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BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

In the Matter of Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC's Request for Agency Action to Adjudicate Rights and Obligations under PURPA, Schedule 38 and Power Purchase Agreements with Rocky Mountain Power	Docket No. 17-035-36

PREFILED DIRECT TESTIMONY OF RYAN CREAMER

Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC hereby submit the Prefiled Direct Testimony of Ryan Creamer in this docket.

DATED this 29th day of June 2017.

HATCH, JAMES & DODGE

/s/ *Gary A. Dodge*_________
Gary A. Dodge
Attorneys for Glen Canyon Solar A, LLC & Glen Canyon Solar B, LLC

CERTIFICATE OF SERVICE
Docket No. 17-035-36

I hereby certify that a true and correct copy of the foregoing was served by email this 29th day of June 2017 on the following:

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BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

In the Matter of Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC's Request for Agency Action to Adjudicate Rights and Obligations under PURPA, Schedule 38 and Power Purchase Agreements with Rocky Mountain Power	Docket No. 17-035-36

Direct Testimony of Ryan Creamer

On Behalf of Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC

June 29, 2017

I. INTRODUCTION AND SUMMARY

Q. Please state your name and business address.

A. My name is Ryan Creamer. My business address is 2180 south 1300 East, Salt Lake City, Utah 84106.

Q. By whom are you employed and in what capacity?

A. I am the Founder and Chief Executive Officer of Sustainable Power Group (**"sPower"**), where I am responsible for overseeing daily operations and growth of the company.

Q. On whose behalf are you testifying in this proceeding?

A. My testimony is offered on behalf of Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC (collectively, **"Glen Canyon Solar"**), which are subsidiaries of sPower.

Q. Please summarize your work and educational experience prior to joining sPower.

A. I am a Civil Engineer by training. While growing up in St. George I worked at my father's engineering firm as a surveyor, lab technician and engineer in training. Over the last 20 years, I have been involved in and owned three successful businesses, all of which were based in Utah, and all of which had both national and global footprints. I began my career at ISG resources developing building products that utilized a high volume of fly ash from coal-fired power plants. While at ISG I had the opportunity to work with 175 of America's 250 coal-fired power plants, where ISG managed the fly ash. Following my time at

ISG, I helped co-found Energysolutions. Energysolutions is a nuclear service company that managed the back end of all 103 nuclear reactors in the U.S., operated all 20 reactors in the United Kingdom and was a major environmental remediation contractor at Department of Energy and Department of Defense sites around the country. With my career being dedicated to the environment and energy, I founded sPower in 2012 to develop, build, own and operate renewable energy facilities.

Q. Have you previously testified before the Utah Public Service Commission ("Commission")?

A. No.

Q. Have you testified previously before any other state utility regulatory commissions?

A. No.

Q. What is the purpose of your testimony?

A. My testimony is filed in support of the Request for Agency Action filed by Glen Canyon Solar in the matter before the Commission in Docket No. 17-035-36, titled *In the Matter of Glen Canyon Solar A, LLC and Glen Canyon Solar B, LLC's Request for Agency Action to Adjudicate Rights and Obligations under PURPA, Schedule 38 and Power Purchase Agreements with Rocky Mountain Power*.

Q. Please summarize your testimony.

Utah is an excellent resource for solar generation and Utah's solar resources provide significant economic benefits to the State. Through its subsidiary, Glen Canyon Solar, sPower seeks to utilize this excellent resource to build its first utility-scale solar project in Utah. While access to transmission can be problematic for some solar projects in Southern Utah, it is not a problem for the Glen Canyon Solar projects because RMP can redispatch resources to transmit the output from our projects along existing transmission lines using RMP's existing transmission rights. Indeed, the avoided-cost pricing we received from RMP was based on RMP's redispatch of resources along the transmission path to accommodate the output from our projects. However, RMP has thus far refused to inform its transmission function that it can or will redispatch resources to deliver the output from our projects and has not asked for transmission studies to reflect that fact. RMP's refusal to request studies using the redispatch options available to it increases the risk that these transmission studies will assume that otherwise unnecessary and very expensive transmission upgrades are necessary to transmit the energy from our projects. RMP should not be permitted to act in this unreasonable manner.

Q. Can you please provide background information regarding sPower?

A. Headquartered in Salt Lake City, with offices in San Francisco, Long Beach, and New York City, sPower is the largest private owner of operating solar assets in the United States. sPower owns and operates more than 150 utility and commercial distributed electrical generation systems. With 10 gigawatts (GW) of operating, construction and pipeline projects, sPower is actively buying select utility-scale renewable assets in virtually any stage of development in the United States. sPower operates more than a gigawatt of solar projects. When including sPower's growing wind portfolio, sPower's total portfolio of operating renewable assets is more than 1,230 megawatts (MW).

Q. Does sPower's portfolio of renewable assets include any projects in Utah?

A. Yes. sPower currently has four operating projects in Utah: the Latigo Wind Park in Monticello, UT, a 60 MW QF, and three distributed generation solar projects at the University of Utah totaling 0.63 MW.

The two solar projects totaling 95 MW at issue in this docket are the first utility scale projects of any kind to be developed by sPower in Utah.

Q. Does sPower intend to continue to invest in Utah development?

A. Yes. While we have projects all over the United States from Massachusetts to Hawaii, Utah is our home and our headquarters. We intend to continue developing economic Utah projects.

Q. Does Utah have good solar resources?

A. Yes. Utah has exceptional solar resources. A study commissioned by the State of Utah in 2009 set out to identify the theoretical potential for deriving electric power from the clearly-abundant solar resources in our State. The study, performed by the Governor's Office of Energy Development (**"OED"**), identified 6,371 square miles of land in Utah with a theoretical potential to produce about

826 GW of utility-scale capacity.[1] The study confirmed what solar developers already knew—that Utah's solar resources are of the highest quality in the southern parts of the state, and that the quality decreases moving south to north.[2] The study specifically found that the area of Southeastern Utah where Glen Canyon Solar has cited these projects is of especially high quality for solar generation.[3]

Q. Can the availability of good solar resources result in significant solar development?

A. Yes. According to a June 9, 2017 report by the Solar Energy Industries Association (**"SEIA"**), over 1.5 GW of solar capacity has already been installed in Utah, ranking Utah 7th in the country in total installed solar capacity.[4] In 2016 alone, 1.2 GW of solar capacity was installed in Utah, the second highest in the United States.[5] SEIA projects that over 1.4 GW of solar capacity will be installed in Utah over the next 5 years, ranking Utah 19th in the country.[6]

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[1] Resource Profile: Solar Energy in Utah, Governor's Office of Energy Development, http://energy.utah.gov/resource-areas/renewable-energy/resource-profile-solar-energy-utah/ (last visited Jun 26, 2017).
[2] *Id*.
[3] Renewable Energy, Governor's Office of Energy Development, http://energy.utah.gov/category/renewable-energy/ (last visited June 26, 2017) (citing Utah map identified as "Utah's Renewable Energy Resources"). *See also* OED Map of "Utah's Renewable Energy Resources," attached hereto as Exhibit 1.
[4] Solar Spotlight Utah, Solar Energy Industry Association, http://www.seia.org/sites/default/files/2017%20Q1%20UT.pdf (last visited June 26, 2017) (citing SEIA/GTM Research in *U.S. Solar Market Insight* located at http://www.seia.org/research-resources/us-solar-market-insight). *See also* SEIA report titled Solar Spotlight Utah, attached hereto as Exhibit 2.
[5] *Id*.
[6] *Id*.

Q. Does solar development create jobs in Utah?

A. In 2016, an estimated 4,408 of Utahns held jobs in the solar industry, ranking Utah 14th in the country.[7] This is more than double the approximately 2,000 coal jobs in Utah, according to OED.[8] Both coal and renewable energy jobs are important to the economic health of Utah, especially in rural counties where prime resources are often located. The number of good Utah solar jobs will continue to grow, assuming others are not permitted to thwart the development of economic resources.

Q. Does access to transmission play a role in the development of utility-scale solar projects in Utah?

A. Yes. While Southern Utah enjoys particularly good resources for solar generation, limited transmission capacity in that area makes development very difficult. As a result, Southern Utah remains underdeveloped for solar projects, despite the quality of the resource. This is unfortunate for Utah ratepayers, because—as a result of technological advances—power from solar and wind generation resources is the most economical power to produce.

Q. When sPower develops a project, does it consider availability of transmission resources?

A. Yes. Access to transmission is an important factor in citing any generation project. Utility-scale projects, such as those at issue here, go through various

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[7] *Id*. (citing The Solar Foundation, State Solar Jobs Census: http://www.thesolarfoundation.org/solar-jobs-census/states/).
[8] Advancing Utah Coal: Technology, Policy, and a Path Forward, Governor's Office of Energy Development (May 2017). A copy of this report is attached hereto as Exhibit 3.

development phases and plans change as new information is gathered. For example, the Glen Canyon project was initially proposed as a 380 MW project, but was significantly downsized to match available transmission rights as they became known. Because we purposefully downsized our projects to match RMP's existing rights, we did not anticipate transmission issues.

Q. Please explain the general nature of the dispute at issue in this docket, as you understand it?

A. Glen Canyon Solar has signed Power Purchase Agreements ("**PPAs**") with Rocky Mountain Power (**"RMP"**) for the output of two QF solar projects that we are developing in southern Utah. The avoided-cost prices offered by RMP for those projects assumed that RMP could and would redispatch certain other resources so that it could purchase and utilize our energy. However, RMP now refuses to confirm that it has submitted appropriate requests to PacifiCorp's transmission function that include requests for studies that similarly assume such redispatch of resources. This failure could lead to significant errors in the resulting studies and might result in the incorrect assumption that hundreds of millions of dollars in transmission system upgrades will be needed in order for RMP to utilize the energy it has contracted to buy from our projects.

Neither our projects nor RMP's ratepayers should be at risk for significant network upgrades that can be avoided by RMP simply using its available rights and options to receive and deliver energy from our projects, and in the manner assumed in setting PPA prices.

If the Glen Canyon Solar projects were forced to bear significant expenses for unnecessary transmission facilities, it would make the projects uneconomical and would render them incapable of performing under the PPAs. If RMP were forced to bear such costs—which I understand is likely under existing laws—it would put RMP and its Utah ratepayers at risk of significant unnecessary costs. Neither result is acceptable. Fortunately, neither result is necessary, if RMP will simply follow existing procedures and use available resources in the manner assumed in setting PPA prices.

I respectfully urge this Commission to direct RMP to act in a reasonable and prudent manner, and in a manner I am confident all Utahns would expect from a company granted the privilege of providing utility services within this State: avoid the risks and costs associated with unnecessary and uneconomic transmission upgrades by using all available rights and resources to the greatest extent possible in connection with energy produced by QF projects.

Q. Why should RMP utilize its available transmission rights in connection with its PPAs with the Glen Canyon Solar projects?

As an initial matter, the avoided-cost prices included in the Glen Canyon Solar PPAs were based on RMP redispatching other resources as necessary and available to utilize the output of our projects. Thus, the redispatch of resources necessary for RMP to take our energy has already been accounted for in the pricing. This alone is reason enough why RMP should use its existing rights for that purpose.

More fundamentally, Utah (and federal) laws and policies are expressly intended to encourage development of clean, efficient renewable resources by non-utility developers like sPower. It would be fundamentally inconsistent with sound Utah laws and policies for RMP to thwart QF development by refusing to use available transmission rights for QF resources. Otherwise, a utility could prevent QF development by hoarding transmission rights and refusing to use uncommitted rights to transmit QF energy. That result would be inappropriate and inconsistent with sound Utah policies. RMP should thus be required to utilize available transmission rights and available procedures to purchase and utilize energy purchased from QFs.

Q. Does this conclude your direct testimony?

A. Yes, it does.

EXHIBIT 1

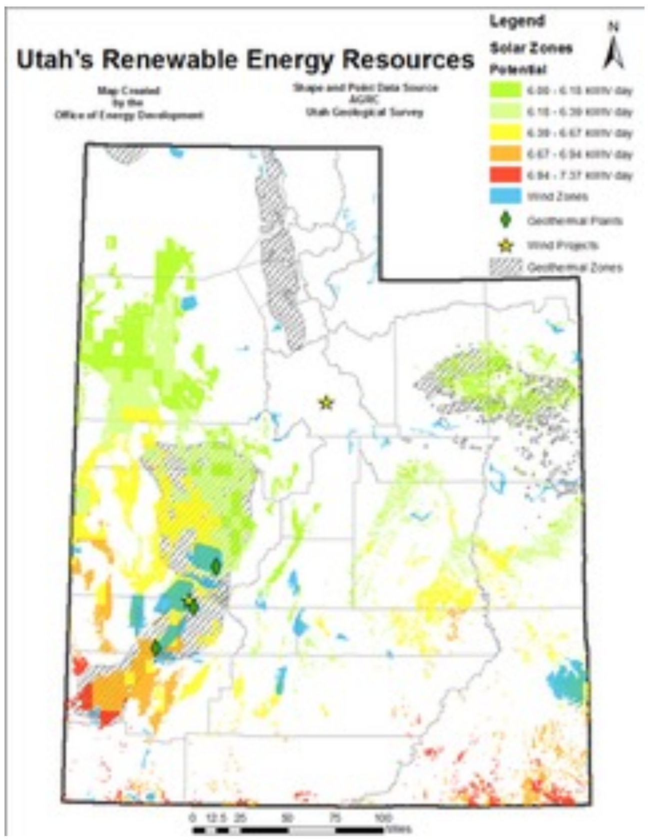
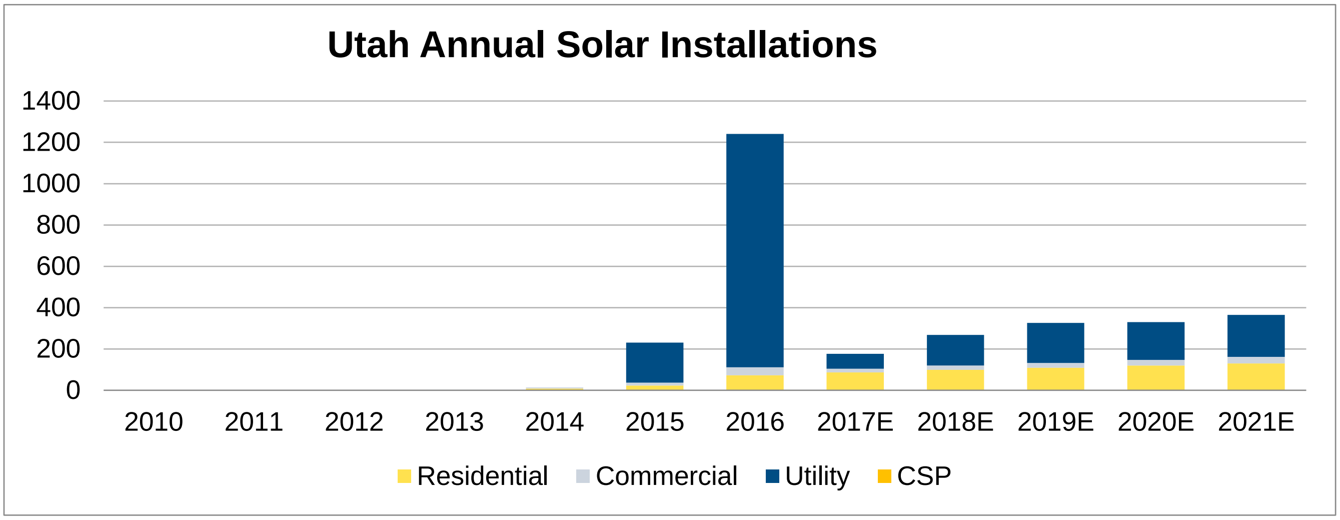

Utah's Renewable Energy Resources
Map Created
by the
Office of Energy Development
Shape and Point Data Source
AGRC
Utah Geological Survey
Legend
N
Solar Zones
Potential
6.00 - 6.10
6.10 - 6.39
6.39 - 6.67
6.67 - 6.94
6.94 - 7.37
Wind Zones
Geothermal Plants
Wind Projects
Geothermal Zones
0 12.5 25 50 75 100
Miles

EXHIBIT 2

SOLAR SPOTLIGHT
Utah

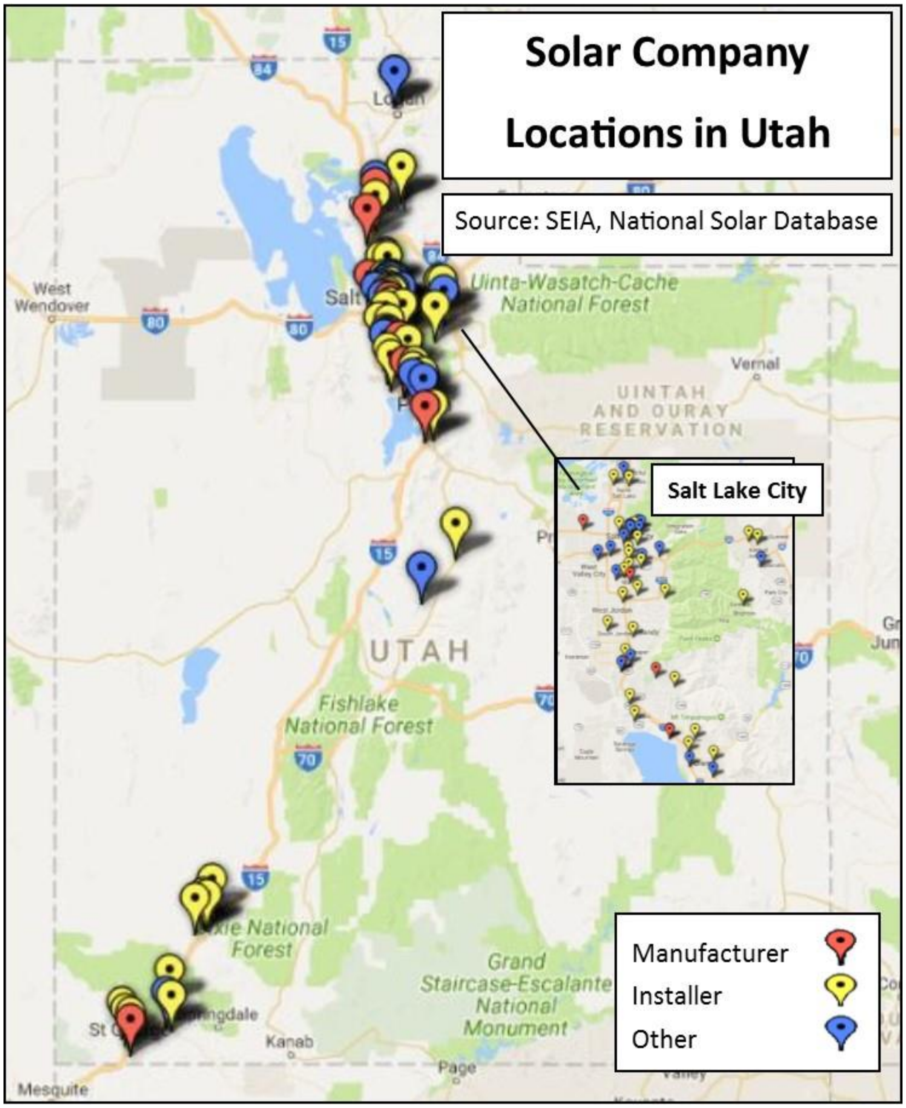
AT A GLANCE

- **Solar Installed:** 1,526.6 MW (1,240.8 MW in 2016)[i]
- **National Ranking:** 7th (2nd in 2016)
- **State Homes Powered by Solar:** 300,000
- **Percentage of State's Electricity from Solar:** 3.56%[ii]
- **Solar Jobs and Ranking:** 4,408 (14th in 2016)[iii]
- **Solar Companies in State:** 108 companies total; 18 Manufacturers, 52 Installers/Developers, 37 Others[iv]
- **Total Solar Investment in State:** $2,141.59 million ($1,600.06 million in 2016)
- **Price Declines:** 64% over last 5 years
- **Growth Projections and Ranking:** 1,463 MW over next 5 years (ranks 19th)



NOTABLE PROJECTS

- Utah Red Hills Renewable Energy Park was completed in 2016. This photovoltaic project has the capacity to generate 104 MW of electricity -- enough to power over 20,419 Utah homes. [v]
- Several large retailers in Utah have gone solar including IKEA, Patagonia and Uinta Brewing Company. IKEA has installed one of the largest such installations with 1 MW of solar capacity at their location in Draper. [vi]
- At 3 MW, Buckhorn Solar Plant in Paragonah is among the largest solar installations in Utah. This project has enough electric capacity to power more than 589 homes. [vii]



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[i] All data from SEIA/GTM Research *U.S. Solar Market Insight* unless otherwise noted: http://www.seia.org/research-resources/us-solar-market-insight
[ii] Energy Information Administration, Electric Power Monthly: http://www.eia.gov/electricity/monthly/#generation
[iii] The Solar Foundation, State Solar Jobs Census: http://www.thesolarfoundation.org/solar-jobs-census/states/
[iv] SEIA, National Solar Database: http://www.seia.org/research-resources/national-solar-database
[v] SEIA, Major Solar Projects List: http://www.seia.org/research-resources/major-solar-projects-list
[vi] Ibid
[vii] SEIA, *Solar Means Business*: http://www.seia.org/campaign/solar-means-business-2016

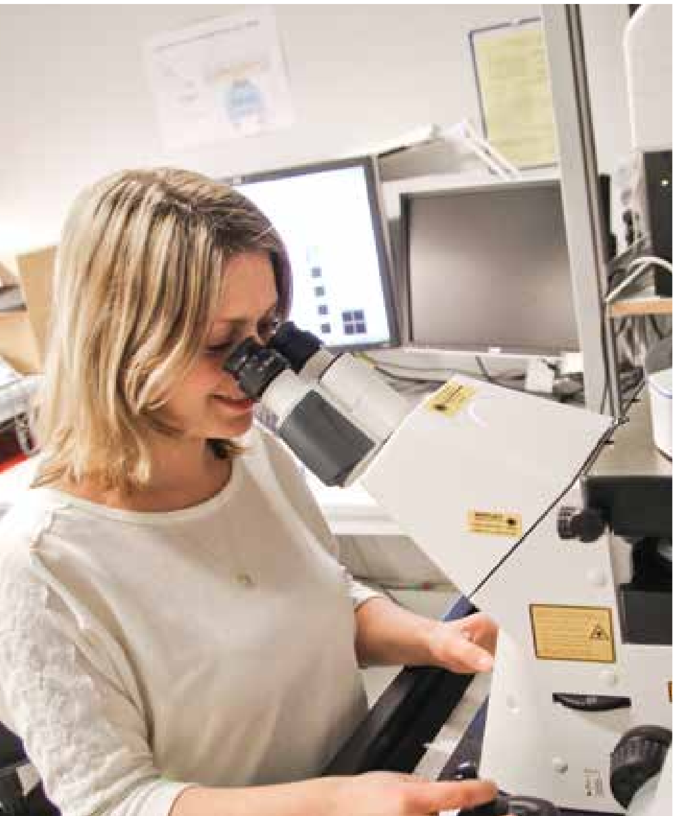
EXHIBIT 3

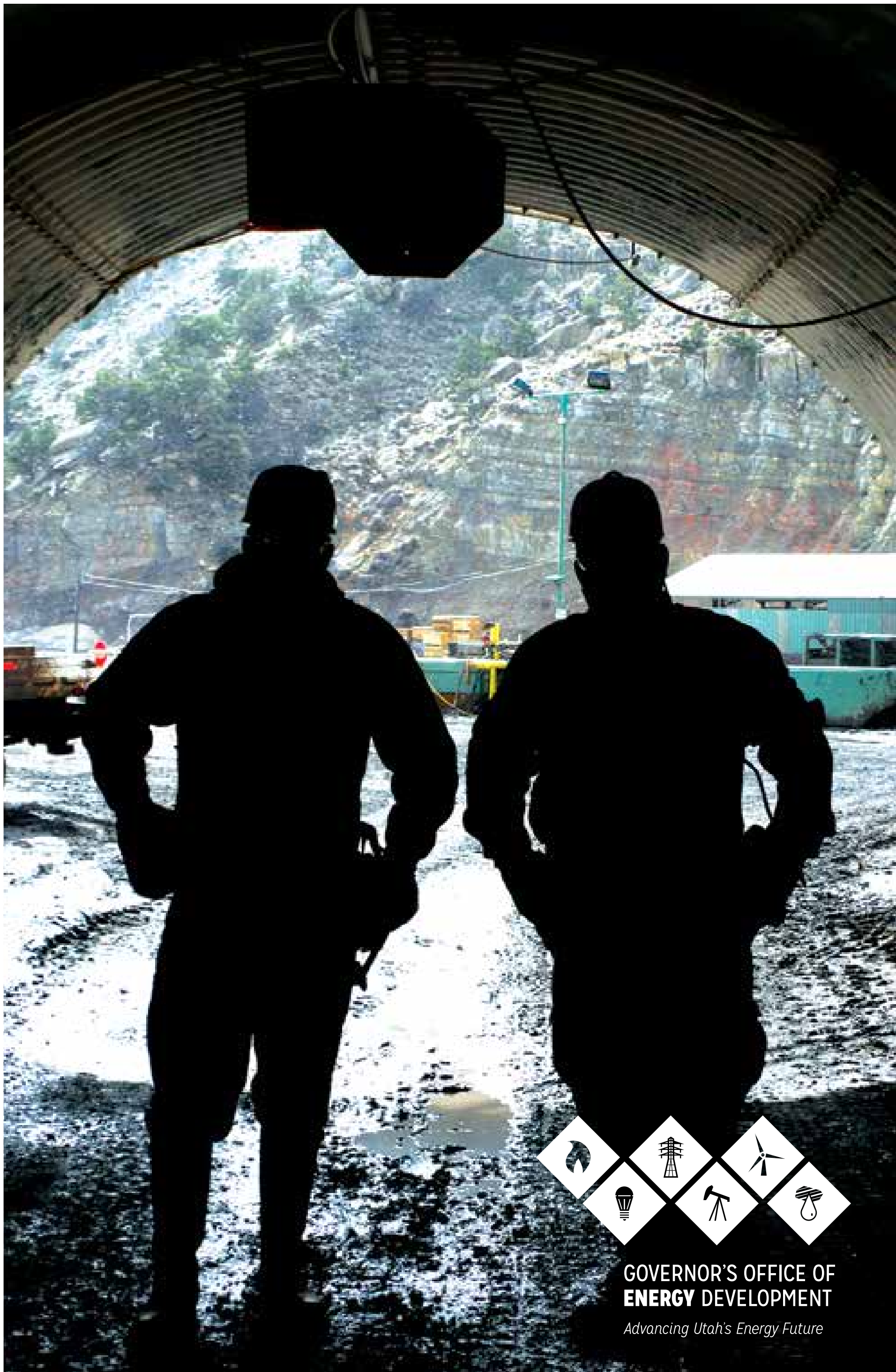
ADVANCING UTAH COAL

Technology, Policy, and a Path Forward

Governor's Office of Energy Development

May 2017
www.energy.utah.gov





Cover Photo Credit (bottom left):
NTNU, Faculty of Natural Sciences and Technology

Cover Photo Credit (top right):
George Frey

PURPOSE

To provide a framework and recommendations for the advancement of strategic coal technologies and a sustainable coal economy in Utah.

KEY THOUGHTS

- The coal industry remains viable.
- The effective development and deployment of advanced coal technology can provide numerous opportunities for responsible coal development and coal industry growth.
- Innovative coal technologies can provide for energy and environmental security.
- Specific state and federal policy actions can support the sustainable development of coal.

ACKNOWLEDGMENTS

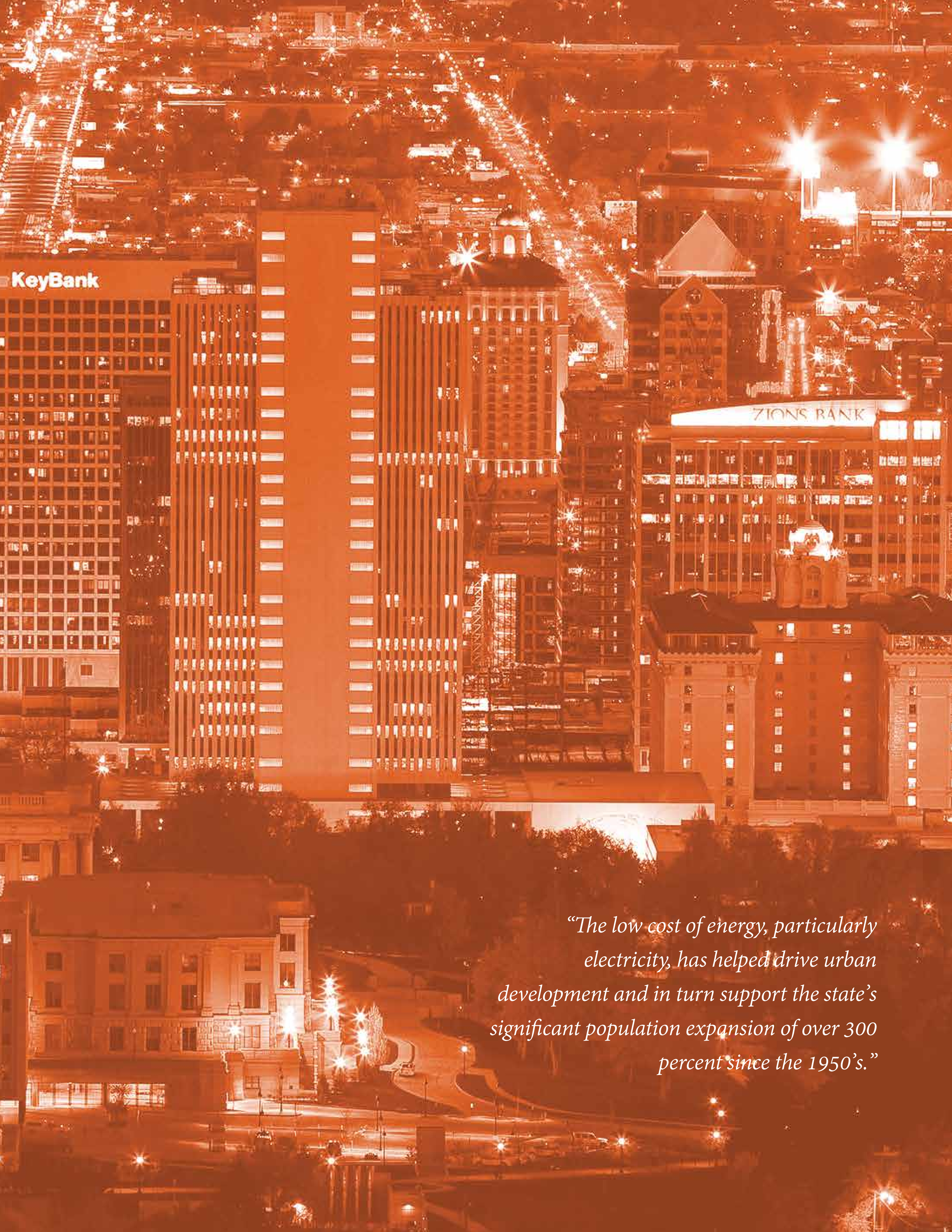
The Office of Energy Development would like to recognize the contributions of leading private-sector and public-sector stakeholders and industry experts who lent their expertise and guidance to this effort. In particular, these individuals participated in meetings and conference calls, dedicated time and organizational resources, provided critical information and perspective in their areas of expertise, and reviewed and provided valuable input during the drafting of the report. The State representatives extend their thanks to all who contributed to the effort that made this work possible.

BACKGROUND

Transformation of the energy sector is accelerating globally and locally. Market forces, technology, and policy bring challenges and opportunities to Utah's coal economy. As it has for decades, coal provides the majority of the state's baseload power at plants that reliably produce electricity around the clock. Coal-fired electricity generation allows Utah to consistently offer some of the lowest electricity rates in the country. Affordable energy has been a key component of Utah's economic success, including providing a competitive advantage in the State's efforts to recruit new and expand existing businesses that offer high-paying jobs. More recently, Utah's coal industry has faced significant challenges and uncertainties. This report, Advancing Utah Coal: Technology, Policy, and a Path Forward, highlights innovative technologies presenting opportunities for developing Utah's coal economy and provides recommendations for sustainable economic and environmental outcomes.

Created in 2011 as a key recommendation of Governor Gary R. Herbert's 10-Year Strategic Energy Plan, the Governor's Office of Energy Development (OED) is tasked with advancing the development of Utah's energy and minerals economy through planning, policy implementation, and stakeholder outreach. OED supports and encourages innovation and responsible development of all resources, including renewable, conventional, and unconventional, as well as advancements in the areas of efficiency, conservation, and alternative transportation.

CONTENTS



"The low cost of energy, particularly electricity, has helped drive urban development and in turn support the state's significant population expansion of over 300 percent since the 1950's."

INDUSTRY BACKGROUND

Credit: George Frey

Mined throughout Utah for more than 100 years, the majority of Utah coal is consumed in-state for electric power generation.[1] Valued at over $800 million, Utah's coal economy is especially important to rural Utah, providing roughly 2,000 high-paying jobs and a significant portion of county tax bases.[2, 3] Efficient coal-fired generation has provided the State with some of the most affordable electricity prices in the nation.[4, 5]

Roughly 80 percent of Utah's residents live along the Wasatch Front, which contains the major cities of Salt Lake City, Provo, West Valley City, West Jordan, and Ogden. Reliable, affordable energy has provided these cities a foundation for economic growth. The low cost of energy, particularly electricity, has helped drive urban development and in turn support the state's significant population expansion of over 300 percent since the 1950's.[5]

Recently, a variety of pressures have affected Utah's coal industry and the entire domestic energy spectrum. Coal, in particular, has been impacted by:

- Slow growth in electricity demand
- Strong price competition from natural gas
- Increased grid integration of renewable energy sources with associated load-following issues
- New and expanded environmental regulations
- Pressure from changing energy dynamics
- Public perception
- Aging facilities

"For many of these counties, coal is more than just a valuable resource: it provides for their livelihood, high quality of life, and is an important part of the regional culture of hard work and self-determination."

Coal Resource Overview

For thousands of years, coal has been burned as a primary source of heat. By the end of the nineteenth century, utilization of the resource for its energy content expanded to electricity generation. The energy density of coal along with its vast availability made it a highly viable resource for electricity production nationally and globally. The United States' demonstrated reserve coal base is estimated at 477 billion short tons.[6] The majority of global coal reserves are located in the US, followed by Russia, China, Australia, India and Germany, which collectively account for 76.9 percent of the global total.[7] Utahns have mined coal for over 100 years; a large portion of the State's most economic coal reserves are found in coalfields located in Sevier, Emery and Carbon counties—the heart of Utah's coal country.[8, 9]

Coal is generally divided into four distinct types that are ranked in decreasing order of heat content: anthracite, bituminous, subbituminous, and lignite. Different types of coal also contain varying quantities of sulfur and mercury. Utah has significant quantities of high-BTU (British thermal unit), low-sulfur and low-moisture coal. The average heat content for coal mined in Utah ranges from 10,781–11,953 BTU/lb. Sulfur contents range from 0.4%–0.9%.[8] Although some of the easiest-to-mine seams have been mined for decades, a substantial amount of identified coal resources remain—just under 15.5 billion tons.[9]

In addition to serving as a fuel source, coal is used as an input for other industrial operations. Metallurgical coal is used in the process of creating coke for iron and steel-making. Coke is a porous carbon material that is created by heating high-BTU coal without air at extremely high temperatures. Coal can also be used to prepare materials used in petroleum, cement, tar and synthetic rubber operations. Chemicals, such as ethylene and methanol are two examples of chemicals that can be synthesized from coal. Coal-derived materials are often used in the production of fertilizers, plastics and synthetic fibers.[10]

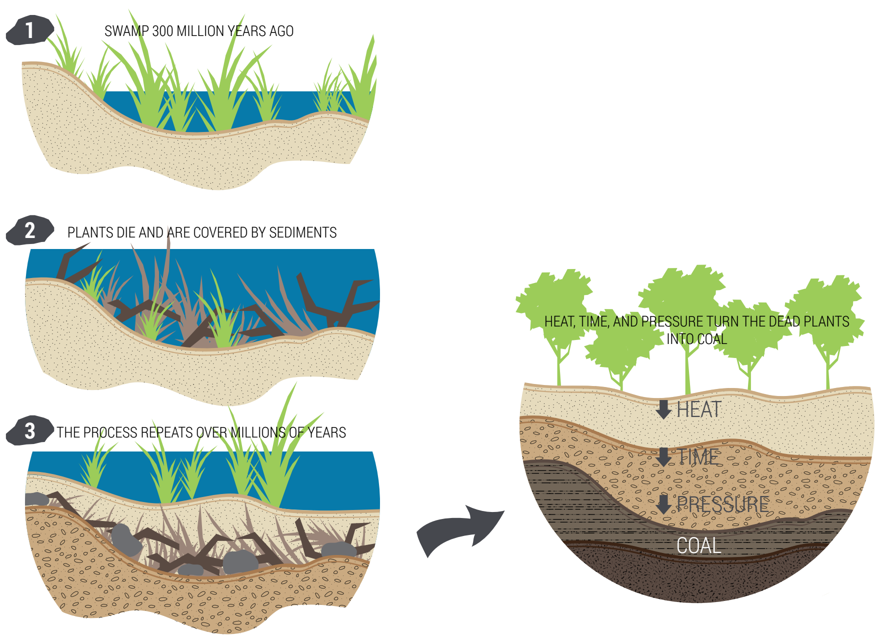


Illustration 1: Coal formation process

Table 1: Types of Coal

NAME	DESCRIPTION	LOCATION	HEAT VALUE	USE
Lignite	Brownish-black coal with generally high moisture and ash content and lower heating value. Accounts for 9% of the US coal reserves	Gulf Coast and Northern Plains	Contains 25–35% carbon and the lowest heating value: 4,000–8,300 BTU/lb	Electricity generation and production of synthetic natural gas and liquids
Subbituminous	Dull black coal that accounts for about 37% of the coal reserves in the US	Predominately found in Montana, Wyoming, Utah, Colorado, New Mexico, Washington, and Alaska	Contains about 35–45% carbon and has a heating value between 8,300–11,500 BTU/lb	Primarily used for generating electricity and space heating
Bituminous	Often called "soft coal", bituminous is the most common type of coal found in the United States. About 52% of domestic coal reserves are bituminous coal	Found primarily east of the Mississippi River in Midwestern states like Ohio and Illinois and in the Appalachian mountain range from Kentucky to Pennsylvania	Contains 45–86% carbon and has a heat content between 10,500 and 14,000 BTU/lb	Type most commonly used for electric power generation in the US and for producing coke for the steel industry
Anthracite	Sometimes called “hard coal”, anthracite has the highest energy content of all coals It accounts for about 2% of the coal reserves in the United States	There are about 7.3 billion tons of anthracite reserves, located in 11 counties of northeastern Pennsylvania	Contains 86 to 97% carbon and has a heat content of nearly 15,000 BTU/lb	Used for space heating and generating electricity

Source: Utah Mining Association, 2016

Utah Coal and Power Production

The State of Utah's land mass covers 84,899 square miles of the western United States and is one of the most geologically diverse states.[11, 12] Utah is the only state that has collective land holdings in the Great Basin, Colorado Plateau, and Rocky Mountains. The Colorado Plateau is of particular interest because it holds some of the largest energy-mineral concentrations of coal, uranium, and thorium in the country.[13, 14]

In 2015, 75.5 percent of Utah's net electricity generation came from coal, down from the past decade, when coal fueled more than 90 percent of generation.[15] Just under 20 percent of the state's 2015 net generation was provided by natural gas.[1] The remainder of Utah's net electricity generation comes from hydroelectric, wind, geothermal, solar, and biomass sources.

Recent Challenges

Over the past decade, the coal mining industry has faced a series of challenges including competition from other fuel sources, as well as increased regulations. In 2015, Utah mines provided 1.6 percent of the 897 million tons of American coal produced.[17,18] 14.6 percent of Utah's production went to other states and roughly 5 percent went to foreign countries.[17,18] In response to market conditions, Utah's 2016 coal production dropped to 13.9 million tons, the lowest reported amount since 1985.[18] Production in Utah is forecasted to reach an estimated 14.5 million tons in 2017.

In 2015, the number of U.S. coal employees, approximately 66,000, was the lowest on record since the Energy Information Administration began collecting data in 1978. Due to uniquely challenging regulatory and market conditions, many coal operators across the nation have experienced, or currently face, bankruptcy.[19] The world's largest private-sector coal producer, Peabody Energy Corporation, filed for U.S. bankruptcy protection in 2016 and Arch Coal, the second-largest U.S. coal mining company, also filed for bankruptcy.[20]

In 2013, Arch Coal sold holdings that included three Utah mines — Sufco, Skyline and Dugout Canyon — to Bowie Resources.[21] The Sufco operation is the state's highest-producing coal mine.[17, 22] The company also maintains mining operations in Colorado and produces a combined aggregate of 13 million tons of high-BTU, low-sulfur bituminous coal annually.[23]

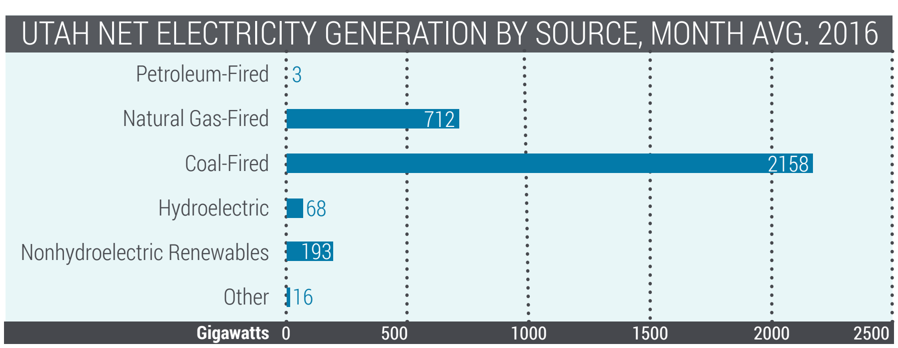


Illustration 2: Utah electric generation by source

Source: Utah Geological Survey (UGS)

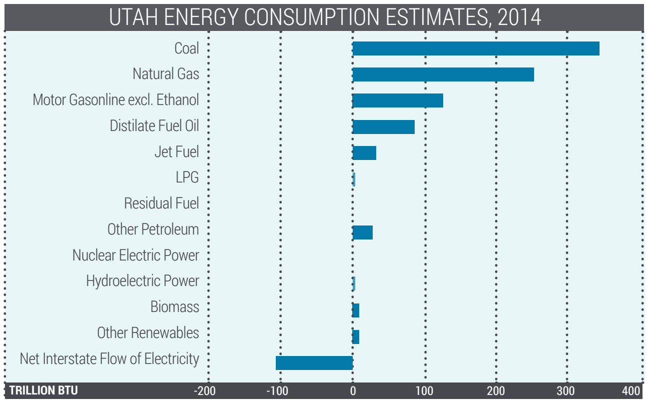


Illustration 3: Utah energy consumption

Source: U.S. Energy information Administration (EIA)

Recently, the U.S. Department of Interior announced the approval of a $22 million coal lease on the Greens Hollow tract located in Sevier and Sanpete counties to Canyon Fuel Company, LLC, a subsidiary of Bowie Resource Partners.[114]

Alton Coal Development operates the Coal Hollow and Burton mines located on 635 acres of private land in Kane County. The Coal Hollow development is the state's only surface mine and produces subbituminous coal.[24]

Located in Emery County, the Deer Creek coal mine ended mining activities in 2014 after 40 years of operation. PacifiCorp, the mine owner and operator, cited rising costs as the reason for the closure.[25] The following year, Consol Energy sold its idled Emery County mine, with an estimated 30 million tons of reserves, to Bronco Coal Resources.[26, 27, 28] Bronco Utah Operations has begun the permitting process required for a planned expansion of the operation.[29]

Utah's coal-fired electricity generators also face significant challenges in the near- and mid-term. The state's largest coal-fired generating station, the Intermountain Power Project (IPP), faces the most immediate effects of changing conditions. Constructed to generate an average of more than 13 million megawatt hours each year from two coal-fired units, the energy is delivered over the project's AC and DC transmission systems to 35 regional participants, principally located in Utah and Southern California.[30] While power is available to all of its members, six California utilities that historically purchased more

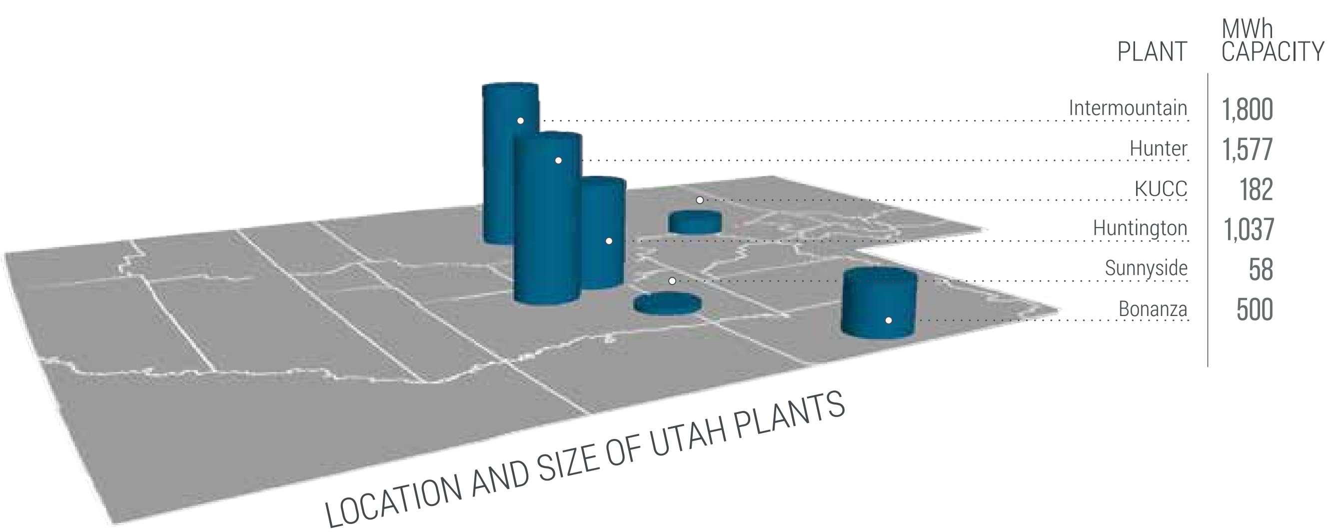


Illustration 4: Utah's Coal-fired Power Plants, 2016

Source: Utah Geological Survey (UGS)

than 99 percent of the plant's power are now required by the State of California to remove coal power from their portfolio. After purchase agreements expire in 2027, California-based utility members will no longer be able to purchase coal-generated electricity from IPP. In order to continue to serve the California market, the coal units are scheduled to be replaced with a natural gas-fired plant; construction of the first natural gas plant is expected to begin in 2020.[31]

PacifiCorp's two Utah coal-fired plants, Hunter and Huntington, face regional air quality challenges. Under the Clean Air Act, the Environmental Protection Agency has finalized its Regional Haze Rule. This rule requires federal and state agencies to develop plans to cut air emissions with the potential to impact visibility in national parks and wilderness areas. Utah submitted a compliance plan to cost-effectively achieve the goals of the most recent Regional Haze Rule at the Hunter and Huntington plants. This plan was not accepted by EPA, and PacifiCorp and the State of Utah each filed suits against the EPA in 2016.[32]

The Bonanza plant, operated by Deseret Power, will now operate under an agreed settlement that limits the amount of coal that can be consumed at the plant. The settlement, entered into with regulators and environmental groups, limits coal utilization to 20 million tons. A potential outcome of the restrictions is that plant operations will ceases by 2030.

The Sunnyside power plant, located in Carbon County, is a much smaller generator than the State's other coal-fired power plants. It is a qualified cogeneration facility and burns waste coal.[34]

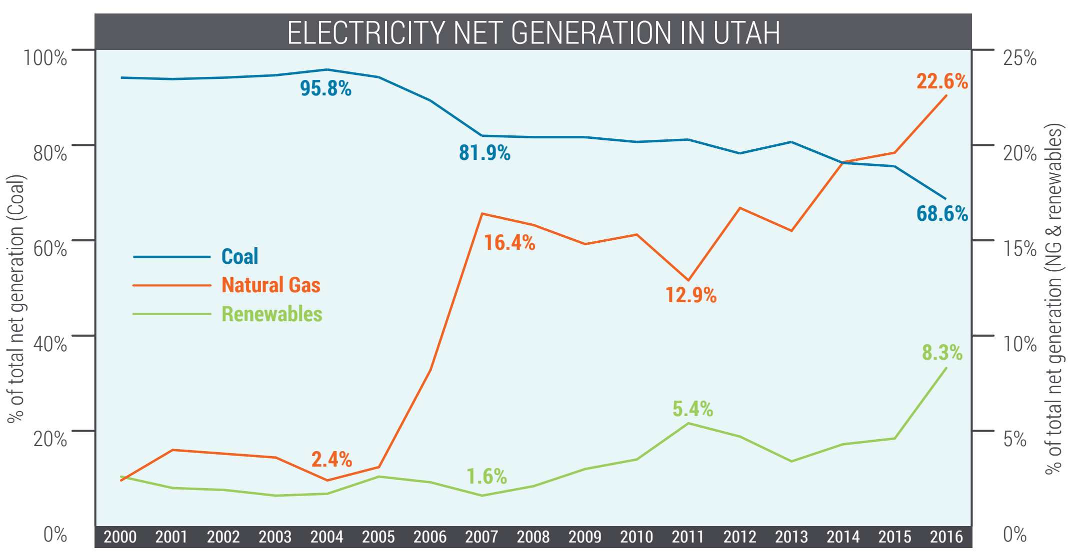


Illustration 5: Utah electric generation by source

Source: Utah Geological Survey (UGS)

Utah Coal Communities
A RURAL WAY OF LIFE.

Ranked as the "Best State for Business and Careers" six out of the last seven years, Utah's low energy prices are one of the reasons for its economic success.

Utah's coal-extracting and power-producing rural counties support Utah's low electricity rates. Out of Utah's twenty nine counties, six make up the bulk of the state's coal industry, namely: Carbon, Sevier, Emery, Kane, Millard, and Uintah.

For many of these counties, coal is more than just a valuable resource: it provides for their livelihood, high-quality of life, and is an important part of the regional culture of hard work and self-determination. An active and vibrant coal industry provides these counties the resources they need for essential services such as clean water, good roads, and quality schools. Because coal industry jobs pay generally twice the state average, the industry is able to attract an educated workforce. [3]

The heart of Utah's coal extractive industry is situated across Carbon, Sevier, and Emery counties where three coalfields form an inverted "U" in the center of the state (see Illustration 6). In 2014, these counties produced 98 percent of Utah's coal. In addition, three of the state's five coal-fired power plants are located within the region, adding to the area's proud reputation as "coal country." [8]

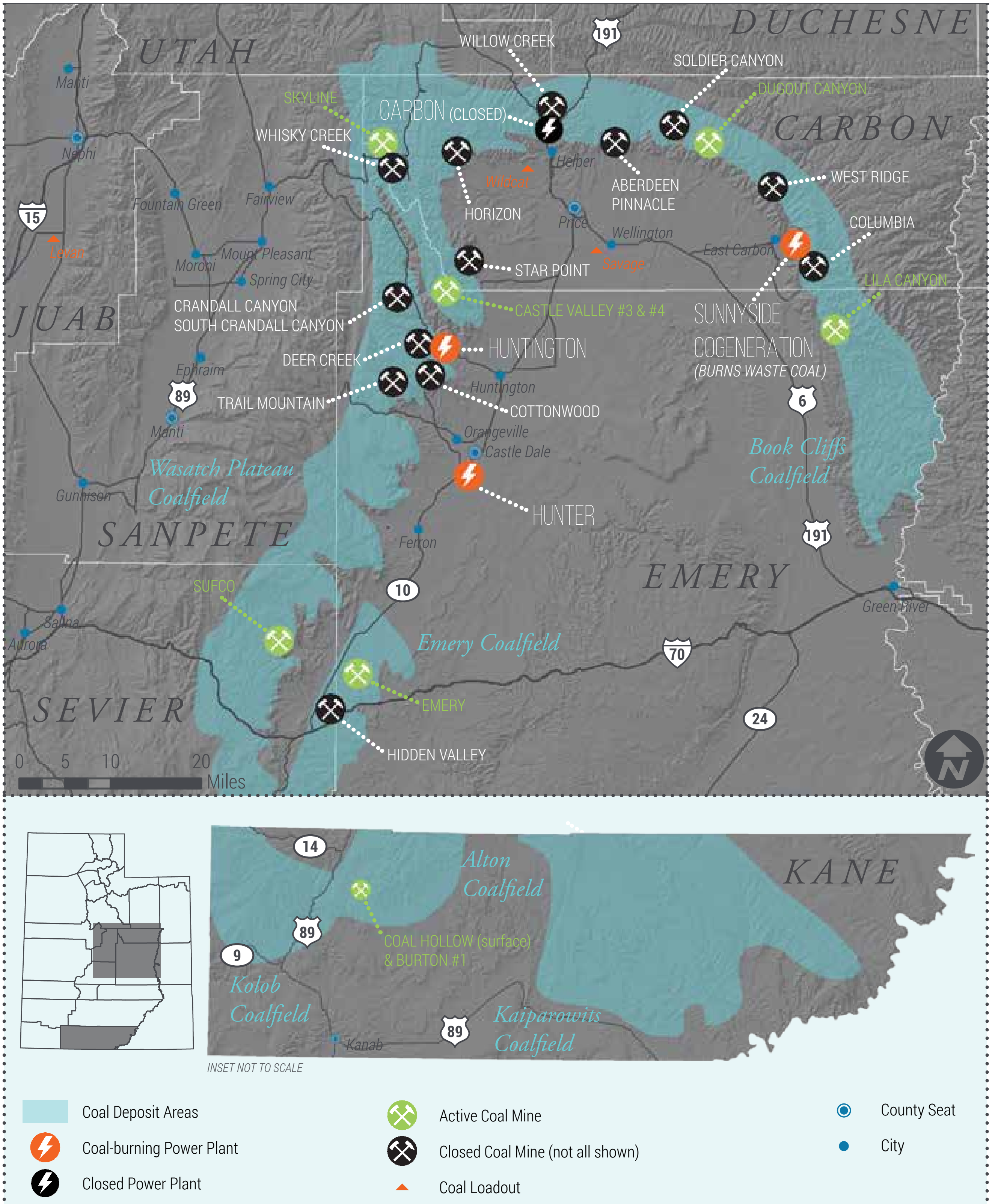


Illustration 6: Utah coal mines and power plants

Sources: Utah Geological Survey (UGS), Utah Automated Geographic Reference Center (AGRC)

Members and advocates of the coal industry gather in Salt Lake City to oppose the federal coal moratorium

Market Forces

From an energy perspective, coal provides a unique combination of advantages: it is affordable, generally safe to transport and store, and widely available. Because of these attributes, coal has played a key role in powering growing economies, not only in this country but throughout the world. For over forty years, coal production was on the rise in the United States. Through the 1980s and 1990s, mining productivity made great gains worldwide. The onset of Longwall mining, a form of underground coal mining where a long wall of coal is mined in a single pass, greatly improved efficiency in Utah's underground coal mines. However, a surge in demand for metals and minerals in the early 2000s resulted in an industry shift toward boosting production volumes rather than efficiency. Correspondingly, mining companies fell behind on productivity goals. Mining operations globally are currently 28 percent less productive than a decade ago. [35, 36]

For many years, coal dominated the U.S. electricity generation space. It was reliable, inexpensive to build and maintain, and very competitive on operating costs based on low and stable fuel prices. Coal was able to maintain its position as the electric utilities' preferred fuel for power production and reached a 50 percent share of the nation's power supply in 2007.[37, 38] Nonetheless, by 2014, coal's annual share of total net generation within the United States declined to 39 percent.[39] This was the result of a variety of factors. Most notably coal began losing its price advantage over natural gas for electricity generation in some parts of the country as early as 2009, particularly in the eastern United States. Increasing natural gas production from domestic shale basins helped reduce the price of natural gas, making it more competitive for use in generating electricity.[40] This, along with other factors including the lower capital costs and faster construction timelines associated with new natural gas plants, introduced a move toward natural gas electricity generation in Utah. Since 2004, 2,302 MW of gas-fired electric generating capacity has come online in the State.[41]

The nation's abundant supply of natural gas and low gas prices encouraged utilities to continue building gas-fired power plants, a move that has locked in the advantage of natural gas over coal for the near term. In 2013, natural gas represented more than 50 percent of new power generating capacity in the U.S.[42, 43]

Although increased regulations have impacted the coal industry, they are not the only reason for coal's decline in the United States. Some companies, on the belief that economic growth in China would continue to expand rapidly, broadened their investments in coal operations despite mounting market pressures. When China's economic growth fell short of forecasts and the 2002–2012 commodities "super-cycle" ended, the majority of global prices for commodities plunged dramatically.[44] This coincided with significant increases in natural gas production and associated cost decreases. Expansion of natural gas electricity production combined with increased energy efficiencies and flat electricity demand alongside continued growth in the renewable energy sector resulted in energy production growth that greatly outpaced demand growth.[40] Anti-coal pressures further amplified market impacts, resulting in a reduction in coal's competitive advantages compared against other energy sources.[40]

Although coal powered generation has struggled through a difficult period, recent forecasts call for improved market conditions.[45, 46] International demand for coal, in particular, is on the rebound. The International Energy Agency (IEA) forecasts worldwide demand for coal-fired power to increase to 730 GW of new high efficiency coal plants by 2040.[47] It is expected that global coal shipments for 2017 will meet 2014's record high. As a result, producers have announced upgraded production targets for 2017.[47] Many coal producers are actively pursuing coal port expansion or creation on coasts located in the United States and internationally.[48,49,50,51,52]

Analysts and experts expect coal to maintain and possibly expand its position within the global energy mix over the upcoming decades. For U.S. coal producers, it places an emphasis on looking at cost-effective ways to meet the expected international need for coal. So long as sufficiently large markets exist, coal production will operate to meet demand. The question becomes what locations will produce the coal, not whether production will occur.

Policy Challenges

Over the past decade a number of new rules and regulations moved forward in the Environmental Protection Agency, the Office of Surface Mining Reclamation and Enforcement, the Bureau of Land Management (Department of the Interior), and the Mine Safety and Health Administration (Department of Labor).[53]

At the federal level, the range of policies, regulations, subsidies, incentives, disincentives, and restrictions administered by various federal departments and agencies can limit future options for coal power and coal development.[54] Faced with costly compliance requirements and regulatory uncertainty, utilities have retired more than 100 GW of coal-fired generation (for reference 1 GW of power can power roughly 700,000 homes) since 2000. In 2015, 94 coal-fired plants closed and nearly 14 GW went offline.[54]

Energy Development and Environmental Gains

Current energy development practices have significantly reduced the primary impacts of coal mining. This coupled with effective restoration practices, Utah landscapes that once were mined are being returned successfully to their natural state.

Utah's efficient power plants have invested hundreds of millions of dollars in reducing their emissions. For example, the coal-fired power plants that produce the majority of electricity consumed in Utah have reduced their NOx emissions by 70% over the past decade. Located outside of Utah's sensitive Wasatch Front air shed, Utah's efficient coal-fired power plants provide the affordable and reliable power needed to support greater adoption of electric vehicles (EV), and electric alternatives for homes, businesses and industry along the Wasatch Front.

Along with providing affordable and reliable electricity, Utah's diverse power generation fleet is consistently reducing its carbon emissions. According to the US Energy Information Administration, Utah reduced its power generation carbon emissions by 14% from 2008 to 2015. These significant carbon reductions are expected to continue based on Utah's commitment to markets, competition and investment in technology.

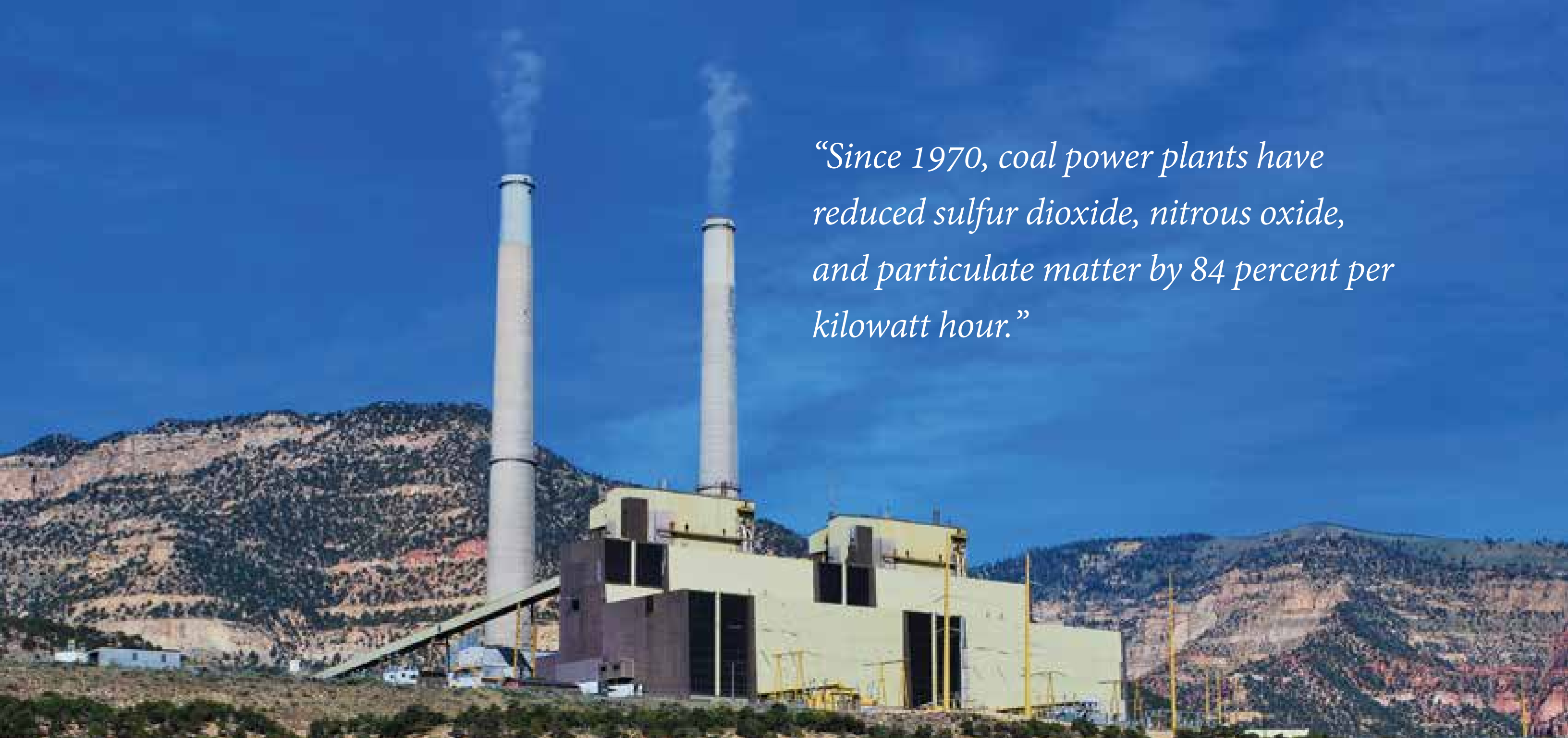
In general, the economics of burning coal to produce power has been influenced significantly by increasingly strict emission control regulations, such as the EPA's 2011 Mercury and Air Toxics Standards. In 2015, the EPA finalized a rule for regulating carbon emissions from power plants: the Clean Power Plan. This rule potentially requires coal-fired plant operators to incur prohibitively high costs to retrofit plants, reduce operating levels, or consider closing down completely.

Just over 600 coal-fired power plants still operate in the United States.[55] Even though coal is expected to remain an important fuel for generating electricity in the United States, absent a re-tooling of policies and regulations, the outlook for the use of coal in domestic power production remains challenging.

Environmental Advocacy and Public Perception

Often, the full spectrum of social, economic and environmental impacts inherent in transitioning electrical generation away from coal and toward other options is not fully considered. Coal provides many benefits to the United States power system, including fuel security, grid resiliency, and abundant, affordable, baseload power that supports many of society's quality of life and environmental goals.

However, social investment in new and advanced coal technologies has been limited. For example, in 2013 coal only accounted for six percent of federal subsidies although it represented almost forty percent of the country's electricity generation.[10]



Public perception of coal, influenced by a variety of campaigns, has likely been a key factor in the limited public investment in research, development and demonstration of new coal technologies.[58,59] Additionally, active campaigns and related legal challenges have contributed to the early decommissioning of numerous coal-fired power plants.

Aging Plants

The average coal plant in the United States is 42 years old, but the oldest date from the 1940s and early 1950s.[61] Fortunately, Utah's major coal-fired plants were built more recently and have undergone significant retrofits that have allowed them to comply with environmental regulations over their years of operation. These plants were designed on the principle that planning for long-term use was good for the public. Continuously replacing systems, rather than repairing and upgrading, can result in increased costs, waste, and increased emissions.

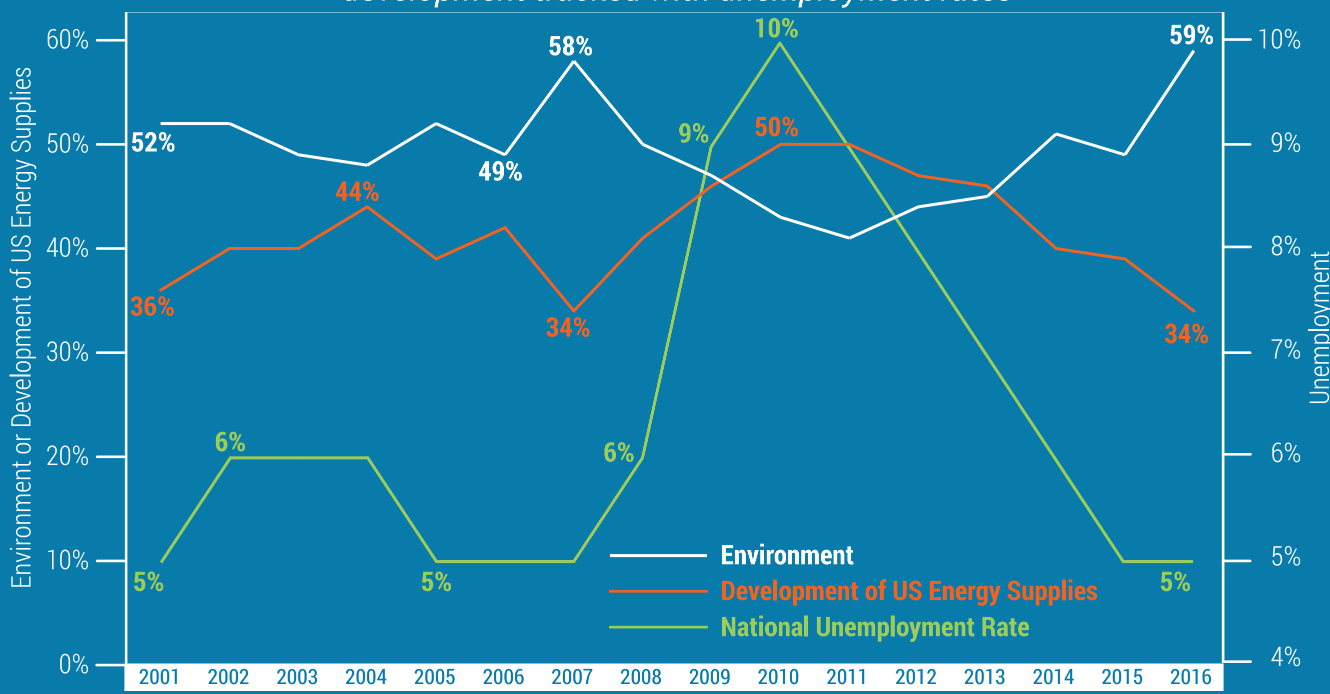
Public Lands

Just over 64 percent of the land in the state is managed by the federal government. Roughly 10 percent of land in Utah is held by the state trust, 21 percent is private, and 4.5 percent is held by tribal governments. Approximately two-thirds of Utah's energy resources are located on federally-owned lands.[64,65] Management and ownership of Utah lands impacts access to resources and development. Certain federally managed lands are closed to leasing for minerals exploration and development including: National Monuments*; National Parks, Department of Defense regions, BLM Wilderness Areas, U.S. Forest Service Wilderness Areas, and U.S. Fish and Wildlife Service Areas. This leaves 22 million acres of federal land, or roughly 40% of the State of Utah, technically open to mineral leasing.[66]

The Mineral Leasing Act of 1920 authorizes and governs the leasing of public lands for developing coal, petroleum, natural gas and other hydrocarbons, in addition to phosphates, sodium, sulfur, potassium,

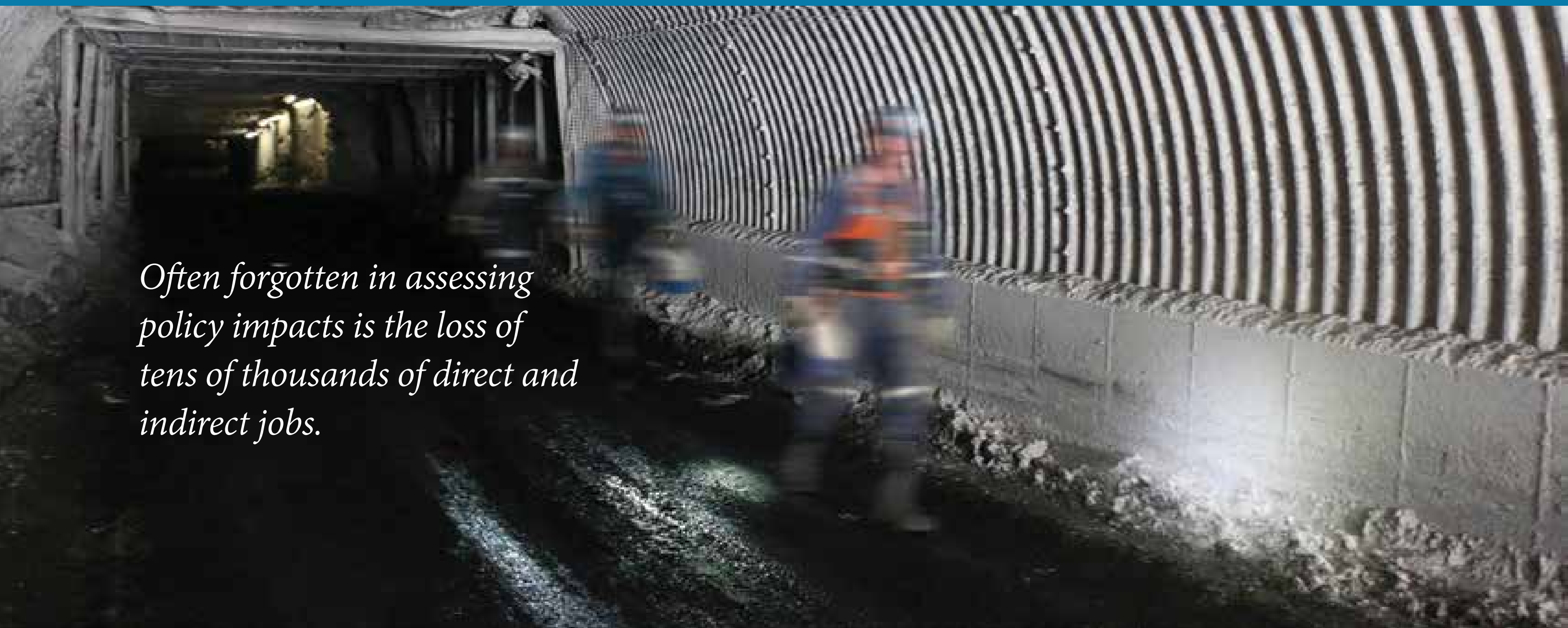
The Grand Staircase-Escalante National Monument contains roughly 9 billion tons of coal and represents a significant percentage of Utah's remaining recoverable coal. The monument status prohibits development of this resource.[70,71]

Illustration 9: Public opinion on energy development tracked with unemployment rates



Source: Bureau of Labor Statistics, Gallup

The above graphic illustrates two important points: (1) perception of energy development as a national priority is greatly impacted by economic conditions, (2) the concept that energy development and environmental preservation are mutually exclusive. Environmental impacts occur with any energy development; however, new energy development practices have largely mitigated primary impacts and restoration of mines (especially in Utah), has succeeded in returning the land to a natural state. The question is not either/or; rather it is how energy development and environmental protection can occur simultaneously to protect both natural resources and energy security.



Often forgotten in assessing policy impacts is the loss of tens of thousands of direct and indirect jobs.

and other hard rock minerals in the United States.[67] A company can lease a tract of coal from a government entity through a competitive public bidding process where various sized tracts of coal reserves are offered. In Utah, the sizes of these tracts have varied from as small as 120 acres, to as large as 7,171 acres.[67]

Federally managed lands in Utah hold 73 percent of known recoverable coal reserves; 22 percent of reserves are on private lands, and 5 percent is on state lands.[64] The value of mineral lease disbursements to Utah from the federal holdings are calculated at roughly 50 percent of the value of minerals produced (includes minor non-energy minerals).[70]

The debate over federal land ownership and control in Utah is long and ongoing. The State of Utah's Legislature created the Utah Public Lands Policy Coordinating Office in 2008 to study and analyze public land issues and develop Utah's policy on public land use and access. The office is tasked with balancing the preservation and protection of Utah's scenic and natural value in a way that reflects state and local interests.[63]

County Resource Management Plans, slated for completion statewide this summer, identify local goals for resource management aimed at protecting environmental, energy, recreation, and other resources based on input from those closest to and most affected by these issues.

Overall, the state seeks to avoid regulations, processes, and management policies that impose costs without delivered benefits. Full assessment of impacts of policies includes consideration of diminished public revenues, job losses and economic challenges in rural communities.[63]

Environmental Concerns

All energy sources have associated environmental consequences. The benefits and tradeoffs among all energy resources, including coal, require evaluation. Coal combustion produces sulfur dioxide, nitrogen oxide, particulates, and acid gases, which have collectively been linked to acid rain, regional haze, and other environmental and health-related concerns. The utility industry has focused on addressing environmental issues and has worked to reduce emissions. Since 1970, coal power plants have reduced sulfur dioxide, nitrous oxide, and particulate matter by 84 percent per kilowatt hour.[54]

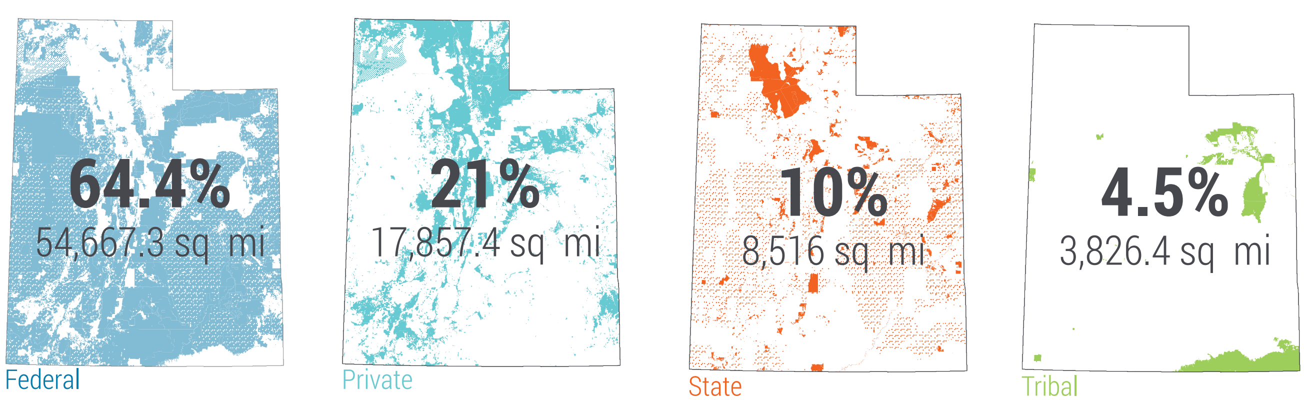


Illustration 8: Land ownership in Utah. Public lands are a complex and controversial issue

Source: Utah Automated Geographic Reference Center (AGRC)

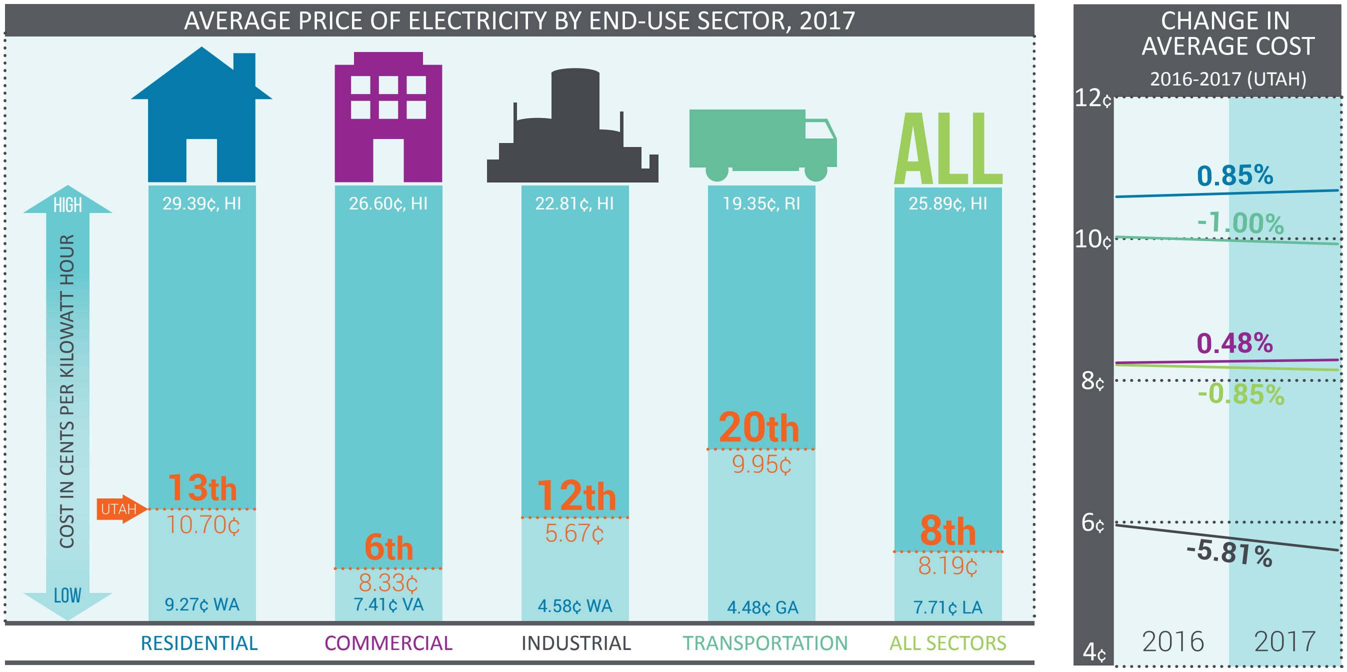


Illustration 10: Average price of electricity by end-use sector, state rankings, 2016

Source: Energy Information Administration (EIA)

Coal Market Considerations

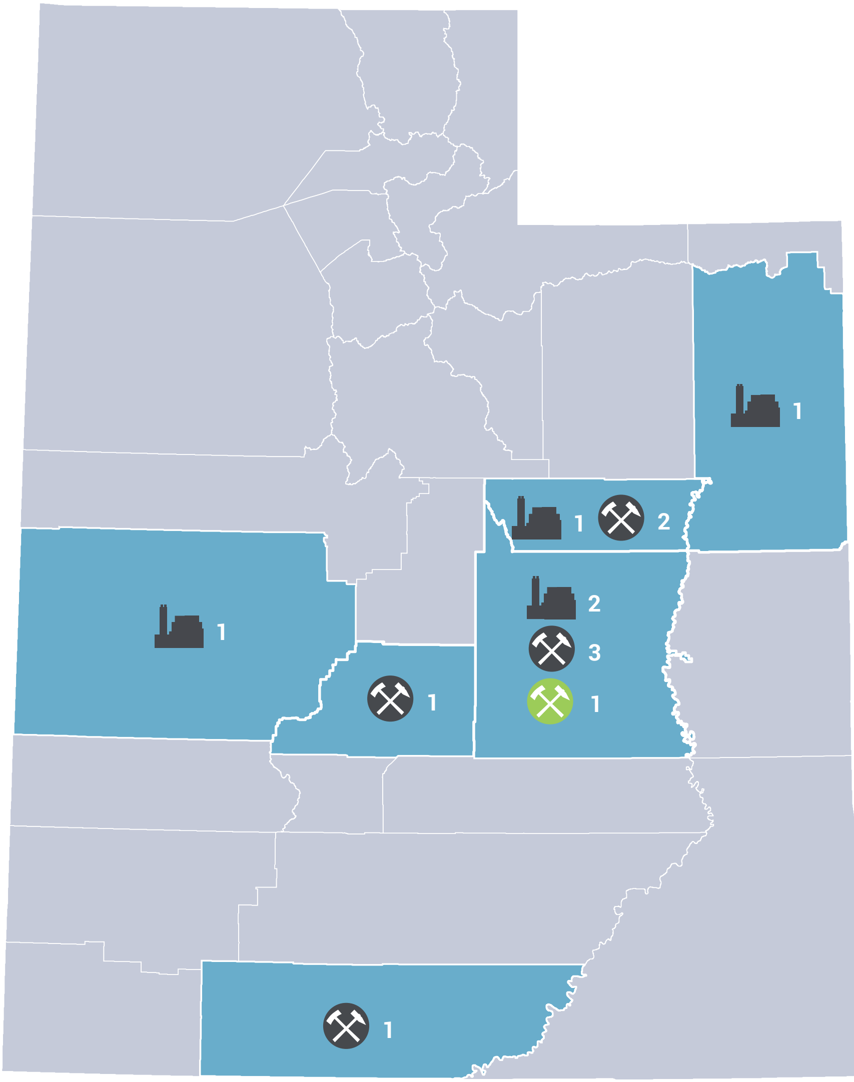
Global, national, and local markets can impact Utah's coal industry.

GLOBAL

Global trends illustrate continued and developing reliance on coal-fired power in both developed and developing nations. In many nations, this includes a significant increase in the number of coal-fired plants, while others have plans to maintain their fleets for the foreseeable future. A variety of factors are driving this growth, ranging from elimination of national nuclear power plant fleets in developed nations to maintaining economic growth rates in developing nations. At the core of this growth is demand for low-cost, reliable electricity. Utah coal's ability to compete in these growing markets will be largely based on product, production, and transportation costs. Port access will play a crucial role in accessing these markets.

UNITED STATES

Despite recent federal actions to reverse the Clean Power Plan and other regulations affecting coal development, planning for new coal-fired power plants within the U.S. is marginal. Ultimately, Utah producers may be capable of outcompeting other coal options for domestic buyers, but most indicators suggest that coal producers are competing in a shrinking domestic coal-fired power industry. This general trend demonstrates the challenges that coal producers will have in finding new contracts within the U.S. New, less-expensive pollution reduction technologies could reverse this trend, but until these technologies are proven cost-effective at utility scale, the domestic coal-fired power market is forecasted to face continued gradual decline as coal-fired power continues to be replaced with natural gas and other energy sources.



Sources: Utah Geological Survey (UGS), Utah Automated Geographic Reference Center (AGRC)

UTAH

In 2015, 80.9 percent of Utah coal was used within the State of Utah for power generation. Prevalent in-state coal use indicates that the future of Utah's mining operations are currently dependent on the continued operation of these power plants. Electricity demand, a changing resource mix, transmission capacity, regulations, and policies in Utah and surrounding states will play an important role in the future of Utah's coal-fired plants.

Table 3: Coal Production & Coal-Fired Power in Utah

PLACE	COAL-FIRED POWER '16		COAL PRODUCTION '16			POWER/MINING EMP.		
	UNITS / CAPACITY	CONSUMPTION	PRODUCTION	%*	RANK	#	%**	$***
Millard	1 / 1,620 MW	8.39 MST	--	--	--	571	14.0%	32.1%
Sevier	–	--	5.38 MST	39.1%	1	643	7.7%	12.5%
Emery	2 / 2,615 MW	6.23 MST	2.48 MST	18.1%	3	650	20.5%	41.6%
Carbon	1 / 58.1MW	Unavailable	5.19 MST	37.7%	2	703	8.0%	20.2%
Uintah	1 / 499.5 MW	1.57 MST	–	–	–	187	1.3%	3.0%
Kane	--	--	703K	5.1%	4	43	1.3%	3.0%
Rest of Utah	1 / 182	Unavailable	–	–	–	7938	0.6%	0.9%

Percent production is within the State of Utah. ** Percent employment is for each county. * Percent of total county payroll. Rank is for all Utah counties. Coal consumed is not necessarily Utah produced.*
Source: Utah Geological Survey (UGS)

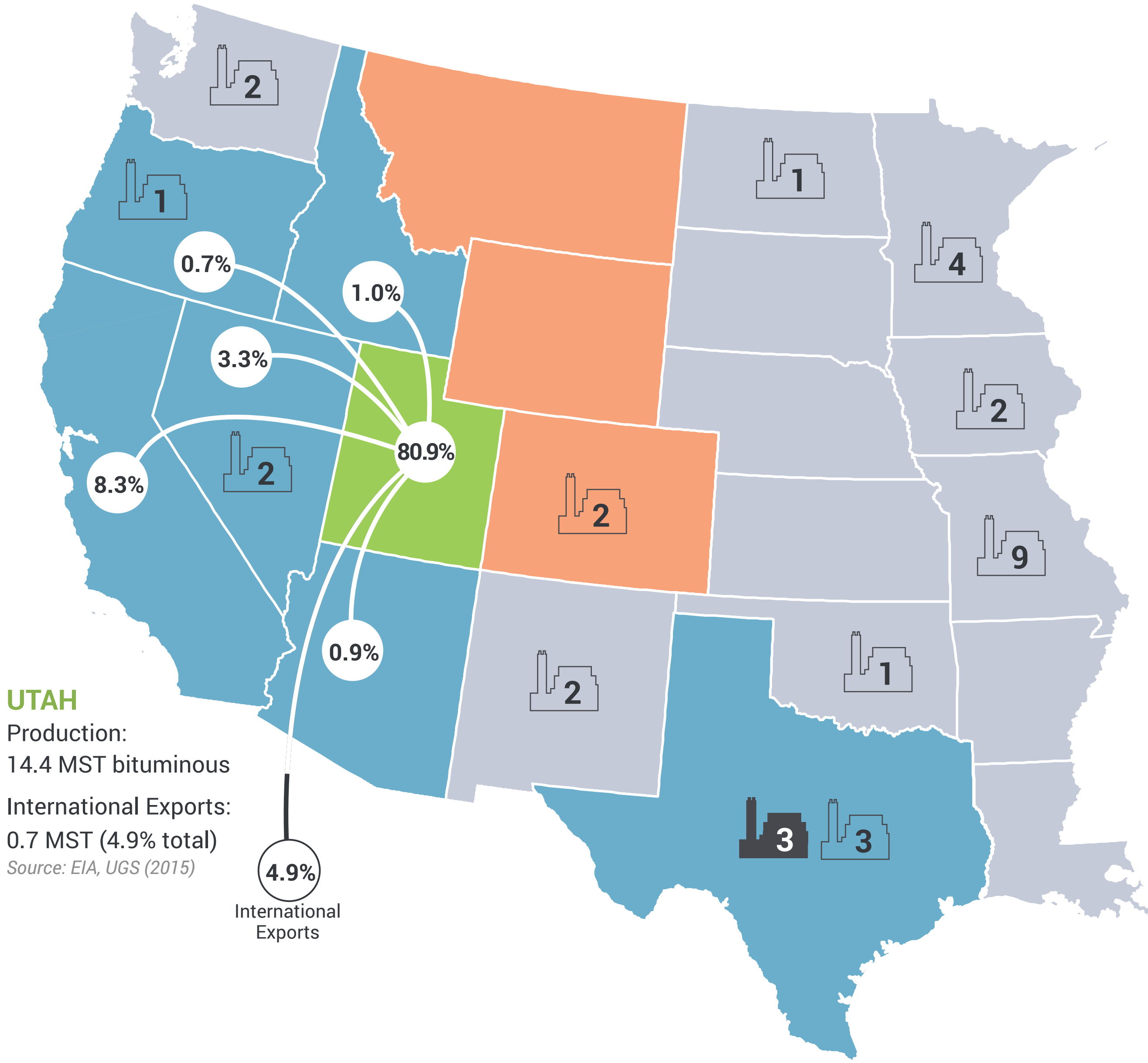
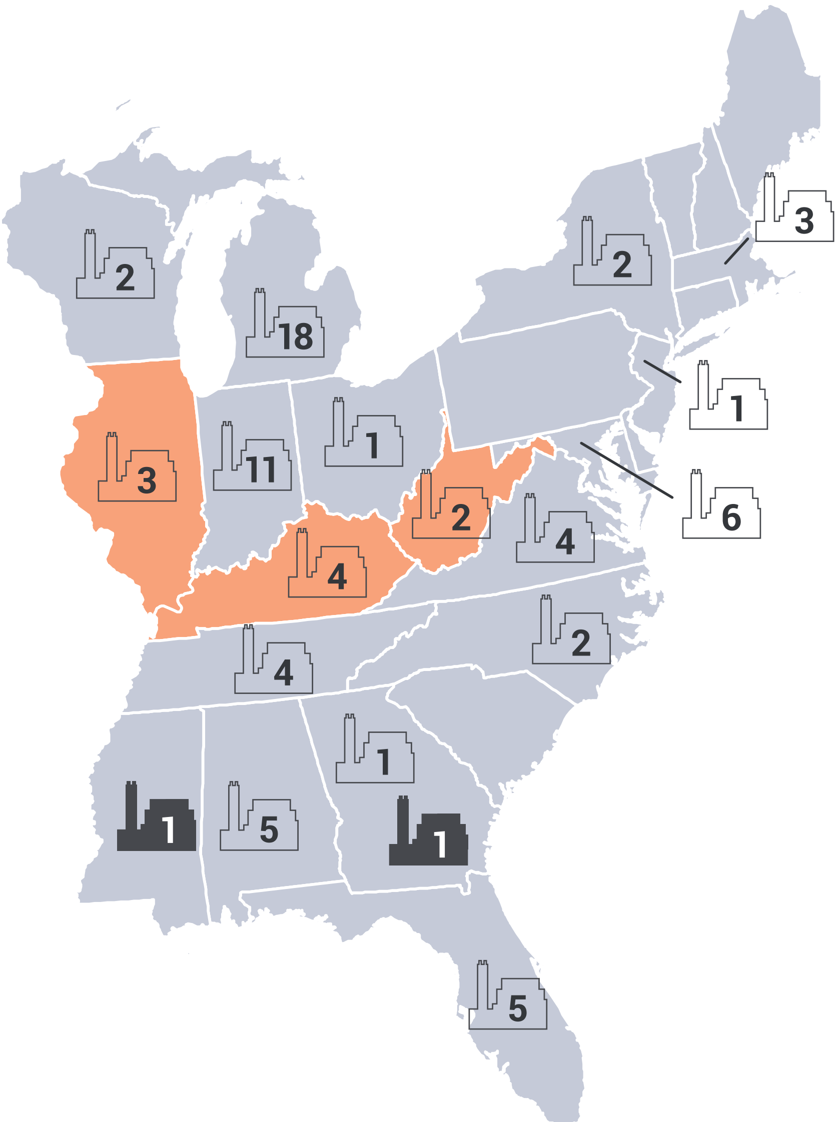


Table 2: Other Coal Producing States

PLACE	BITUMINOUS			SUBBITUMINOUS			INTERNATIONAL EXPORTS	
	PRODUCTION	%	RANK	PRODUCTION	%	RANK	EXPORT	% OF PRODUCTION
Wyoming	2.7 mil	0.7%	14	373.0 mil	88.9%	1	52.4K	0.01%
Colorado	14.4 mil	3.6%	7	4.4 mil	1.1%	4	1.7 mil	10.4%
Montana	6.4 mil	1.6%	13	35.1 mil	8.4%	2	10.3 mil	24.6%
West Virginia	95.6 mil	23.8%	1	–	–	–	23.5 mil	26.7%
Kentucky	61.4 mil	15.3%	2	–	–	–	3.4 mil	5.9%
Illinois	56.1 mil	13.9%	3	–	–	–	10.3 mil	17.9%
Utah	14.4 mil	3.6%	8	–	–	–	0.7 mil	4.9%
Rest of U.S.	159.4 mil	39.6%	–	6.9 mil	1.6%	–	24.7 mil	2.8%

Unless otherwise noted, percent is the portion of national production. Exports are in short tons.
Source: U.S. Energy Information Administration (EIA)

A Common Vein: Utah Coal and the U.S. Market



As Utah coal companies look for opportunities, they face a difficult national marketplace. Many coal-fired power plants are scheduled to be retired or replaced with natural gas or other fuels. Exports of Utah coal to other states have declined steadily since 2001. Utah exported 15,900,000 short tons of coal to 21 states in 2001; in 2015, Utah exported 2,100,000 short tons to 5 states. This trend highlights the ongoing challenges of operating in the U.S. coal market as well as the importance of access to international markets.

Current or potential trade partners

Other competitive producing states

Proposed coal projects (2016–2025)

Coal-fired power units scheduled for retirement (2015–2025)

Table 3: Current and Potential Trade Partners

PLACE	COAL POWER PLANTS		ALL COAL			UTAH COAL EXPORTS	
	NEW PROJ.	PLANNED RETIRE	DOM. IMPORTS	%	RANK	AMOUNT	%
California	–	–	1.4 mil	0.3%	35	1.2 mil	8.3%
Nevada	–	2	1.7 mil	0.3%	31	496.2K	3.3%
Arizona	–	–	15.2 mil	2.8%	17	131.4K	0.9%
Idaho	–	–	310K	0.1%	40	152.2K	1.0%
Oregon	–	1	1.6 mil	0.3%	32	98.7K	0.7%
Texas	3	3	56.0 mil	10.3%	1	–	0.0%
Rest of U.S.	2	98	467.0 mil	86.0%	–	–	0.0%

All Coal percent is the portion of all domestic state imports. Utah Coal Exports percent is the portion of total Utah coal production. Amounts are in short tons. New and retiring projects are coal power plants planned to be online or retired by 2015–2025.
Source: U.S. Energy Information Administration (EIA), Utah Geological Survey (UGS)

Global Opportunities, Global Competition

In a dynamic global market, Utah's coal has many opportunities and significant competition. Export capability will be essential for accessing new opportunities from developing economies. Utah's production is small in comparison to global competitors, but Utah coal offers unique and desirable qualities which can help capture specific economic and environmental requirements.

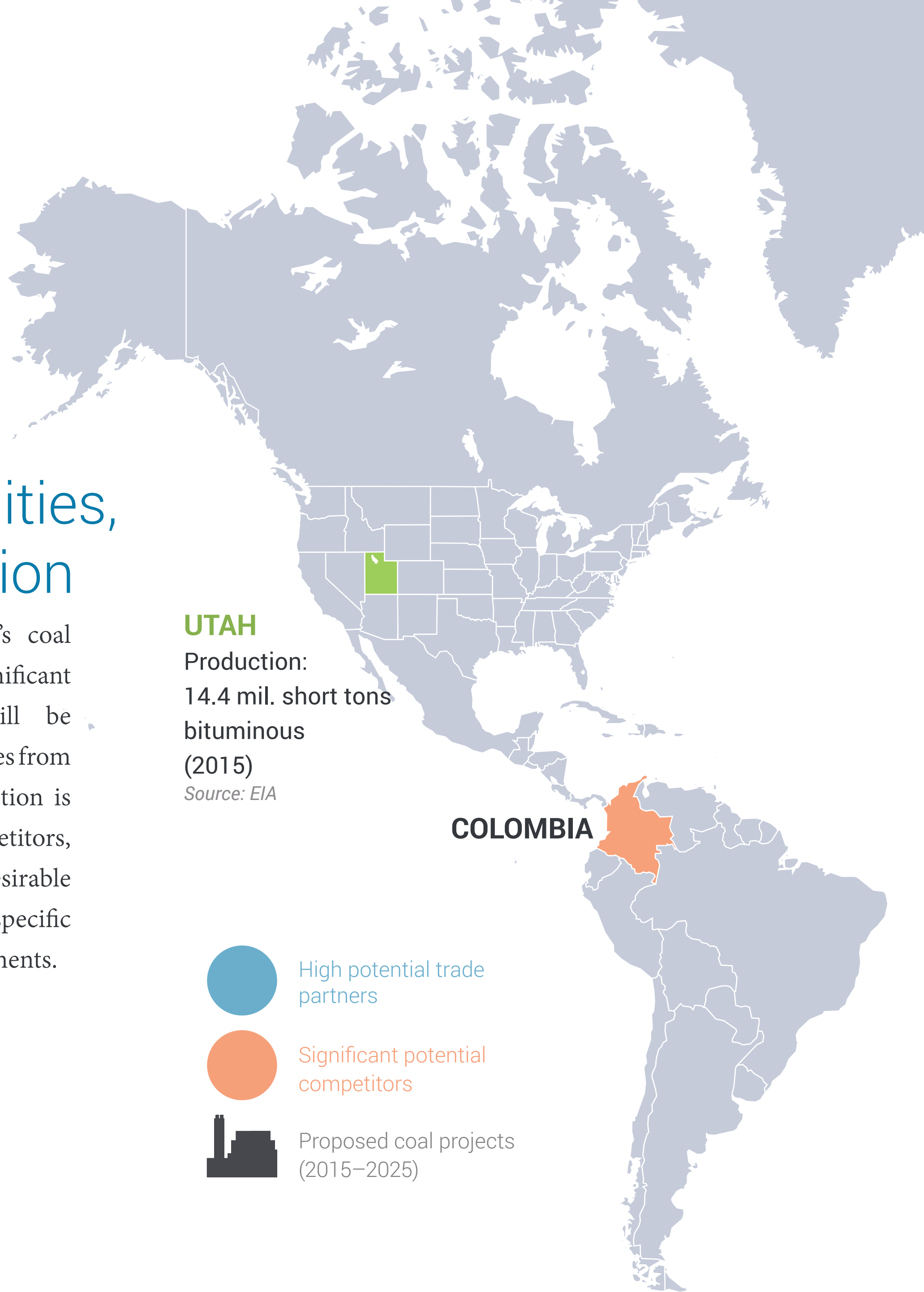


Table 4: Significant Potential Competitors

PLACE	BITUMINOUS			SUBBITUMINOUS			LIGNITE		
	EXPORTS	%	RANK	EXPORTS	%	RANK	EXPORTS	%	RANK
Australia	200.7 mil	30%	1	–	–	–	–	–	–
Russia	131.5 mil	19%	2	–	–	–	2.7 mil	4%	2
Colombia	94.4 mil	14%	3	–	–	–	–	–	–
South Africa	83.3 mil	12%	4	225K	–	9	–	–	–
Indonesia	71.3 mil	10%	5	229.0 mil	84%	1	57.2 mil	87%	1
United States	30.4 mil	4%	7	6.5 mil	2%	3	24K	–	13

Percent is the portion of global exports. Exports are in short tons.
Source: U.S. Energy Information Administration (EIA)

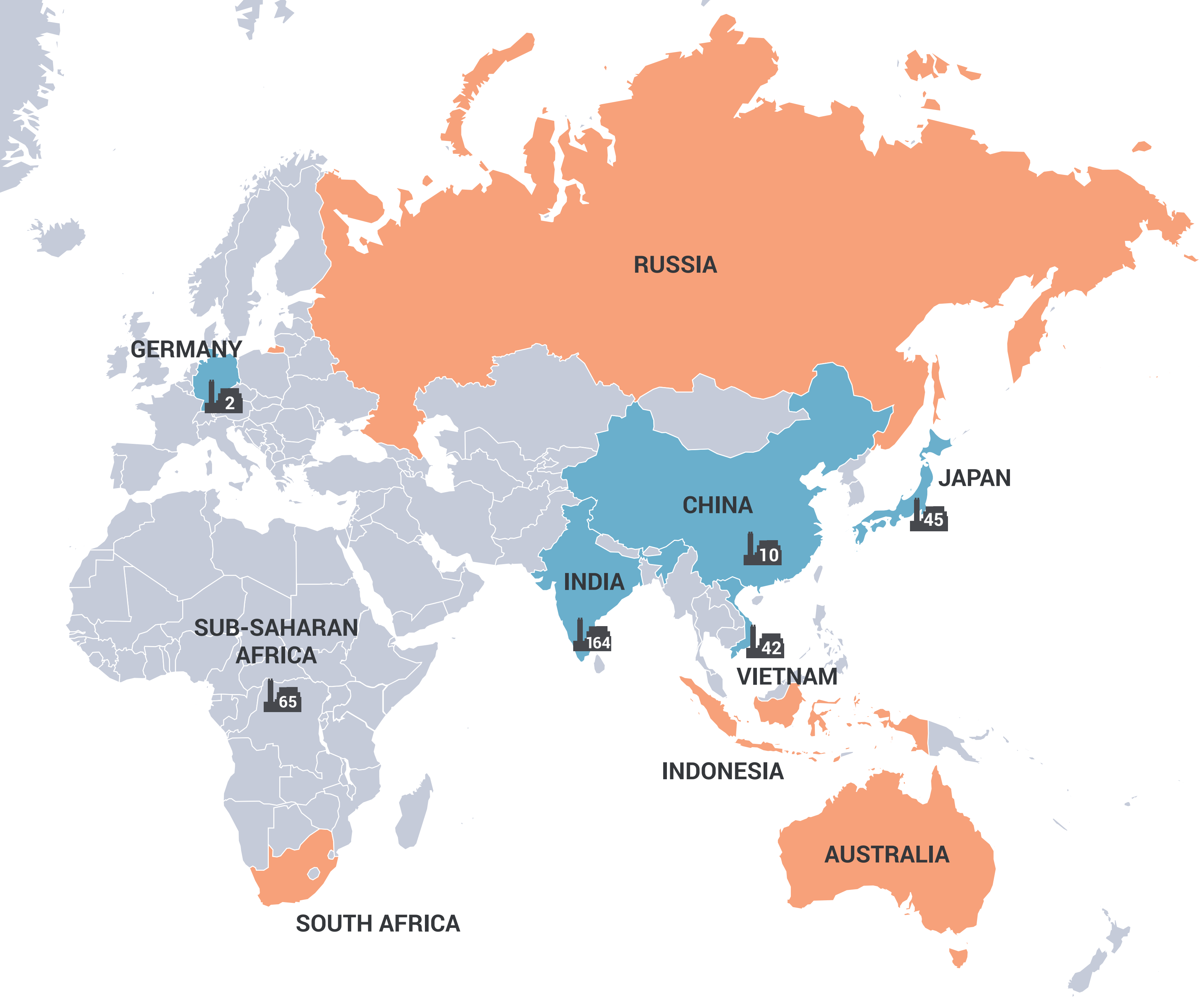


Table 5: High Potential Trade Partners

PLACE		BITUMINOUS			SUBBITUMINOUS			LIGNITE		
	NEW PROJ.	IMPORTS	%	RANK	IMPORTS	%	RANK	IMPORTS	%	RANK
China	10	123.4 mil	16%	2	25.6 mil	9%	2	69.7 mil	93%	1
India	164	11.1 mil	1%	16	149.0 mil	54%	1	1K	–	32
Japan	45	140.2 mil	18%	1	12.1 mil	4%	5	15K	–	19
Germany	2	50.2 mil	6%	5	–	–	–	14K	–	20
Vietnam	42	2.1 mil	–	30	620K	–	17	1K	–	31

Percent is the portion of global imports. Imports are in short tons. New projects are coal plants planned to be online by 2015–2025.
Source: U.S. Energy Information Administration (EIA), Business Monitor International Ltd.

Global Energy and Coal's Role

While market volatility has created uncertainty around coal consumption, many countries around the globe continue to bring new coal-fired plants online. The possibility exists for Utah's coal industry to partner with rapidly-growing economies that are in need of low-cost, reliable energy. Because of its high-energy, low-sulfur qualities, the majority of Utah's coal is expected to have a competitive advantage within the global export space, particularly since many countries are working to address environmental considerations associated with power production. [135]

Outlook for Utah Coal Exports

The following is a sampling of countries that are experiencing changing energy resource conditions that could result in new global market demand for Utah coal.

CHINA

The global coal market is expected to see increasing volatility in 2017 and beyond as it moves away from Chinese-led demand growth.[72] The Chinese government has initiated an ambitious campaign to diversify its energy sources, consolidate its coal mines and cap coal consumption as part of a concerted effort to improve air quality. Domestic Chinese coal production decreased to an estimated 3.59 billion metric tons in 2014: the first fall registered since 2000.[72] Despite this expected decline in coal consumption, China will remain the largest coal importer in the world.

A desire to replace lower-grade, higher-emission coal with higher-grade, lower-emission coal supplies is expected to remain a Chinese goal. This could open up an opportunity for cleaner, higher BTU coals, such as those produced in Utah, even if projected declines in China's overall coal use are realized. Other factors could come into play when considering coal trade opportunities with China. For instance, China recently suspended all imports of coal from North Korea. Coal has accounted for 34 percent to 40 percent of North Korean exports in the past several years, and almost all of it was shipped to China.[73]

INDIA

As China's demand for thermal coal slowly weakens, India has boosted imports. 2014 imports increased by 28 million tons to 164 million tons, allowing the country to overtake Japan as the world's second-largest importer.[74] Coal should remain India's primary energy source for electricity generation and the country is expected to remain in a coal deficit until 2020.[72] India does not have many large-scale, low-cost fuel options for power generation. The result is that as the country works to support an annual economic growth rate of 6–7 percent, it will have to rely on thermal coal power generation and foreign coal imports.[74]

GERMANY

According to Business Monitor International (BMI), coal power in Germany will "remain more profitable than gas over a longer timeframe and will only be removed from [Germany's] energy mix very gradually—still accounting for almost 41 percent of electricity generation in 2025."[74] The demand for coal is expected to continue into the foreseeable future. Utah's clean burning coal could have significant market potential in Germany.[136]

VIETNAM

Vietnam's economy is experiencing a rapid and sustained expansion. In the last two decades it has maintained an economic growth rate averaging nearly 6 percent per year per person. This growth has boosted Vietnam from its position as one of the poorest countries in the world to a middle income bracket nation.[75, 76] In 2016, due to concerns over feasibility, foreign collaboration, and safety issues, Vietnam pulled away from plans for nuclear power development and turned back to coal as the main source of fuel in its future electricity generation mix, about 74 percent of total energy. Currently, Vietnam has up to 20 coal-fired plants and plans to increase that number to 32 by 2020 and to 51 by 2030.[75] Vietnam represents an emerging market for coal exporters.

SUB-SAHARAN AFRICA

Coal is expected to remain a key fuel for Sub-Saharan Africa's power sector over the coming decade.[72] Domestic politics and periods of civil unrest have significantly disrupted the region's ability to maintain broad infrastructure development and could present opportunities for exporters interested in supplying coal to these countries.

RUSSIA

Supported by government investment, Russia's coal production is projected to grow in coming years.[72] Over 60 percent of Russian coal is extracted in Siberia and most of their exports have been transported to Great Britain. That is expected to change as Russia's coal export focus shifts towards Asia to meet expected market growth. This will provide significant competition for U.S. coal exporters looking at Asian markets.[77] The Russian Ministry of Energy has stated that the government will spend an estimated $123 billion USD on the coal sector through 2030. This could present and opportunity for increased trade of mining equipment, services, and technology.[78]

COLOMBIA

Columbian coal production competes with U.S. coal exporters. Colombian coal is expected to continue gaining ground in Asia, supported by competitive operating costs, low freight costs, and the expansion of the Panama Canal. These competitive advantages have

Germany is powered by vast amounts of fossil fuels from abroad

For over 16 years, Germany's Renewable Energy Law of 2000 supported a boom in their wind and solar power production. "Renewable" electricity increased to 17 percent by 2010 and reached 33 percent in 2015. However, in an abrupt turnabout, the government's cabinet in 2016 agreed to a major reform of the system. In an attempt to stabilize growing energy costs, the government moved to control the retail price of electricity and allow utilities to continue to burn large quantities of coal.

Germany imports most of its energy: about 98 percent of its crude oil, 88 percent of natural gas, about 87 percent of (hard) coal, and 100 percent of uranium.

The Federal Institute for Geosciences and Natural Resources has predicted that the country's dependency on imported energy will increase with the continuing decline in domestic production.[41]

The country has put together ambitious climate change targets and political and technical concerns for energy reliability have placed coal as a source of baseload power for many decades. The experience in Germany demonstrates the value of system interactions that can occur between base load coal and renewables as technologies continue to evolve across resources.

enabled Columbian coal to compete with Australian coal producers. Colombia, which traditionally ships coal to North America and Europe (mostly Turkey and Netherlands), began ramping up coal exports to Asian countries including India, Japan, South Korea and the United Arab Emirates in the first half of 2016.[137]

AUSTRALIA

Coal exports from Australia's Queensland state hit an all-time high of 221 million metric tons in 2016.[79] Despite this, Australian coal faces significant uncertainty in the coming years due to expected inability to compete on price in the export markets.[72] BMI states that many coal producers in Australia have started liquidating their portfolios as a direct result of these difficulties. Despite these challenges, Australian coal exports will remain an important competitor in Asian markets for the foreseeable future. Australian coal export challenges illustrate the difficulty inherent to competing in the international market for current and potential Utah exporters.

SOUTH AFRICA

South Africa will remain a competitor in the global coal export market, particularly in India. Many Indian power companies prefer South African coal because it is higher quality than Indonesian coal and lower cost than Australian coal.[72]

JAPAN

As Japan works to solve internal energy issues, coal's role in the energy mix is expected to expand. Japanese companies have announced that they are planning to develop up to 45 coal power plants in the next decade as the country gradually ramps down nuclear power generation and ramps up coal-fired power generation following the Fukushima nuclear plant breakdowns in 2011.[138]

INDONESIA

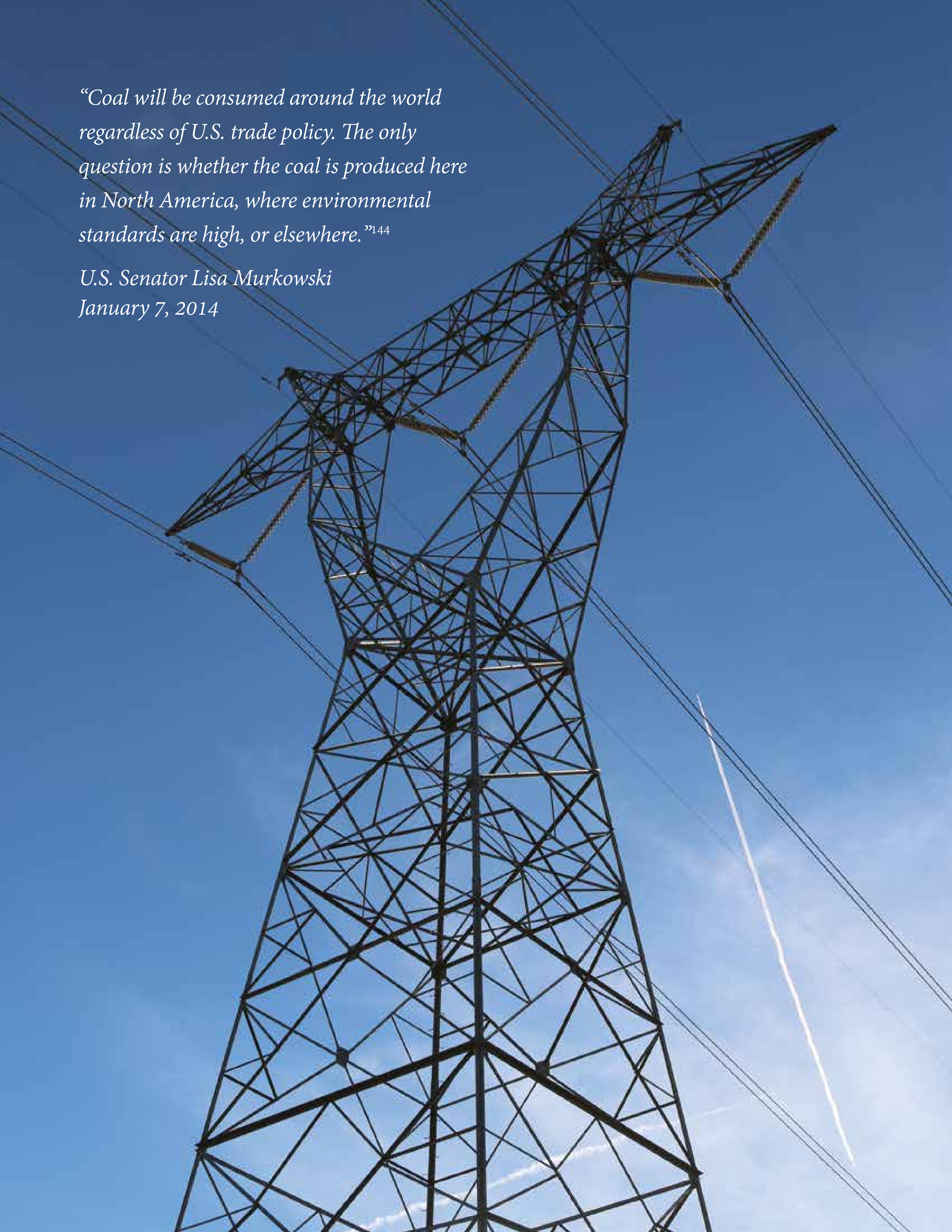
According to EIA, Indonesia is responsible for 30 percent of global coal exports, most of which is exported to Asian nations. Their coal is generally higher sulfur content than many of their competitors, yet port access near mine mouths and cheap labor help Indonesian coal producers maintain low prices. Sulfur and other pollutant content is a primary concern for companies purchasing Indonesian coal, creating an advantage for Utah and other cleaner coal in the region.

Export Considerations

Three primary factors to consider when evaluating the potential for Utah coal exports are (1) price, (2) access to international markets, and (3) transportation costs. Production and purchase prices will ultimately dictate whether Utah mines can profitably maintain production. However, significant demand currently exists around the globe for high-quality coal and mining expertise. That demand appears to be growing in several countries. Utah companies have an opportunity to provide product and professional services to meet these needs.[76]

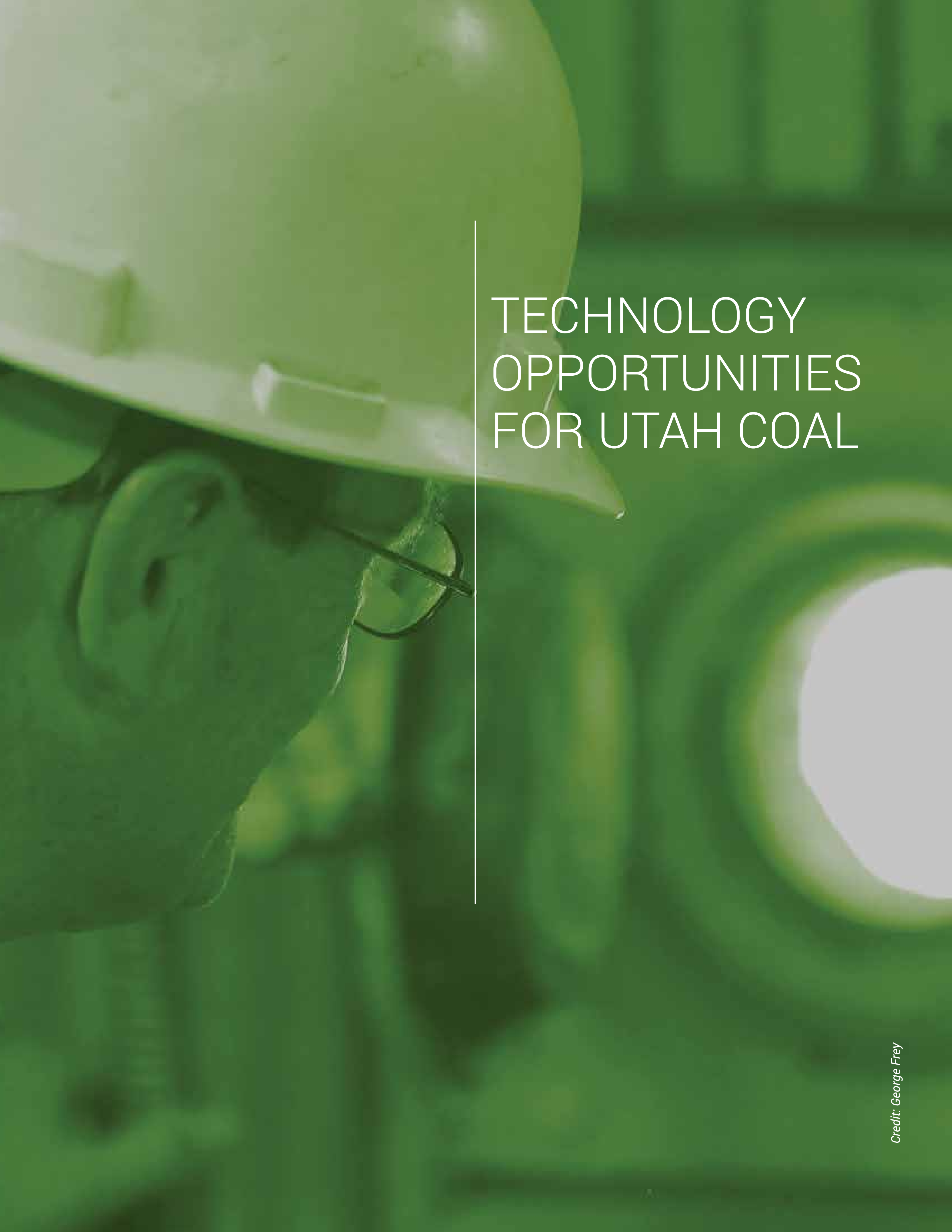
It only takes comparably limited port access to ship a high percentage of Utah's coal production. Similarly, a single contract with a large international buyer could account for a large percentage of the State's coal production. Limited coal port capacity on the West Coast makes international shipping a challenge. Without obtaining contracts for current West Coast coal ports, much of Utah's reserves would be unable to reach international markets.

If adequate shipping capacity off the West Coast is available, and Utah's production and transportation costs remain competitive, international markets remain a feasible option for Utah coal. On the other hand, if port access is unavailable or costs eclipse demand for Utah's cleaner coal, Utah coal will struggle in the international market.



"Coal will be consumed around the world regardless of U.S. trade policy. The only question is whether the coal is produced here in North America, where environmental standards are high, or elsewhere."[144]

U.S. Senator Lisa Murkowski
January 7, 2014



TECHNOLOGY OPPORTUNITIES FOR UTAH COAL

Credit: George Frey

New technologies offering opportunities for advanced coal combustion are on the horizon and can provide for coal-derived product development and licensing of valuable intellectual property. By taking advantage of a wide range of opportunities and pushing the envelope beyond what is currently considered, Utah's coal industry could be revitalized. Advances have the potential to bring new industry prospects to the state, expand the talent pool, create new jobs, address environmental concerns, and support economic growth.

Utah, with its forward-thinking research universities and entrepreneurial spirit, is well-positioned to provide world leadership in advanced coal technology.[81] Recently, Carbon County officials led an effort to support coal technology through the formation of the Advanced Coal Resource Group. At the State level, the Utah Legislature approved the Sustainable Transportation and Energy Plan (STEP) in 2016.[82] The legislation established a five-year pilot program, under which regulators will authorize Rocky Mountain Power to spend an average of $1 million per year on clean coal technologies, some of which is discussed in the following sections.[82]

University groups and technology companies within the State continue to innovate through research and development. Since 2015, R&D groups in the State have received over $10 million in coal technology grants. The University of Utah's Industrial Combustion and Gasification Research Facility, located in Salt Lake City, houses some of the most advanced combustion test equipment found in the United States. Additional important and State-led development efforts are presented in the following sections:

- Advanced Combustion
- Carbon Management and Utilization
- Hybrid Systems and Retrofit Options
- New or Alternative Product Development

Clean Coal Facility Operational

The nation's first large-scale "clean coal" facility was recently completed and declared fully operational on January 10, 2017. The Petra Nova project is a joint venture between NRG Energy, Inc. and JX Nippon Oil & Gas Exploration. The coal-burning power plant, located just outside of Houston, began capturing emissions in September 2016, and has trapped more than 100,000 tons of carbon dioxide.[133]

Advanced Combustion

New technologies that focus on more efficient and environmental ways of burning coal are under development. The following section highlights three potentially transformational combustion processes and describes state-led development efforts in these areas: (1) Oxy-combustion, (2) Chemical Looping Combustion (CLC), and (3) Entrained-flow Gasification. These three state-led efforts illustrate Utah's leadership in forward-thinking coal technologies. The impact of these technologies could help improve a power plant's ability to realize a favorable emissions profile and expand energy output.

1. Oxy-combustion

Coal-based oxy-fuel combustion involves burning coal in an oxygen-intense environment instead of an ambient air mixture. Because the inert nitrogen component of air is not present, fuel consumption is reduced and flame temperatures are higher. Oxy-fuel combustion produces approximately 75 percent less flue gas than air-fueled combustion and produces exhaust consisting primarily of CO_2 and water.[83] The justification for using oxy-fuel is to produce a CO_2 rich flue gas that is ready for sequestration or process utilization.[83] This method costs more than a traditional air-fired plant and requires additional energy — nearly 15 percent of additional production energy can be consumed by a coal-fired power plant for this process. However, a new technology called chemical looping combustion may reduce costs.[83]

State-led efforts:

UNIVERSITY OF UTAH'S INSTITUTE FOR CLEAN AND SECURE ENERGY (CASE) PROGRAM

The CASE program conducts oxy-coal combustion research. Its goal is to produce predictive capability for bounding oxy-coal operations. This predictive tool will then be developed for application to full-scale, industrial burner operations.[84,85]

BRIGHAM YOUNG UNIVERSITY (BYU)

Under a recently awarded grant, "Development of Enabling Technologies for a Pressurized Dry Feed Oxy-Coal Reactor," a 100 kilowatt oxy-coal reactor using a first-of-a-kind dry coal feed system will be built at BYU in Provo, Utah.[86] The work will address technology issues for future design, development, and testing of commercial-scale pressurized oxy-coal systems.

REACTION ENGINEERING INTERNATIONAL (REI)

Recently, Reaction Engineering International, a Utah-based firm, was chosen to lead a grant team that includes the University of Utah, Praxair, and Jupiter Oxygen Corporation to perform multi-scale experiments and modeling to generate tools and mechanisms capable of describing high-temperature and high-pressure oxy-coal combustion.[87]

2. Chemical Looping Combustion (CLC)

A recent combustion technology, called chemical looping may achieve equal or higher efficiencies than found in existing power stations, even those with geologic sequestration of CO_2. In this process, coal is exposed to oxygen-bearing materials such as iron oxide. The coal reacts with these materials and the bound energy breaks the bond between the oxygen and the iron. Chemical looping is still in the early stages of development and several technical challenges remain before utility-scale implementation is feasible.[88]

State-led efforts:

UNIVERSITY OF UTAH

The University of Utah has been researching CLC since 2007. The university's work in chemical looping combustion aims to develop a new carbon-capture technology for coal. Research targets for this project include: identifying reaction mechanisms and rates,

Dr. Andrew Fry and David Mohler (Deputy Assistant Secretary, U.S. Department of Energy) examining enhanced coal-fired power generation.

exploring operating options with a bubbling bed reactor, developing process models and economics, and validating simulation tools.[84,89] The University of Utah and Amaron Energy received an award in 2015 from DOE's National Energy Technology Laboratory totaling $2.5 million to advance the development of CLC with oxygen.[90]

3. Entrained-flow Gasification

In entrained-flow gasification, fine coal feed and an oxidant and/or steam are fed cocurrently to a gasifier. This results in the oxidant and steam surrounding or entraining the particles as they flow. Entrained-flow gasifiers operate at high temperature and pressure and have the ability to handle a variety of feedstocks. Because the produced syngas consists of mainly H_2, CO, and carbon dioxide, successful development and implementation of this technology would offer improved efficiencies and reduce pollutant levels.[91]

State-led efforts:

UNIVERSITY OF UTAH

The goal of the university's high-pressure entrained-flow coal gasification research is to understand system heat transfer, coal conversion, soot formation, and synthesis gas composition. The work includes laboratory and pilot-scale gasification experiments and high-performance simulation tools.[84, 92]

REACTION ENGINEERING INTERNATIONAL

Reaction Engineering has recently been selected to lead a team that includes the University of Utah, Southeastern University (China), Praxair, Corrosion Management (United Kingdom) and the Electric Power Research Institute to design and construct a dry-pulverized coal-feeding and firing system for an entrained flow pressurized reactor and to determine how dry feeding affects overall performance of the system.[94]

Carbon Management and Utilization

The advanced combustion technologies described in the previous section are largely being developed to design fossil fuel thermal power plants that release low or zero emissions. This section describes a variety of research projects and cooperative initiatives that have focused on sustainable coal utilization and continued fuel diversity through management and utilization options for CO_2 emissions. Some of these approaches would be suitable for retrofit of existing plants. Carbon dioxide capture and sequestration (CCS) is a set of technologies that can greatly reduce CO_2 emissions from new and existing coal- and gas-fired power plants and large industrial sources. CCS is a three-step process that includes:

- Capture and compression of CO_2 from power plants or industrial processes
- Transport of the captured and compressed CO_2
- Underground injection and geologic sequestration (also referred to as storage) of the CO_2 into deep underground rock formations

In addition to capture and storage, efficiently directing captured CO_2 toward value-added end use is also being explored and is discussed in the sections: Enhanced Oil Recovery and Hybrid Systems and Retrofit Options.

Carbon Capture

Carbon capture involves trapping carbon dioxide at an emission source, transporting it to a storage location (usually deep underground) and isolating it. Often offered as a solution to climate change, carbon capture aims to safely dispose of the carbon dioxide produced at power stations, and industrial sites.

State-led effort:

SUSTAINABLE ENERGY SOLUTIONS, LLC

Sustainable Energy Solutions has developed an innovative approach to carbon management that involves de-sublimation (the conversion of a gas to a solid). Their Cryogenic Carbon Capture™ technology is designed to eliminate most emissions from fossil fuel combustion and is projected to cost significantly less than current alternatives.[84] The company has demonstrated the technology at pilot scale and at multiple locations, capturing between 96 and 98% of carbon dioxide from a variety of combustion sources including coal, natural gas, and biomass.[84, 85, 86]

Sequestration

Sequestration means storage. Coal-fired power plant carbon sequestration focuses on long-term storage of the carbon dioxide produced during combustion processes. Studies conducted by the Utah Geological Survey show that CO_2 can be stored in specific areas in Utah. These include:

- large folds of rock, referred to as anticlines
- coal beds
- deep saline (salty) aquifers, especially near power plants[87, 88]

State-led effort:

ENERGY & GEOSCIENCE INSTITUTE

The Department of Energy recently selected the University's Energy & Geoscience Institute for a $1.3 million grant under the Carbon Storage Assurance and Facility Enterprise (CarbonSAFE) initiative. The program supports the development of integrated CCS storage complexes with a 2025 construction goal.[89] Phase

I objectives include the formation of a coordination team that will address regulatory, legislative, technical, public policy, commercial, financial, and other issues specific to commercial scale deployment of a large CO_2 storage project.[89]

Enhanced Oil Recovery (EOR)

For over 40 years, oil companies have piped stored CO_2, mostly from naturally occurring reservoirs, to oil fields in the U.S. in efforts to recover residuals from declining oil fields.[90] Moving beyond natural CO_2 sources, large-scale carbon sequestration from power industry emissions is expected to be compatible with the energy production and delivery infrastructure in place and required for enhanced recovery projects.[90]

State-led effort:

The Energy & Geoscience Institute at the University of Utah is preparing a report, Enhanced Oil Recovery in Shales. This study assesses the suitability of using water, CO_2, natural gas, ethane or propane for enhancing recovery from oil-rich shales.[91]

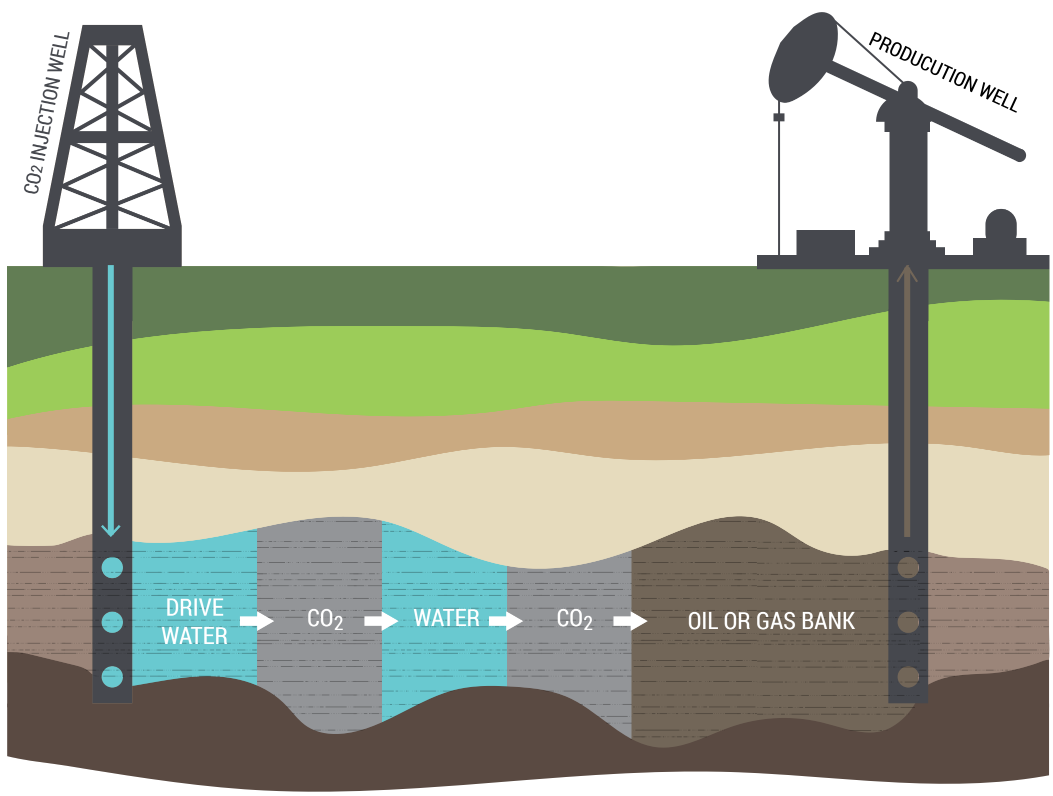


Illustration 10: CO_2 injection process to retrieve oil or gas in shale formations

Hybrid Systems, Efficiency and Retrofit Considerations

By pushing the boundaries of power plant design, engineers are working to provide opportunities for low-emission coal to play a pivotal role in a clean, global energy mix to mid-century and beyond.[103] New plant designs target modularity, efficiency and flexibility. Because of increased integration of renewable energy sources, smart grids, and other emerging technologies, twenty-first century power systems will favor those resources that are flexible and can compete on costs with other options.[104] The following systems, currently under development, could be of interest to state power producers.

HYBRID BURNERS

Slight changes in fuel price can significantly impact utility production costs. Advanced Power Control Solutions has developed a hybrid burner technology that provides the capability to emulate dual fuel burners and replace an estimated 30-40 percent of a power plant's coal feedstock with natural gas or natural gas liquid. The approach could provide environmental benefits through reduction of SOx, NOx, particulates, mercury, and carbon dioxide.[105]

BIOMASS

The six worst U.S. wildfire fire seasons have occurred since 2000 and forest fuel loads in the Western states are at an all-time high while fire-fighting costs continue to soar.[106] Active Energy Group (AEG) has developed a modular process that produces a fuel from woody biomass that can be co-fired with coal. AEG has constructed a demonstration facility in Salt Lake City.[107] Amaron Energy, based in Utah, has also developed a woody-waste torrefaction process. Material from both processes will be evaluated as part of Rocky Mountain Power's woody waste co-firing assessment under the STEP Clean Coal program.[108]

PLANT EFFICIENCY

If the average global emissions rate of coal-fired power plants could be lowered by deploying more advanced off-the-shelf technology, significant amounts of CO_2 emissions could be cut while maintaining economically viable plant operations.[109] Gap Engineering Process Control recently undertook optimization of a utility's 615 MW coke-fired power plant's boiler management system. Initial results showed that this reduced fuel consumption by $3 million annually and increased power generation output by 3 MW. This type of improvement can improve emissions, and could allow coal-plants to comply with stricter regulation without retrofitting the plant.[110]

COMBINED TECHNOLOGY

Researchers at the Gas Technology Institute (GTI) are working on a portfolio of technologies that include: novel uses of captured CO_2, advanced power cycles using supercritical CO_2 rather than steam as the working fluid, low-cost oxygen generation (for oxy-combustion), and more efficient CO_2 capture methods for plants without oxy-combustion. GTI and their partners, Southwest Research Institute and GE Global Research, have been selected by the U.S. Department of Energy for an $80 million award to design, build, and operate a 10 MWe supercritical CO_2 pilot power plant.[111,112]

Coal to Products

Coal has many important uses worldwide. Presently, the most significant uses of coal are in electricity generation, steel production, cement manufacturing, home heating, and as a converted liquid fuel.

Other important users of coal include: alumina refining, paper manufacturing, and the chemical and pharmaceutical industries. Several chemical products are produced from coal by-products. Refined coal tar is used in the manufacture of chemicals, such as creosote oil, naphthalene, phenol, and benzene. Ammonia gas, recovered from coke ovens, is used to manufacture ammonia salts, nitric acid and agricultural fertilizers. Thousands of products rely on coal or coal by-products including: soap, aspirins, solvents, dyes, plastics and fibers, such as rayon and nylon.[113] Anthracite is even used in municipal water filtration systems. Coal products with significant current or potential development opportunity for the State of Utah are described below.

COAL TO LIQUIDS

Most coal liquefaction processes require high-temperature/high-pressure conditions and significant energy consumption. Liquefaction has typically only been economically viable when oil prices are high. The U.S. Department of Energy and the Department of Defense have collaborated on coal liquefaction development to look at the production of military-specification fuels.[114]

A coal-to-liquids company, Revolution Fuels, has begun the permitting process for a facility near Wellington, Utah. Its operations will include coal handling, coal gasification, ash handling, syngas treatment, and product upgrading. The facility will produce jet fuel, diesel fuel, liquefied petroleum gas, and naptha.[115] Additionally, Ceramatec, a Utah-based materials development firm, has demonstrated the production of liquid hydrocarbons from coal-derived gas using a proprietary reactor system.[116,117]

GAS PRODUCTION

Coal gasification is a process that involves converting coal to a synthetic gas or a mixture of carbon monoxide and hydrogen gas. Syngas (SNG) can be used to fire gas turbines to produce electricity. Hydrogen, obtained during the gasification process, can also be used for various purposes, such as ammonia production or fossil fuel upgrading.

The Great Plains Gasification Plant in Beulah, North Dakota, is a coal-to-SNG facility that produces up to 160 million cubic feet per day of SNG and has been operating since 1984.[118] Dakota Gasification Company owns and operates the plant, which is the only commercial-scale coal gasification facility in the United States that manufactures SNG.

COALBED METHANE (CBM)

Coalbed methane operations involve extracting methane gas absorbed into the solid matrix of coal beds.[119] Unlike natural gas from conventional reservoirs, coalbed methane contains very few heavy hydrocarbons such as propane or butane, and no natural gas condensate.

In the United States, CBM production is located mainly in the Rocky Mountain States. Coalbed methane reserves are still a relatively untapped energy source with significant potential. Estimated global reserves are 9,000 trillion cubic feet with 3,000 trillion cubic feet in the United States alone.[120] The Uintah Basin coalbed methane play is located in Utah and Colorado, and is considered one of the major coalbed methane producing areas in the U.S. It is estimated to have 8–10 trillion cubic feet of gas reserves.[119,121] Drilling Products Incorporated and REI Drilling, headquartered in Salt Lake City, have developed technology specifically suited for gas extraction in mineable and non-mineable coal tracts located within this basin.[139]

According to one developer, new technology has had a major impact on CBM productivity and profitability. Since 1998, over 500 wells treated with Halliburton's remediation service have yielded long-term production enhancement in the Drunkards Wash Unit, the leading coalbed methane field in the Uintah Basin. Halliburton reports its technology is also largely responsible for field-wide production of over 260 million cubic feet of gas per day from over 470 treated wells that tap the coal seams of the Ferron Sandstone.[122]

CARBON FIBER

Engineers from the University of Utah recently launched a $1.6 million project to research carbon-friendly methods of turning coal-derived pitch into carbon-fiber composite material.[123] Typically, heated coal produces hydrocarbon materials that are burned as fuel in the presence of oxygen. But if heated in the absence of oxygen, those hydrocarbons can be captured, modified and turned into an asphalt-like material known as pitch. The pitch can then be spun into carbon fibers and used to produce a composite material that is stronger and lighter than steel. Depending on the success of the project; coal-based carbon fiber could become a major material for the production of lightweight, fuel-efficient vehicles.[123]

RARE EARTH ELEMENTS

Reaction Engineering, teamed with Southern Research Institute, has been awarded a DOE research project to investigate recovery of rare earth elements from coal and coal byproducts. The project will focus on the development and testing of a metal melting process to concentrate the elements in post-combustion coal fly ash at pilot scale.[94]

COKE

Oven coke is a material used throughout the world in blast furnaces to make iron. Smaller quantities of coke are used in other metallurgical processes, such as the manufacture of ferroalloys, lead, and zinc, and in kilns to make lime and magnesia.[124] The development of a high-grade specialty carbon product for use as a feedstock in high-temperature furnaces is currently under development in Utah. This technology focuses on the production of customized carbon products for use in electric arc furnaces and mini-mills and also in the production of elemental phosphorus, steel recycling, metal making and finished metal products.[125]

The nation has a tremendous opportunity to realize the promise of technology vital to the support of a secure, efficient and affordable energy future. Through the power of innovation, the United States no longer faces the prospect of oil shortages or embargoes. The country has increasing domestic oil supplies thanks, in part, to new technology adoption. These recent energy developments serve as a reminder of the potential that new technology offers. This is especially true in the coal space where significant opportunity exists for the resource to continue to play an important role in the delivery of the affordable, clean, and reliable energy needed to fuel human progress and economic growth around the world.

"We have yet to reach our full potential to be the world leader in energy technology. If we don't up our game as a nation, we risk falling behind."[145]
Acting ARPA-E Director Eric Rohlfing, 2017

POLICY CONSIDERATIONS

Credit: Scott Catron

In collaboration with industry, active state and local leadership can play a key role in maintaining the viability of coal, including the development and deployment of new technology. In order for coal to maintain a strong position within Utah and the nation's energy mix and to realize new product development over coming decades, the industry will need to continue to innovate, enhance cost competitiveness, and develop strategies that ensure public support.

Decisions made by both state and national leaders will play a fundamental role in the future of the coal industry. New developments, technologies, and opportunities can benefit Utah, the United States, and the globe. Understanding the possibilities associated with advanced coal processes can assist in formulation of policy decisions that foster technology-driven opportunities. The following recommendations are presented as considerations for addressing coal-specific issues.

CONSIDER THE COST AND BENEFITS OF ENVIRONMENTAL REGULATIONS

Numerous environmental regulations have been proposed or implemented to address goals that range from improving water quality to decreasing global warming. Some mandates have advanced without thorough consideration of costs and benefits, resulting in policies that drive higher costs and only marginal progress toward environmental goals. Assessing the full cost of current and proposed regulations and mandates, including economic and security impacts, can provide better energy and environmental gains.

SIMPLIFY FEDERAL LAND PROCEDURES

Due to the need to cross large tracts of federal lands across the West, resource development and infrastructure deployment can be exceptionally timely and costly. Movement of different resources requires adequate infrastructure, including pipelines, transmission lines, and roads. Current permitting processes can significantly limit needed infrastructure expansion and prohibit efficient development. Additionally, most of the remaining coal reserves in Utah are managed by the federal government through the Bureau of Land Management. These vast reserves also underlie lands administered by the U.S. Forest Service, U.S. Department of Defense, and U.S. Parks Service, including National Monuments.

Infrastructure projects and coal mining on and under Federal lands require review under the National Environmental Policy Act (NEPA). These reviews, depending on their scale and classification, have historically taken several years and are often lengthened by litigation. Required studies can be extremely expensive depending on the scale and sensitivity of the project. Simplifying NEPA and improving transparency will help promote accelerated review of projects that encourage environmentally responsible and economically feasible development.

CONTINUE TO SUPPORT THE PRIVATE SECTOR'S RESEARCH AND DEVELOPMENT CAPABILITIES

Encouraging the energy industry and energy entrepreneurs to continue to develop solutions can be realized through effective trade and tax systems. Such policies can be designed to support a climate for private-sector investment and innovation, resulting in the provision of clean, abundant energy sources for the future.

IDENTIFY OPPORTUNITIES TO PROVIDE APPROPRIATE RESOURCE AND INFRASTRUCTURE ACCESS

Identifying corridors for infrastructure and opportunities for responsible resource development can encourage investment. Coupled with consideration of benefit-based regulatory costs, this approach can drive and direct efficient capital disposition for resource development, needed pipeline and transmission line expansions, and efficient power plant deployment.

Under reasoned regulatory regimes, key domestic

energy sources, including coal, can fulfill their potential and help to achieve national energy security and enhanced environmental results. Appropriate access to domestic energy resources supports a resilient and secure domestic energy supply. Advanced technologies can provide solutions to accessing exploration and production in appropriate areas. Limiting opportunities for the deployment of advanced coal technology in the United States can be a significant impediment to adoption of cleaner, safer, and more efficient technologies globally.[117, 118, 119]

ESTABLISH REASONABLE AGENCY REVIEW TIME-FRAMES

Evaluation of new legislation or administrative rules in the context of existing rules or legislation for the same issues can alleviate duplication of costs and provide for a more streamlined, timely, and certain regulatory framework. Incompatible requirements across regulations can create confusion, long review periods, and loss of economic and environmental efficiencies. Adequately assessing how statutory and regulatory rules and practices operate in context of one another can create better timeline certainty and cost efficiencies for industry.

ENCOURAGE FACT-BASED COMMUNICATION ON ENERGY ISSUES

Energy is essential to the quality of life enjoyed in the United States and across the globe. Understanding the value and complexity of the energy systems fueling daily life can lead to informed decision making around energy options. Elements for a fulsome energy education include information on energy policy options and results, market supply and demand changes impacting energy prices, and evaluation of the impacts of disruptions on economies and security.

The expectation of inexpensive electricity can lead to a false sense of security about energy availability and consumption that drives current lifestyle options. Deliberate, honest discussion between policy makers about future energy scenarios is critical to support informed decision making.

This will be best accomplished through establishment of a set of energy policy decision-making criteria to which government leaders and citizens can generally relate. Measures for inclusion as baseline parameters are: (1) maintaining affordable energy to protect quality of life outcomes; (2) providing reliable energy to avoid energy disruptions; (3) advancing environmentally sustainable development; and (4) considering system cost impacts associated with policy actions to promote efficient and environmentally responsive outcomes.

SUPPORT OPEN ACCESS TO THE GLOBAL MARKETPLACE

Remaining an integral part of the global economy is vital to long-term national security and the future of both the Utah and U.S. coal economy. Energy security can be realized through support of fair access to the global marketplace, ensuring obtainable standards are set and followed for transportation development at the state and federal level, and investing in infrastructure that connects Utah to key export points.

DEVELOP PUBLIC SUPPORT TO OPERATE COAL PRODUCTION

A significant challenge facing the coal industry is how to maintain and enhance its social license to operate. It is no longer sufficient for a mineral development effort to merely obtain the necessary permits before commencing operations. Community acceptance has become a critical component of successful development. Building awareness and understanding of the value the industry provides to the overall energy ecosystem may help with the development of a richer knowledge of the important role coal, minerals development, and the mining industry play in our society. Utah will continue assisting in this effort by improving overall information on our energy systems and how changes in the system can impact individuals and businesses. Building on planning and policy, Utah can also lead in defining robust energy priorities and solutions.

EXPAND ONGOING RESEARCH, DEVELOPMENT AND DEPLOYMENT OF ADVANCED COAL TECHNOLOGIES

Coal supports Utah's high quality of life and top-rated economy. State and federal policies that advance responsible coal development play an important role in sustainable resource development and the deployment of new coal technology. Supporting research on a broad array of promising advanced energy systems, including those that utilize coal, contributes to energy system security, resiliency, and sustainability. Additionally, the potential to develop new markets in carbon fiber, carbon black, resins and other molecular-based products that could repurpose Utah coal provide further opportunities for coal utilization. Research initiatives can be actively supported and pursued by the State's research universities and USTAR.

KEY RECOMMENDATIONS

1. Participate in the development of effective state and national coal policy that provides a stable regulatory structure for the leasing, transport and use of coal in the electric power and industrial sectors.

2. Promote policies that (1) advance research, development and deployment of new technologies that improve efficiency and environmental sustainability, (2) advance improved coal combustion systems, and (3) support domestic energy production and manufacturing.

3. Meet the state's future energy demands through a balanced energy portfolio in a market-driven, cost-effective, and environmentally-responsible way.

4. Ensure Utah's continued economic development through access to our own high-quality coal resources in the most efficient and responsible manner possible.

5. Expand opportunities for Utah to export fuels, electricity, and technologies to regional and global markets through collaboration with private sector companies and other local and federal governments.

6. Enhance and further develop partnerships between industry, universities, state government, and local communities — especially those in coal-rich rural communities — to address future energy challenges and opportunities.

7. Coordinate with other western regional states to present a unified voice to federal regulatory agencies on energy and public land issues.

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Advancing Utah's Energy Future