Chapter 5

ENERGY

Key issues facing Utah's energy

Chapter Summary *by BRIAN STEED*

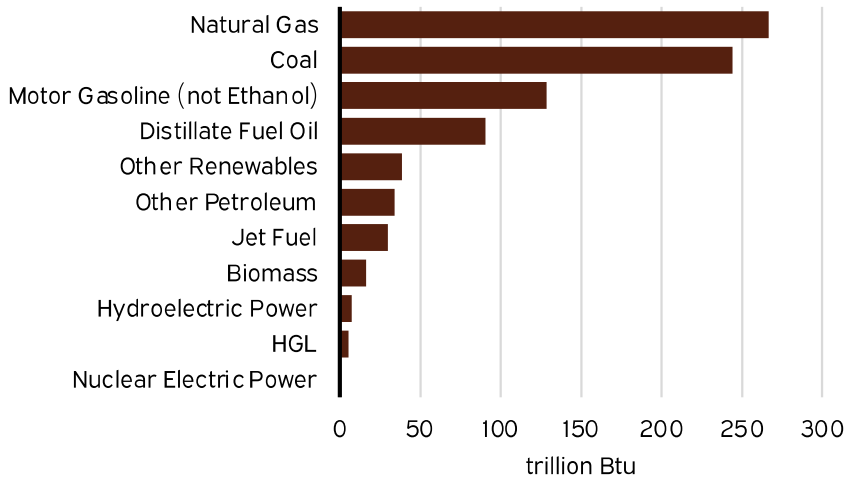
Utah law specifies that "It is the policy of the state that Utah shall have adequate, reliable, affordable, sustainable, and clean energy sources" (Utah State Code 79-6-301). Meeting each of these attributes is challenging. The pursuit of adequate, reliable and affordable energy sources has led to a reliance on carbon-intensive energy production. Indeed, according to the federal Energy Information Administration, 53% of Utah's electricity production came from coal-fired power plants in 2022. An additional 26% came from natural gas fired power in that same time frame. These sources, however, are frequently criticized as neither sustainable nor clean.

Utah has also seen a recent surge in wind and solar electricity generation, which are often held up as more clean, sustainable, and increasingly affordable. But these sources also have limitations in that they struggle at providing base-load power, calling into question their adequacy and reliability. Hence, Utah is seeking alternatives.

In 2023, Rocky Mountain Power indicated its intent to develop adequate, reliable, and carbon-free energy from nuclear sources. Plans are still in the works to identify how affordable and sustainable these efforts might be. Other sources such and geothermal and hydrogen are showing real promise to further meet the state's energy needs, but they are largely still in the development phase.

Energy will truly prove to be the challenge of our day, which highlights the necessity for quality research and innovative approaches. In the following sections, we highlight some of the insights of researchers at USU in the energy space.

Figure 5.1.1 Utah's energy sources (2020)



Source: *U.S. Energy Information Administration*

PLANNING *by BRIAN STEED*

5.A A team to chart Utah's energy future

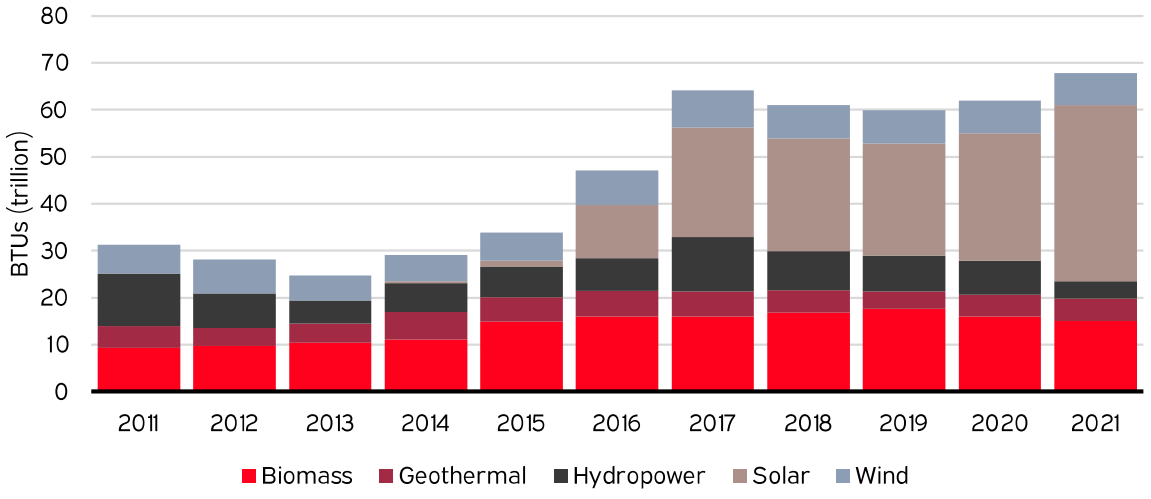
TAKEAWAY» **The Energy Strike Team's collaborative efforts are shaping a sustainable and diverse energy future for Utah, addressing critical issues from resource diversification to workforce development.**

The Energy Strike Team, a collaborative effort initiated by the Governor's Office of Energy Development in response to HB 426, has been diligently working towards shaping Utah's energy landscape. The primary objective of this task force is to align the state's energy policy with the goals of ensuring an energy supply that is adequate, reliable, affordable, sustainable, and clean.

One of the key focal points of discussion within the Energy Strike Team pertains to diversifying Utah's energy portfolio. Currently heavily reliant on fossil fuels, including coal and gas, Utah possesses ample resources to broaden its energy mix. The team grapples with questions about the right balance and how to harness the full potential of diverse energy sources, such as nuclear, geothermal, wind, and solar, while considering affordability and regional resource advantages.

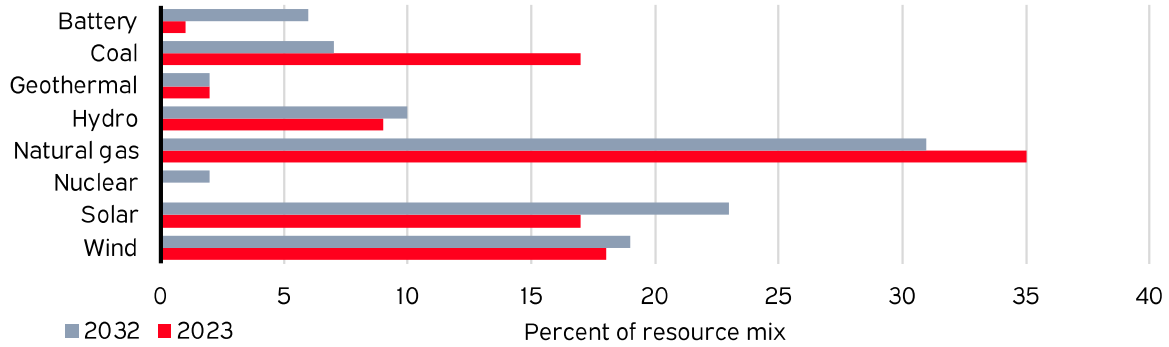
Moreover, energy storage has emerged as a critical concern, prompting discussions about policy reforms, state code amendments, and grid modernization. The team endeavors to explore how to meet these storage needs effectively. Workforce development is another vital area under scrutiny. The team examines

Figure 5.A.1 Utah renewable energy consumption by source (2011–2021)



Source: *United States Energy Information Administration*

Figure 5.A.2 Utah renewable energy consumption by source compared with future projections (2011–2021)



Source: *Western Electricity Coordinating Council*

how to cultivate a skilled workforce for the evolving energy sector and considers the role of educational institutions in this endeavor.

Natural resource exploration in Utah, including uranium for nuclear fuel and critical minerals for energy storage and technology, is also on the agenda. The team seeks ways to harness these resources responsibly and keep the associated jobs within the state of Utah.

Furthermore, the Energy Strike Team addresses the unique challenges faced by rural communities and tribal areas, striving to ensure equitable access to energy and economic opportunities.

The overarching goal is to create a sustainable, economically viable, and environmentally friendly energy future for Utah, all while accommodating a rapidly growing population. The team also aims to enhance the capabilities of the San Rafael Energy Research Center to support these ambitious objectives. Through these deliberations and collaborative efforts, the Energy Strike Team envisions a brighter and cleaner energy future for the state of Utah.

TESLA SUPERCHARGER STATION | BOX ELDER COUNTY

SOLAR ENERGY *by SARAH KLAIN*

5.B Charged perspectives on solar projects in Utah

TAKEAWAY» **Managing the political hot potato of expanding solar PV projects on Utah farms can be improved by understanding growers' opinions, particularly related to fair water policy.**

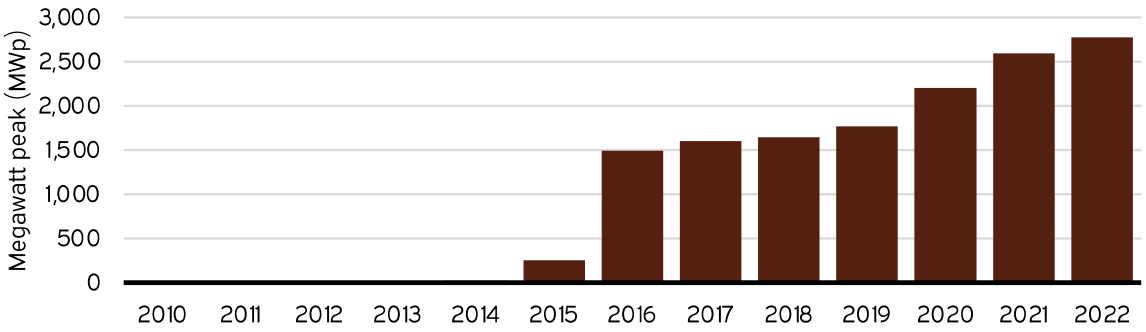
Transitioning to clean energy could help to improve Utah's air quality, but the transition depends on the extent to which individuals and communities accommodate clean energy technologies like solar photovoltaics. An efficient way of scaling up the use of solar energy is to build solar farms on agricultural land. In addition to clean energy, this could offer other benefits to Utah's people and environment—converting water intensive cropland to solar panels could reduce water consumption while generating steady lease income to landowners.

Inevitably, reducing agricultural water use involves trade-offs. New research is investigating conditions that may support or inhibit farmers from converting traditional farmland to solar farms, including concerns about losing future water rights. Interviews and surveys of growers will be able to identify other economic, environmental, cultural heritage and aesthetic considerations at play.

For example, is partial conversion of agricultural fields to solar panel fields more appealing to farmers than other methods of reducing water use? More broadly, this research identifies roles that growers see for themselves in processes for co-developing water conservation policies and managing solar energy development.

RURAL SOLAR FARM | CARBON COUNTY

Figure 5.B.1 Grid-connected solar photovoltaic capacity in Utah (2010–2022)



Source: *Solar Energy Industries Association*

ONE WAY OF SCALING UP THE USE OF SOLAR PHOTOVOLTAICS IS TO BUILD SOLAR FARMS ON AGRICULTURAL LAND. INEVITABLY, IT INVOLVES TRADE-OFFS.

Table 5.C.1 Utah Community Renewable Energy Program Participants

ANCHORS	PARTICIPANTS
Town of Castle Valley	Alta
Grand County	Coalville
Millcreek	Emigration Canyon Township
Moab	Cottonwood Heights
Park City	Francis
Salt Lake City	Holladay
Summit County	Kearns
	Oakley
	Ogden
	Salt Lake County
	Springdale

COMMUNITY ENERGY *by ROSLYNN MCCANN and EDWIN STAFFORD*

5.C Benefits and barriers to moving toward net-100% renewable electricity

TAKEAWAY» **With a coalition of Utah communities committed to moving to net-100% renewable electricity by 2030, USU researchers are examining barriers and finding opportunities in the strategy.**

Working independently of state goals, 18 Utah communities are voluntarily engaged in the Community Renewable Energy Program (CREP), representing about 25% of Utah's electricity demand. The program is an effort to achieve net-100% renewable electricity by 2030 and is the first of its kind in the nation. While communities participating in the program will not run completely on clean energy by the deadline, their efforts are projected to build enough new renewable sources across Rocky Mountain Power's system to offset participants' total annual electricity demand. The program creates a market-based motivation for renewable development by leveraging a large block of customers to work with their monopoly utility to meet renewable demand at a manageable price.

Researchers investigated how Salt Lake City, Park City, and Moab enacted net-100% renewable electricity resolutions, prompting the Utah Legislature to pass the Community Renewable Energy Act of 2019, which established an avenue for communities and Rocky Mountain Power to create the program. Twenty-three communities in Utah took the first step, but five have since dropped out of the program, concerned with administrative costs, impacts on electricity rates (communities are currently negotiating the program's rates with Rocky Mountain Power), and plans by Rocky Mountain to develop renewable energy sources independently of the program.

Wind and solar are among today's most cost-effective electricity sources, especially as issues of base load and energy storage continue to be addressed. In addition to creating better air quality in the state, renewable energy offers price stability while taking virtually no water from drought-prone systems and helping to mitigate climate change. This research is an important step into uncovering why some groups left the program and articulating lessons learned for ways communities and utilities can better collaborate to pursue net-100% renewable electricity.

THE COMMUNITY RENEWABLE ENERGY PROGRAM REPRESENTS ABOUT 25% OF UTAH'S ELECTRICITY DEMAND.

***LEFT:** WIND TURBINES | SPANISH FORK CANYON | UTAH COUNTY*

ENERGY & TRANSPORTATION *by REGAN ZANE*

5.D Creating a strategy for smart electrified transportation in Utah

TAKEAWAY» **Freight transport creates significant challenges to moving more fully to electrified vehicles. Advances in batteries and charging infrastructure can help address these problems.**

Vehicles drive the national economy, transporting more than 11 billion tons of freight and traveling more than three trillion miles annually. However, transportation is also the single largest contributor to emissions and air pollution. Electrification can support cleaner air and reduce costs, but vehicle costs and infrastructure are significant barriers to widespread adoption.

While electric vehicles (EVs) represent just over 1% of all registered vehicles in Utah today, their annual growth rate now exceeds 50%, and estimates predict more than 500,000 EVs in the state by 2035. The need for fast charging ports in the state is expected to grow from approximately 300 today to more than 2,000 in that same time frame. An even larger challenge is addressing zero-emission solutions for the 1.5 million light trucks and 100,000 heavy trucks in the state. A battery-powered electric semi-truck with a 500-mile range would require batteries that weigh over 20,000 pounds and cost over $150,000.

With this in mind, the ASPIRE Center at USU is developing and deploying advanced technologies to minimize vehicle battery size while maximizing electric utility and charging infrastructure utilization. ASPIRE is a National Science Foundation Engineering Research Center headquartered at USU that has received more than $100 million in commitments for research projects and pilot demonstrations. Pilots of technologies from ASPIRE and its partners are being deployed over the next two years in Utah, Indiana, Florida, and Michigan, and have gained national and international attention in public media.

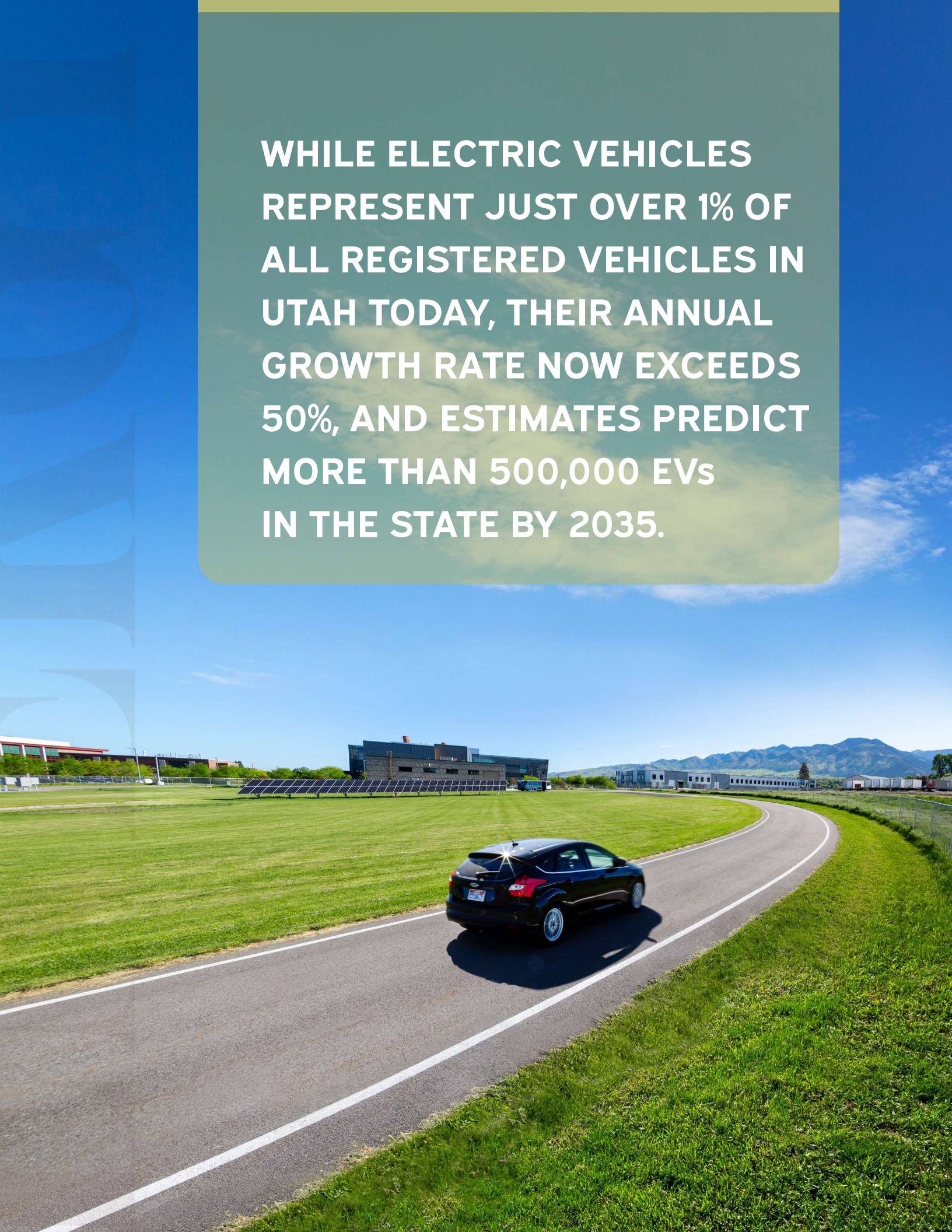
Deployments in Utah include AI-based smart-charge management, in-road dynamic wireless charging for port vehicles, and a one-megawatt wireless power charging system for semi-trucks to be deployed at USU's Electric Vehicle and Roadway (EVR) research facility and at the Utah Inland Port in Salt Lake City. The system will provide valuable data and experience for further electrification planning development on Utah's I-15 corridor and other future projects.

ASPIRE has been designated as the lead research institution in Utah for strategic planning around electrified transportation. In this role, ASPIRE will coordinate across state agencies, communities, and industry sectors in developing a unified electrified transportation plan and in pursuing resources and policies to implement the plan. In a related project funded by the U.S. Department of Energy, ASPIRE is also developing an urban multi-modal freight corridor electrification plan for Utah together with more than 20 partners, including the state's leading utility and transit agency, national labs, and key state government agencies.

ASPIRE's long-term goals are designed to bring society to the tipping point of electrified transportation, where primary barriers are addressed and sufficient momentum and funding are present to carry the transformations forward with continued innovation.

RIGHT: *ELECTRIC VEHICLE TESTING ON TRACK AT USU ELECTRIC VEHICLE AND ROADWAY RESEARCH FACILITY (ASPIRE)*

WHILE ELECTRIC VEHICLES REPRESENT JUST OVER 1% OF ALL REGISTERED VEHICLES IN UTAH TODAY, THEIR ANNUAL GROWTH RATE NOW EXCEEDS 50%, AND ESTIMATES PREDICT MORE THAN 500,000 EVs IN THE STATE BY 2035.



RENEWABLE ENERGY *by JEFF TAYLOR, PHILLIP FERNBERG, and JAMIE BUTIKOFER*

5.E A clean, secure energy transition needs Utah's critical minerals

TAKEAWAY» **Mineral extraction and clean energy development require striking a delicate balance.**

Utah is uniquely positioned to play an outsized role in supplying critical minerals for the United States' ongoing clean energy transition. Last year, Utah's non-fuel mineral production was valued at over $3.6 billion, up 16% from 2020[5.E.1]. Over the coming decades, Utah will receive more attention as rising demand and renewed efforts to secure U.S. supply chains elevate the importance of the state's critical minerals.

At least 38 of the 50 critical minerals designated by the U.S. Geological Survey are found in Utah, including many needed for renewable energy technologies. Lithium and magnesium extracted from Great Salt Lake salt brines are critical for rechargeable batteries used in electric vehicles. Tellurium from the Bingham Canyon Mine is used in solar cells. Vanadium from Southeast Utah could be used for grid-scale energy storage, and thorium from the same region is used for nuclear power. Monazite deposits throughout Utah contain rare-earth elements needed for permanent magnets in wind turbines. By 2040, global demand for critical minerals used in clean energy technologies is projected to quadruple[5.E.2]. Managing growing demand will require careful planning to ensure high industry standards, address market fluctuations, and balance sustainable extraction in sensitive areas.

While demand increases, so do efforts to reduce U.S. dependence on foreign mineral sources. Utah could play a key role in securing domestic supply chains for renewable energy development. For more than a decade, Utah has been a top-ten state for non-fuel mineral production. Utah is currently one of two states with commercial lithium production and the only state producing beryllium, magnesium, and indium. Utah also produces or has produced other minerals with energy impact, including copper, zinc, antimony, molybdenum, gallium, germanium, and uranium.

Table 5.E.1 Critical minerals currently produced in Utah

COMMODITY	ELEMENT SYMBOL	TOP GLOBAL PRODUCER	NOTABLE UTAH LOCATIONS
Beryllium	Be	United States (UT)	Juab Co.
Helium	He	United States	Grand, Emery, San Juan Co.
Magnesium metal	Mg	China	Great Salt Lake
Potash	K (KCl, K2, SO4)	Canada	Great Salt Lake, Tooele Co. (Bonneville Salt Flats), Grand and San Juan Co. (Paradox Basin), Millard Co. (Sevier Lake)
Platinum and Palladium	Pt, Pd	South Africa, Russia	Salt Lake Co. (Bingham mine)
Rhenium	Re	Chile	Salt Lake Co. (Bingham mine)

Table 5.E.2 Established critical mineral resources in Utah

COMMODITY	ELEMENT SYMBOL	TOP GLOBAL PRODUCER	NOTABLE UTAH LOCATIONS
Aluminum	Al	Australia (bauxite)	Beaver Co.
Fluorspar	F(CaF2)	China	Juab Co.
Indium	In	China	Juab Co.
Lithium	Li	Australia	Great Salt Lake, Grand and San Juan Co. (Paradox Basin)
Uranium	U	Kazakhstan	San Juan, Grand, and Emery Co.
Vanadium	V	China	San Juan, Grand, and Emery Co.

Source: *Utah Geological Survey*

KENNECOTT COPPER MINE | SALT LAKE COUNTY

MINING & ENERGY *by JOHN BAZA, Utah Division of Oil, Gas and Mining*

5.F Extractive industries and Utah's economy

TAKEAWAY» **Utah's extractive industries encompass a wide range of raw material extraction processes, presenting challenges in quantifying their overall economic impact. At the same time, they play a significant role in the state's economy.**

The term "extractive industries" broadly refers to companies or individuals involved in the extraction of energy resources and mineral materials from the earth, which are utilized by consumers globally. These resources include crude oil, natural gas, coal, metals, salts, chemicals, strategic and critical minerals, fuel minerals like uranium and vanadium, as well as construction materials such as stone and rock.

In the United States, these raw products are subject to free market business transactions, with some being traded in futures contracts on national commodity exchanges. These resources and materials, which play a role in maintaining a certain standard of living, possess intrinsic value to the public and economic value that drives businesses to invest in and profit from their conversion into usable products. It's worth noting that even agricultural commodities rely on mineral fertilizers, chemicals for crop cultivation, metals for machinery fabrication, and refined petroleum and hydrocarbons for power generation.

In the state of Utah, there exists a substantial economic presence in the petroleum and mining extractive industries. It is important to acknowledge that both of these industries consist of three key components:

1. An upstream sector that involves the extraction of raw materials from the ground.
2. A midstream sector responsible for transporting these raw materials to processing facilities.
3. A downstream sector focused on processing or refining raw materials into consumable products that are then distributed to end-users.

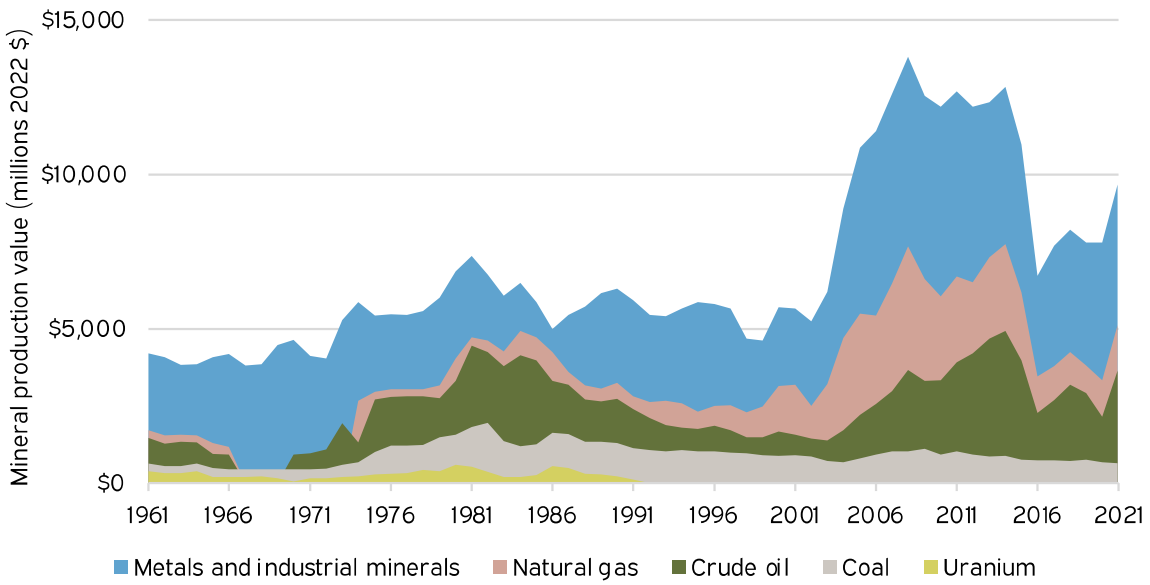
However, it is challenging to locate comprehensive studies that accurately represent the economic impact of all three operational sectors. Some studies aggregate economic value from both upstream and downstream sectors while disregarding the financial contributions of the midstream sector. Additionally, other reports may depict the benefits of tax and royalty revenue to the government based on wellhead or market values of produced commodities, without considering the value-added contributions from midstream transportation or downstream processing.

It is indeed a complex task to correlate the total economic value of all operational sectors, whether collectively or individually. The operational sectors associated with Utah's petroleum and mining industries can potentially contribute billions of dollars annually to the state's economy, possibly accounting for a significant portion of the yearly gross product, estimated at around 10-15%.

UTAH'S PETROLEUM AND MINING CAN CONTRIBUTE BILLIONS OF DOLLARS ANNUALLY TO THE STATE'S ECONOMY.

PHOSPHATE ORE MINE | UINTA COUNTY

Figure 5.F.1 Annual value of Utah energy and mineral production, inflation adjusted to 2022 dollars (1960–2022)



Source: *Utah Geological Survey; U.S. Geological Survey; Utah Division of Oil, Gas and Mining; U.S. Energy Information Administration; Utah Tax Commission.*

UTAH ENERGY *in the news*

As we've tracked Utah and national news through 2023, we have compiled some of the key energy issues and topics that have appeared in media outlets this year.

01. UTAH'S ENERGY TRANSITION

Utah's energy landscape is evolving in 2023, spurred by various factors. Calls for action, tax credits, and climate change concerns are driving the shift to cleaner energy sources. Public support for renewable energy, conservation efforts, and reduced emissions are evident across the Western U.S. Companies, along with government initiatives, are shaping this transition, presenting both environmental and economic opportunities for the state.

02. ALTERNATIVE ENERGY ADVANCES

Utah is diversifying its energy landscape with nuclear technology, hydrogen blending, and geothermal projects. Some policymakers see nuclear power as a grid-stabilizing solution. The state is exploring aquifer thermal energy and solar energy on public lands. Grid-forming inverters show promise, while drought impacted hydropower.

03. UINTA BASIN RAILROAD PROJECT

The Uinta Basin Railroad project has faced setbacks as the U.S. Court of Appeals rejected the Surface Transportation Board's approval, citing environmental and financial concerns. The project is currently paused, pending a potential restart of the environmental review or a petition to the U.S. Supreme Court by its developers.

04. FEDERAL LAND DESIGNATION IN ARIZONA

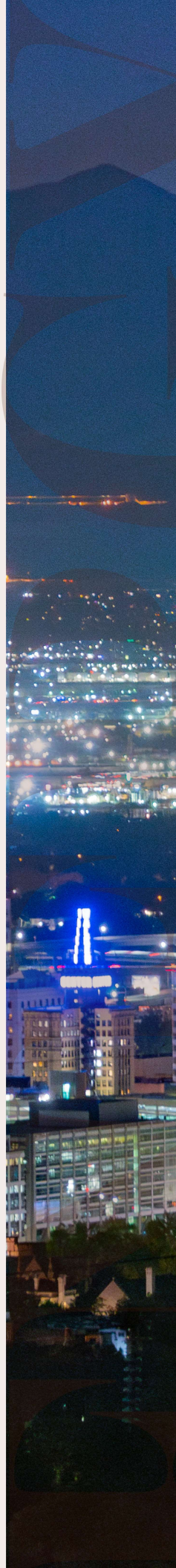
The Baaj Nwaavjo I'tah Kukveni Grand Canyon National Monument proposal in Arizona sparked controversy. While aimed at safeguarding sacred areas and limiting mining, Utah leaders objected, and Arizona Senate Republicans plan to sue over potential uranium mining restrictions. The monument grants tribes co-stewardship but raises the debate over conservation versus resource access.

05. UTAH OIL, GAS, AND COAL

Utah's traditional energy sector is marked by efforts to reduce waste and environmental impacts. Calls for capturing lost natural gas, cleaning up abandoned wells, and highlighting the climate harm of gas leaks impacted the oil and gas industry. Coal mining is declining, with Carbon County seeing its first coal-free period, raising questions about job losses. Additionally, concerns over coal-related pollution persist, as evidenced by coal ash dumping sites and emissions regulations. The state's energy future is closely tied to the transition from coal to cleaner alternatives.

What's going on in Utah's land, water and air?

We publish a weekly email newsletter, containing a categorized roundup of about 30 stories in local and national media outlets related to Utah's land, water, and air. Subscribe at: **usu.edu/ilwa/newsletter**.



CHAPTER 5 REFERENCES

5.C.1 Reed, J. (2022, June 16). 18 Utah communities sign on to ambitious renewable energy pact. *KUER.org*. https://www.kuer.org/business-economy/2022-06-16/18-utah-communities-sign-on-to-ambitious-renewable-energy-pact

5.C.2 Fitzpatrick, T. (2022, June 15). See which Utah communities are taking the lead on clean electricity. *The Salt Lake Tribune*. https://www.sltrib.com/renewable-energy/2022/06/15/see-which-utah/

5.C.3 Utah Renewable Communities. (2020). *Utah 100 Communities*. https://www.utahrenewablecommunities.org/

5.D.1 ASPIRE. (2023). *Advancing Sustainability through Powered Infrastructure for Roadway Electrification (ASPIRE): About-Overview*. https://aspire.usu.edu/about/overview/

5.E.1 United States Geological Survey. (2023). *Mineral Commodities Summaries 2023*. Report. https://doi.org/10.3133/mcs2023

5.E.2 United States Department of Energy Office of Fossil Energy and Carbon Management. (2022). *Producing Domestic Sources of Critical Minerals to Support a Clean Energy Economy*. https://www.energy.gov/fecm/articles/producing-domestic-sources-critical-minerals-support-clean-energy-economy

5.F.1 Utah State Tax Commission. (2022). *Revenue Summary, Final Fiscal Year 2021-2022, a summary of various state taxes collected, including Oil and Gas Severance Tax and Mining Severance Tax*. Retrieved September 27, 2023. https://tax.utah.gov/esu/revenuereports/2022-revenue-summary.pdf

5.F.2 McCarty, T., Wang, Z., Kim, M.K., and Evans J. (2022). The Economic Contribution of Utah's Energy and Mining Industries: Miscellaneous Publication 176. *Utah Department of Natural Resources Utah Geological Survey and Utah State University*. https://ugspub.nr.utah.gov/publications/misc_pubs/mp-176.pdf

5.F.3 PricewaterhouseCoopers. (2023). The Economic Contribution of Utah's Petroleum Industry: 2020-2024. *Utah Petroleum Association*. https://utahpetroleum.org/wp-content/uploads/2023/04/UPA-Economic-and-Fiscal-Impact-Final-Report_04112023.pdf

5.F.4 Utah Department of Natural Resources Division of Oil, Gas, and Mining. (2023). *Statistics*. https://oilgas.utah.gov/statistics.php

LEFT: *SALT LAKE CITY AT NIGHT | SALT LAKE COUNTY*