savings in that they represent new energy savings from programs implemented in 2017, not cumulative savings from all measures implemented in 2017 and prior years. For a full discussion, see American Council for an Energy Efficient Economy, *2017 State Energy Efficiency Scorecard*, available at aceee.org/sites/default/files/publications/researchreports/u1710.pdf.
18 Oil and gas drilling jobs are those in NAICS sector 213111 Drilling Oil and Gas Wells; extraction jobs are those in NAICS sector 211 Oil and Gas Extraction.

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