

UTAH MINING 2023

Metals, Industrial Minerals, Uranium, Coal, and Unconventional Fuels

by Andrew Rupke, Stephanie E. Mills, Michael D. Vanden Berg, and Taylor Boden



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UTAH GEOLOGICAL SURVEY
UTAH DEPARTMENT OF NATURAL RESOURCES
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Cover Photo: *View from the Mammoth mine headframe looking west over Tintic Valley. Photo by Jim McVey.*

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INTRODUCTION

2023 Utah Mining Industry Summary

The estimated combined value of Utah's extractive resource production in 2023 totaled approximately \$10.1 billion, including production of metals and industrial minerals (\$4.0 billion), natural gas and natural gas liquids (\$2.1 billion), crude oil (\$3.8 billion), and coal (\$314 million) (Figure 1). Utah's diverse mining industry (metals, industrial minerals, and coal) accounted for \$4.3 billion (42%) of total extractive resource production, a significant decrease of \$531 million from the 2022 revised value (nominal dollars) and lower than peak values reached in 2011 (\$5.3 billion, nominal dollars). Mining activities in Utah currently produce base metals, precious metals, industrial minerals, and coal (Figure 2). Base metal production contributed \$1.9 billion and included copper, beryllium, molybdenum, and iron (Figure 3). Notably, copper alone accounted for 65% (\$1.4 billion) of Utah's metal production value. Precious metals produced in Utah include gold and silver, and 2023 production was valued at \$250 million (Figure 3). Precious metal production value decreased 19%

from 2022 to 2023, primarily due to less gold production, and base metal value decreased 16%, primarily due to less copper production. Industrial minerals produced in Utah include sand and gravel, crushed stone, salt, potash, cement, lime, phosphate, lithium, uintaite (Gilsonite®), clay, gypsum, and other commodities (Figure 2). The estimated value of industrial mineral production in 2023 was \$1.9 billion (Figure 3), a 4.2% increase over the revised 2022 estimate. The most valuable industrial mineral group in 2023, estimated at \$570 million, was construction material commodity group which includes sand and gravel, crushed stone, and dimension stone. The value of Utah coal production decreased 39% in 2023 to \$314 million; production was much lower in 2023, and the average price also decreased (Figure 3). Notably, Utah is the only state to produce beryllium concentrate, potassium sulfate, and uintaite (Gilsonite®); of these commodities, beryllium, was included in the U.S. Geological Survey's (USGS) 2022 list of critical minerals (U.S. Geological Survey, 2022). Lithium, also considered a critical mineral, has been produced in Utah since 2020, making Utah one of only two lithium-producing states. Throughout this report, production is designated in US short tons (t) or million short tons (Mt) unless otherwise indicated.

Value of Utah Energy and Mineral Production

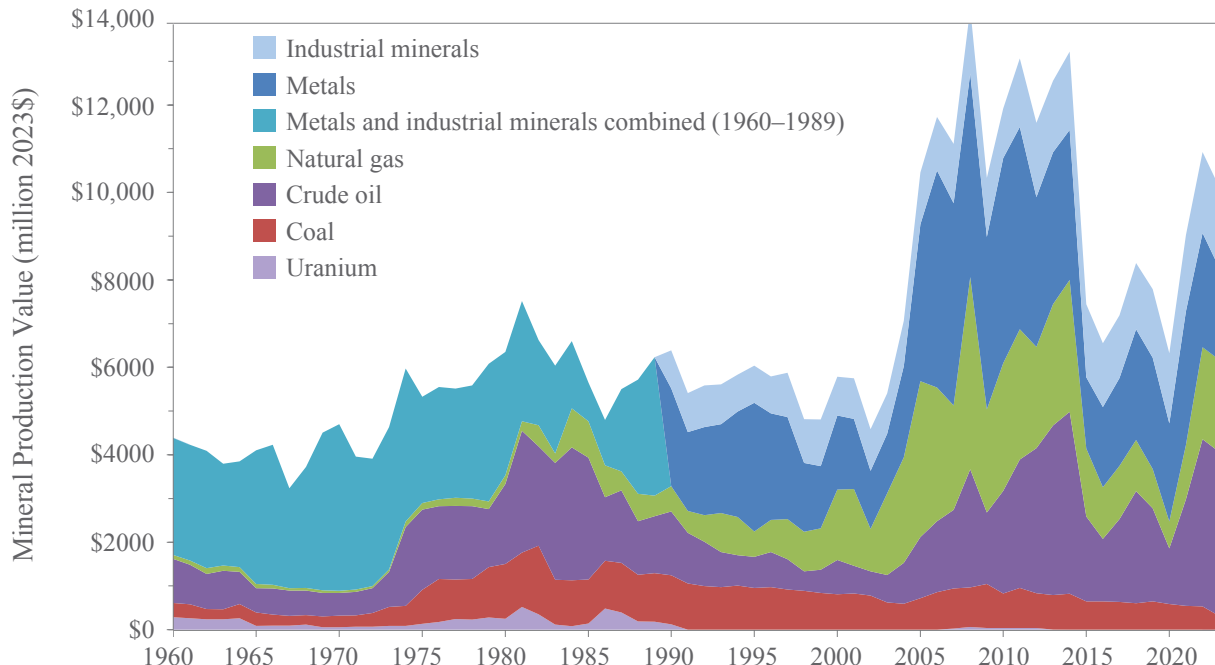


Figure 1. Annual value of Utah energy and mineral production, inflation adjusted to 2023 dollars, 1960–2023. Source: Utah Geological Survey; U.S. Geological Survey; Utah Division of Oil, Gas and Mining; U.S. Energy Information Administration; Utah Tax Commission.

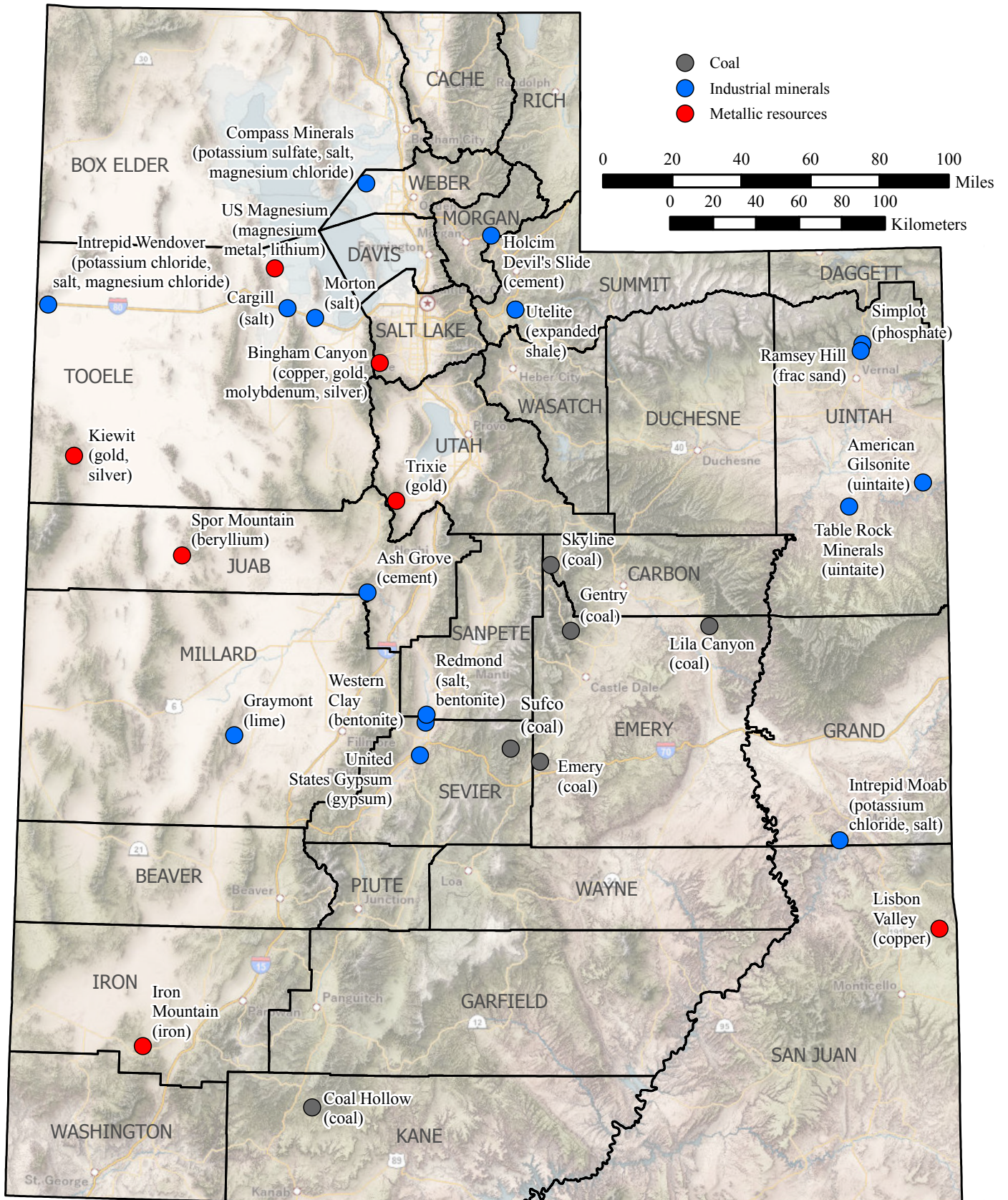


Figure 2. Select metal, industrial mineral, and coal production locations active in 2023 in Utah. Basemap provided by Utah Geospatial Resource Center (UGRC).

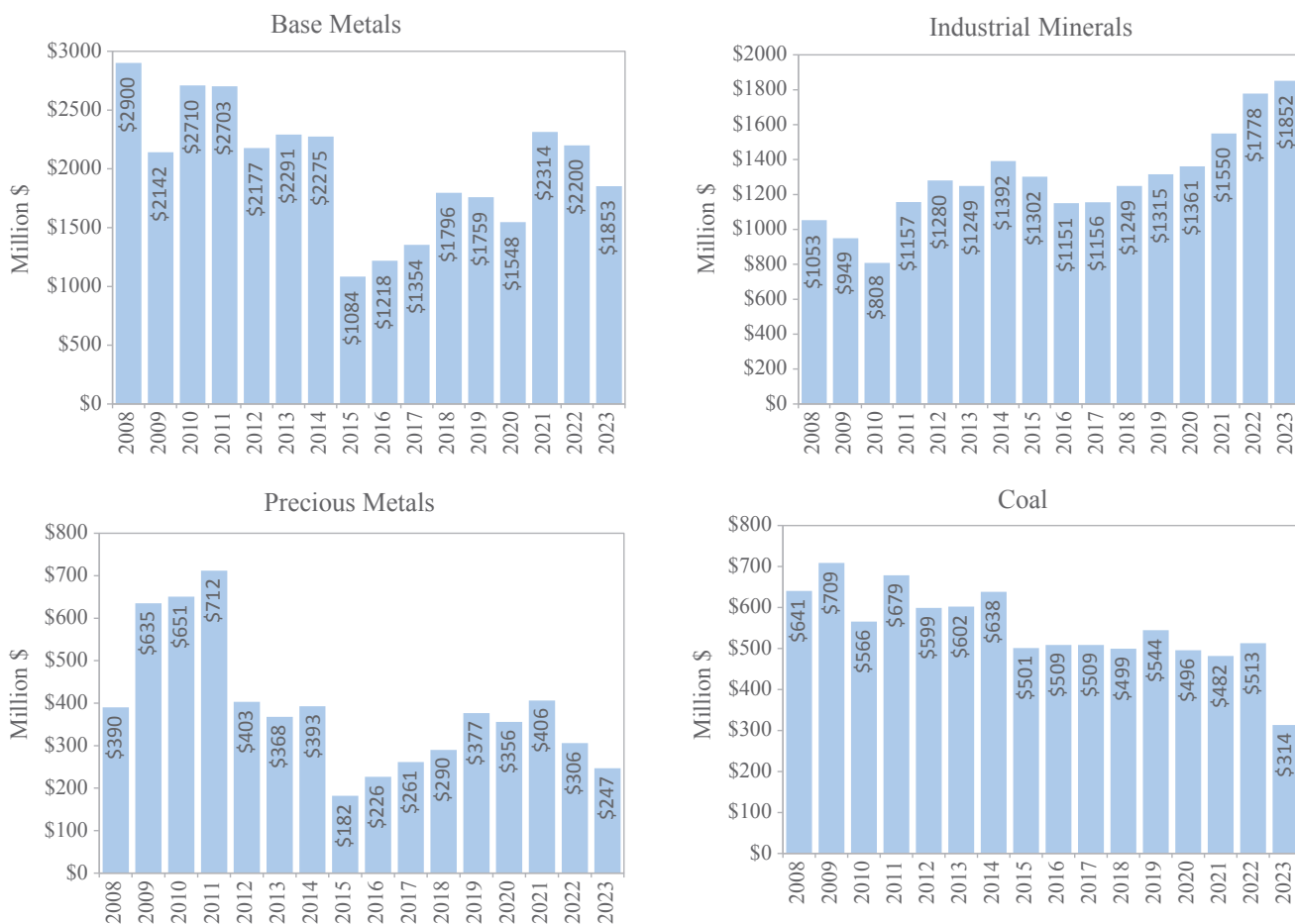


Figure 3. Annual value of Utah mineral production in nominal dollars, 2008–2023. Data source: Utah Geological Survey.

In 2023, the USGS ranked Utah as 11th nationally for production of nonfuel minerals (down three positions from 2022), which include metals and industrial minerals (Table 1). The USGS estimated Utah’s nonfuel mineral production value at \$3.1 billion (compared to the Utah Geological Survey [UGS] estimate of \$4.0 billion), which accounted for 3.0% of the U.S. total, with cement, copper, gold, potash, and salt listed as principal commodities (U.S. Geological Survey, 2024a). With the exception of 2023, Utah has ranked among the top 10 states for nonfuel mineral production for the past decade. In addition, Utah was the 14th largest coal producer of 21 coal-producing states in 2023 and accounted for 1.2% of total U.S. coal production (U.S. Energy Information Administration [EIA], 2024a).

In the 2023 Fraser Institute annual survey of mining companies, Utah was ranked as the most favorable state/nation out of 86 international jurisdictions for overall mining investment attractiveness (Table 1) (Mejía and Aliakbari, 2024). This ranking represents a significant increase from 2022 when Utah was ranked 17th out of 62 jurisdictions; this is also the first time Utah has been ranked 1st. The investment attractiveness index considers a combination of a region’s

geologic favorability (Utah ranked 3rd in this category) and the disposition of government policies toward exploration and development (Utah ranked 1st in this category). After Utah, the next four highest ranked U.S. states were Nevada, Arizona, Alaska, and Montana.

The minerals regulatory program within the Utah Division of Oil, Gas and Mining (OGM) approved six large mine permits, eight small mine permits, and fourteen exploration permits in 2023 (Table 1). The large mine permits were issued for new or expanding construction aggregate operations and one gypsum quarry (Kim Coburn, OGM, written communication, May 2024).

The Utah Trust Lands Administration (UTLA, formally SITLA), which manages about 3.4 million acres of state-owned lands in Utah, issued 43 new mineral leases in 2023, down from 74 in 2022 (Table 1). These leases were issued for the following commodities: metalliferous minerals (16), sand and gravel (12), geothermal (5), building stone (4), mineral salts (2), potash (1), clay (1), limestone (1), and volcanic material (1) (Andy Bedingfield, UTLA, written communication, March 2024).

Table 1. Utah mining rankings and statistics.

Utah mining ranking or statistic	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
USGS rank of U.S. nonfuel mineral production value (metals and industrial minerals)	7th	5th	8th	10th	8th	8th	7th	8th	7th	8th	11th
Fraser Institute annual survey of mining companies (favorability of mining jurisdiction)	15th of 112	14th of 122	9th of 109	11th of 104	15th of 91	7th of 83	14th of 76	25th of 77	11th of 84	17th of 62	1st of 86
U.S. EIA rank for coal production by state	14th	13th	14th	10th	11th	12th	11th	10th	10th	12th	14th
New OGM approved large mine permits	4	2	2	0	0	1	4	2	1	1	6
New OGM approved small mine permits	13	11	12	7	11	13	11	4	12	4	8
New OGM approved exploration permits	9	14	17	11	9	6	8	9	18	10	14
SITLA mineral leases issued	62	56	32	53	57	36	41	38	68	74	43
New BLM mining claims filed	2360	3110	975	5370	5710	5360	2280	3590	5060	8700	10,400
Total BLM mining claims (end of year)	19,500	19,800	18,500	21,500	21,900	23,000	21,600	23,100	28,000	20,400	22,100

Note: USGS = U.S. Geological Survey, EIA = U.S. Energy Information Administration, OGM = Utah Division of Oil, Gas and Mining, SITLA = Utah School and Institutional Trust Lands Administration, BLM = U.S. Bureau of Land Management

In 2023, approximately 10,400 new unpatented mining claims (based on unique serial numbers located in 2023) were filed on federal lands in Utah. In decreasing order, most of the new claims were in San Juan, Grand, Millard, Juab, and Beaver Counties, which recorded over 1300 new claims each. San Juan County was the most active for new claims and recorded more than double any other county. Much of the activity in San Juan, Grand, and Millard is likely due to ongoing interest in lithium, uranium, and vanadium, whereas Juab and Beaver Counties are traditionally targeted for base and precious metal exploration. Approximately 3500 claims were lode claims, and over 6800 were placer claims.

Contributions by the Utah mining industry to the state tax base during 2023 were significant (Figure 4). The metal, industrial mineral (non-metal), sand and gravel, and coal mining industries paid about \$75 million in property taxes in 2023 (up 12% from 2022; calendar year) and about \$14 million in mining-related severance taxes in 2023 (down 8% from 2022; state fiscal year). All extractive industries, including oil and gas, paid nearly \$135 million in federal Mineral Lease disbursements in the 2023 state fiscal year. About 1.4% of Utah's gross domestic product came from the mining industry in 2023, 1.5% if oil and gas are included. Mining employment in Utah was up about 5% from 2022 to 2023 and had a wage increase of about 5% (Figure 5).

Critical Minerals

Critical minerals are defined as those necessary for economic or national security and have a supply chain vulnerable to disruption. In 2023, five critical minerals were produced in Utah (beryllium, lithium, platinum, palladium, and tellurium) and two more remain at production-level (magnesium metal, fluorspar) meaning that production could be started (or restarted) soon. In addition to the produced and production-level critical minerals, Utah hosts known resources of six more (aluminum, indium, gallium, germanium, vanadium, and zinc) plus additional resources of lithium. More details on the produced and production-level Utah critical mineral operations are given below, and further information on the known resources can be found in Mills and Rupke (2023) and Rupke and Boden (2023).

- Beryllium: Utah is the only domestic producer of beryllium, sourced from the Spor Mountain mining district in Juab County, and is the global leader in the sector. The ore reserves at Spor Mountain are estimated to be capable of supporting average production for a minimum of 75 years (Materion, 2024).

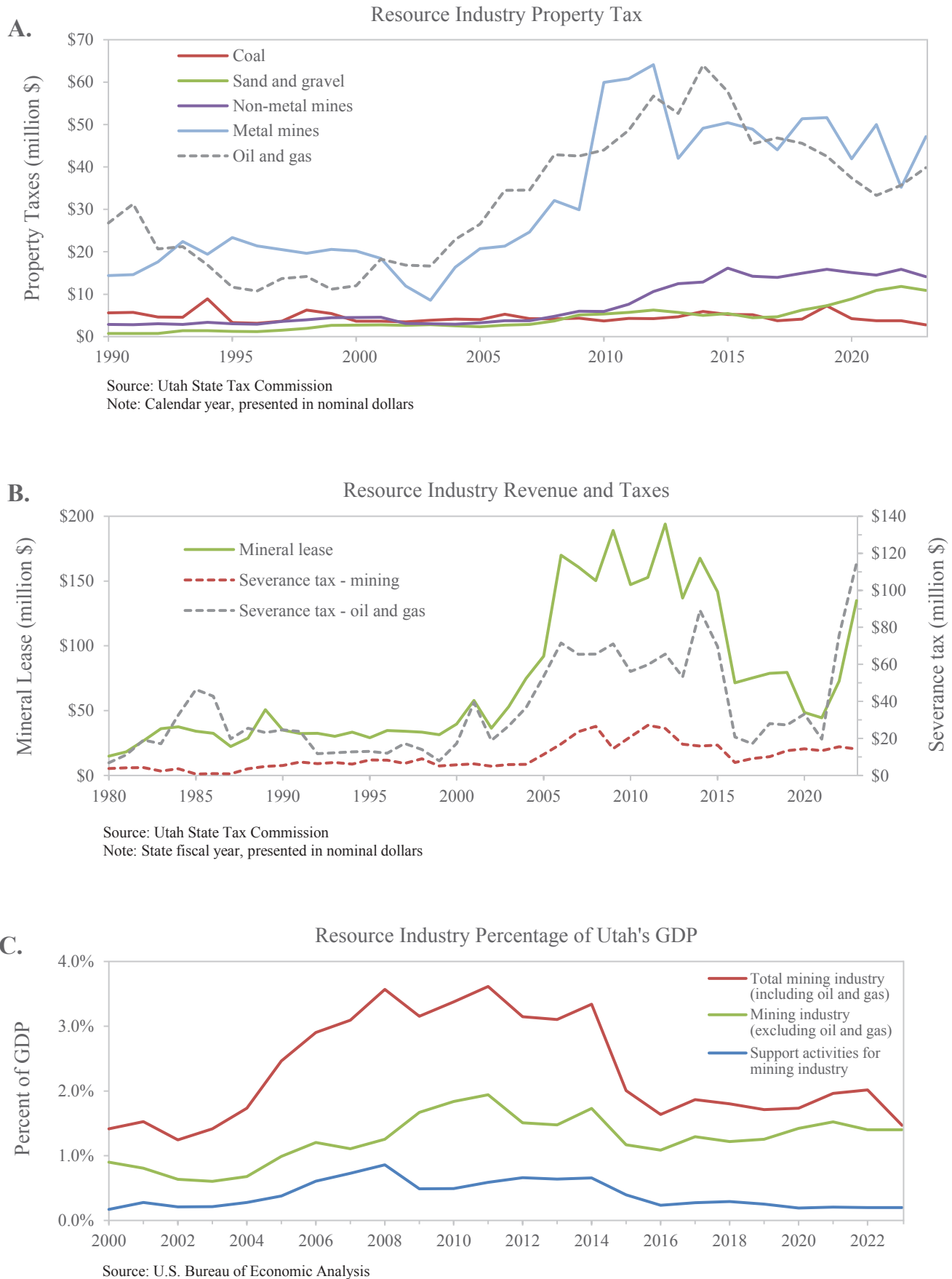


Figure 4. Utah mining economic indicators. (A) Property taxes charged against the mining industry, 1990–2023. (B) Mineral lease revenue and severance taxes, 1980–2023. (C) Percentage of Utah's gross domestic product (GDP) from mining-related activities, 2000–2023.

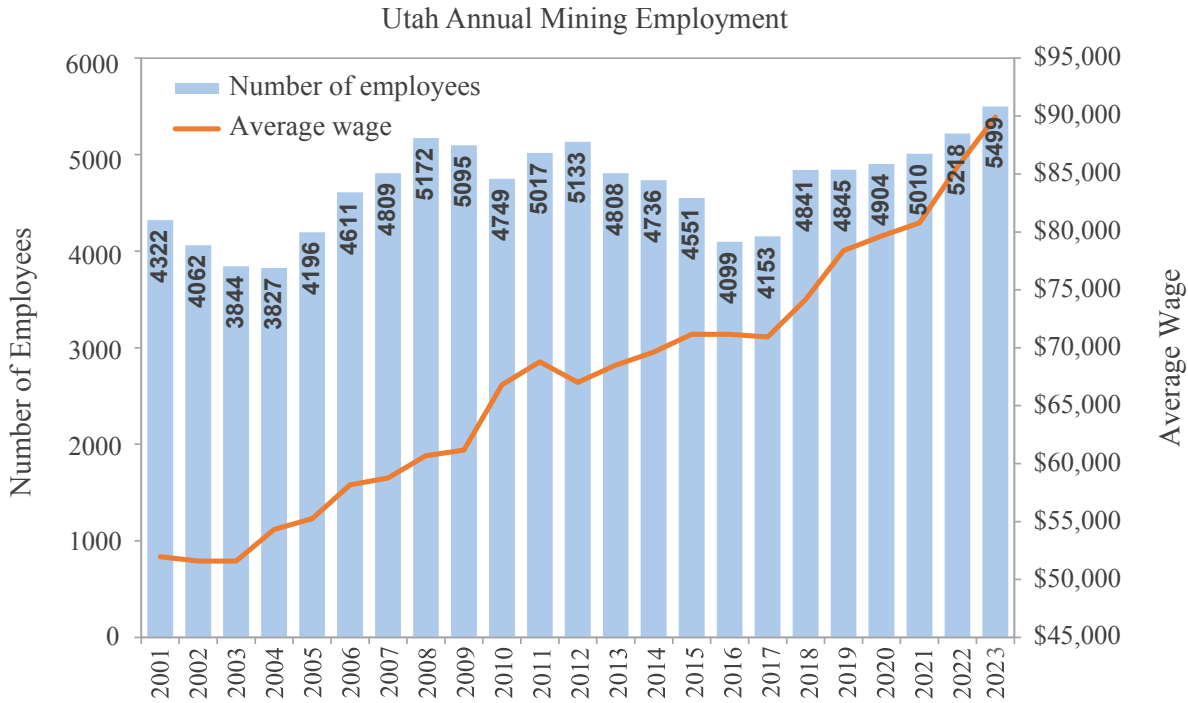


Figure 5. Average annual mining employment and salaries (in nominal dollars) in Utah. Includes metal, industrial mineral, and coal mines and facilities; excludes oil and gas. Source: Utah Department of Workforce Services.

- **Lithium:** Utah has multiple established resources of lithium but the only production has been as a byproduct of magnesium metal production from Great Salt Lake brines by US Magnesium. Lithium was first produced in Utah in 2020 and US Magnesium is working towards an annual production capacity of about 10,000 t of lithium carbonate.
- **Platinum and palladium:** Bingham Canyon, operated by Kennecott Utah Copper Company (a subsidiary of Rio Tinto), produces modest amounts of platinum and palladium as a byproduct of the precious metal refining process. The platinum and palladium are hosted in a crude selenium product and are not refined to pure elemental form.
- **Tellurium:** Tellurium is also a byproduct of the Bingham Canyon mine. A new tellurium recovery plant was built in 2021 and initial production began in May 2022. Annual capacity is designed to produce 22 t of tellurium, roughly 3% of global demand (Rio Tinto, 2023).
- **Magnesium (metal):** Utah has, in recent years, been the only domestic producer of magnesium metal, which is produced from Great Salt Lake brines via solar evaporation and electrolytic processing by US Magnesium. Since 2022, US Magnesium has experienced mechanical issues and their magnesium circuit is currently down.
- **Fluorspar:** Fluorspar (also known as fluorite) has historically been produced from the Lost Sheep mine in Juab County. The mine has been idle since the mid-2000s, but in 2020 Ares Strategic Mining began modern exploration to delineate the fluorspar resource and is currently developing a mine plan. Production is expected to begin in the near future. Once online, the Lost Sheep will be the primary domestic producer of fluorspar.

BASE AND PRECIOUS METALS

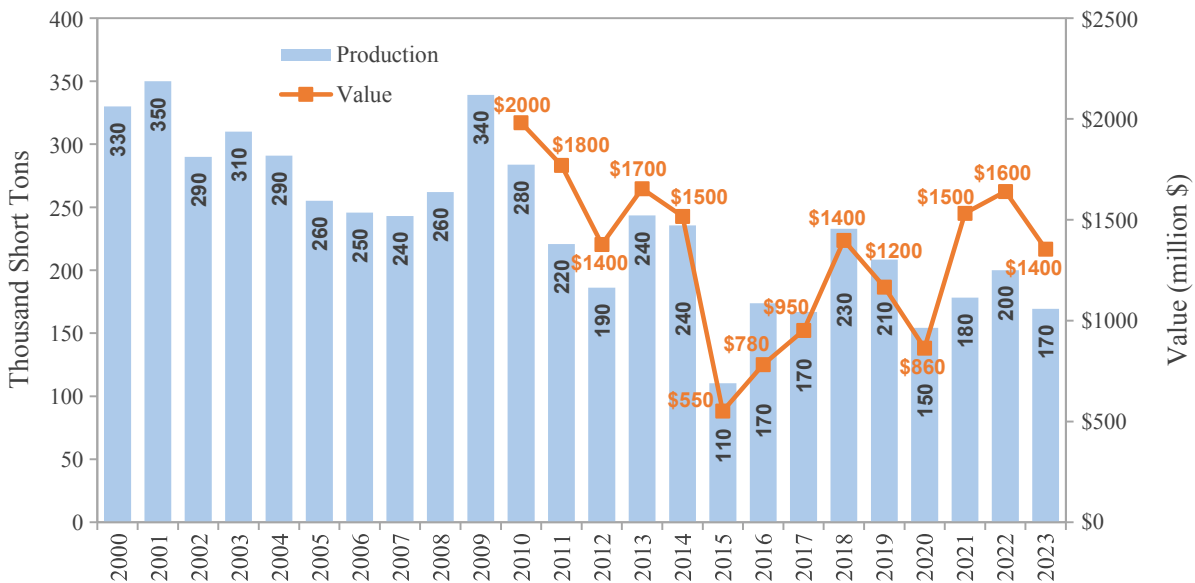
Production

Production Value Summary

Utah's total metalliferous resource production was \$2.1 billion in 2023, of which \$1.85 billion came from base metals and \$250 million came from precious metals (Figure 6). The 2023 production value represents a 16% decrease from the \$2.4 billion metalliferous resource production in 2022 and is mainly related to less production at Bingham Canyon in 2023. The price of copper also dropped slightly from 2022 to 2023, though the impact of the price decrease was somewhat offset by price increases for gold, silver, and molybdenum. Individual commodity updates are given below in order of decreasing mineral production value.

- **Copper:** In Utah, copper was produced from the Bingham Canyon mine and from the Lisbon Valley copper mine in 2023. Production at Bingham was less than in 2022 due to production challenges such as damage to the overland conveyor belt. Copper production is expected to increase modestly in 2024 as Bingham Canyon returns to full production in the open-pit and adds underground production. The price of copper is also expected to remain strong given the importance of copper to infrastructure and consumer electrification shifts.
- **Gold and silver:** Gold and silver were produced mainly by Bingham Canyon in 2023, with very minor production from the Kiewit mine. Gold was also produced from the Trixie mine in 2023, though no silver production was reported. Production of both precious metals was less in 2023 than in 2022 due to the production challenges at Bingham Canyon, which is by far the largest precious metal producer in the state. The price of both gold and silver increased in 2023 given continued geopolitical and economic uncertainty, which traditionally boost precious metal investment.

Utah Copper Production



Utah Gold Production

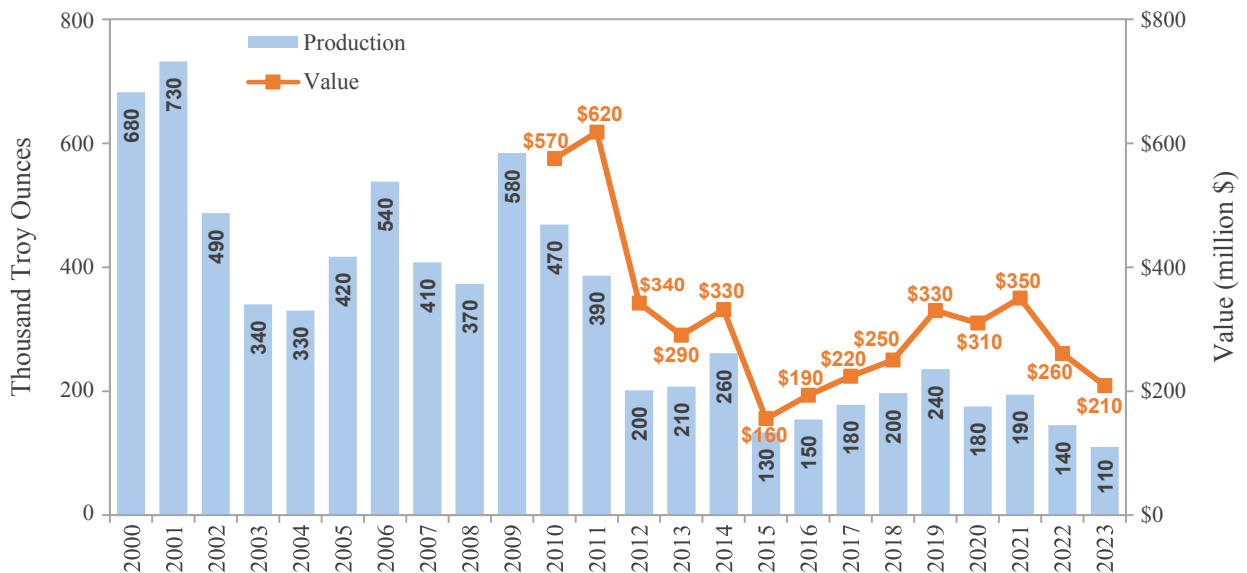


Figure 6. Production (since 2000) and value (since 2010) of select metals. Value in nominal dollars.

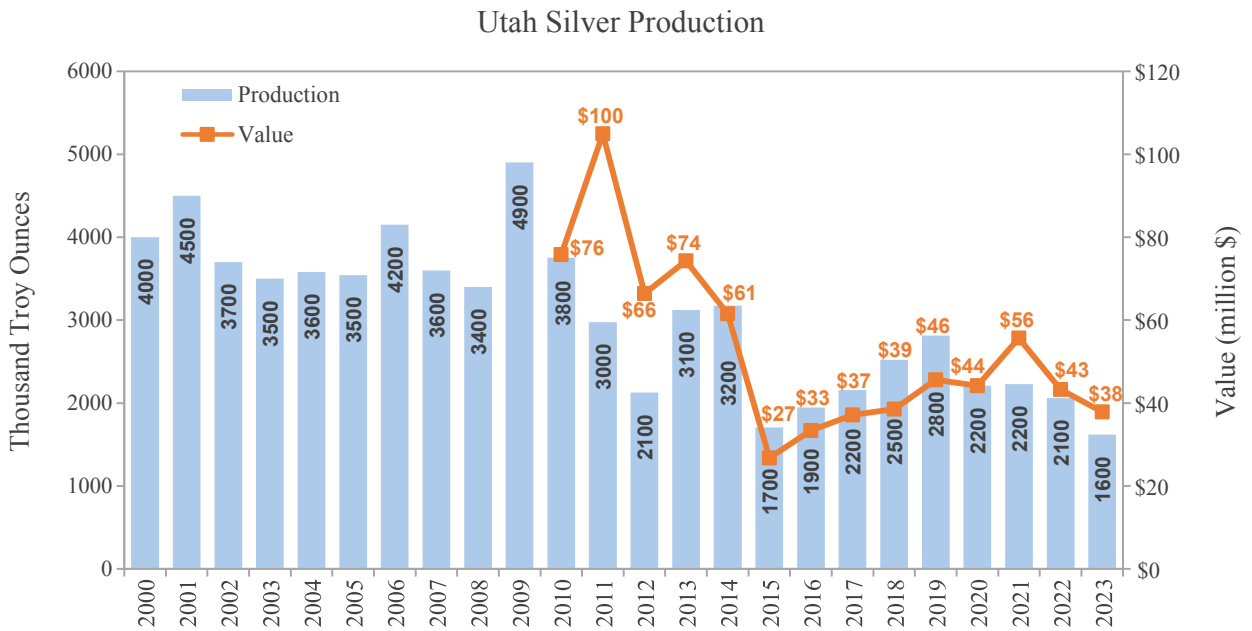
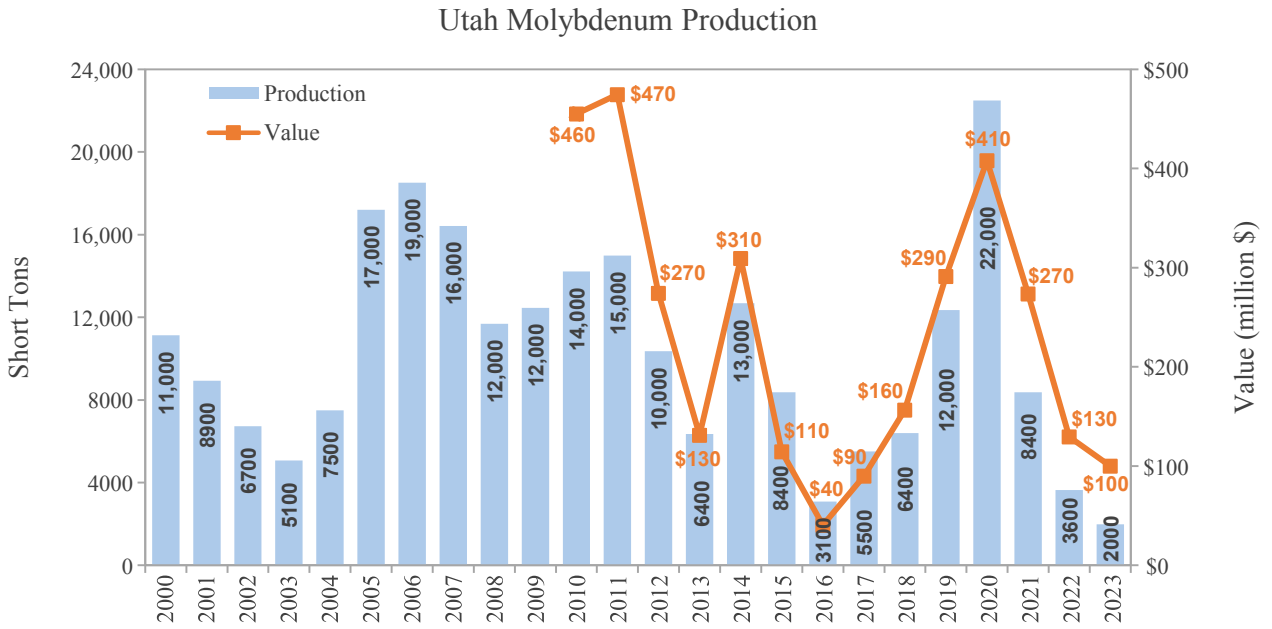


Figure 6 Continued. Production (since 2000) and value (since 2010) of select metals. Value in nominal dollars.

- **Iron ore:** Iron ore was mined at the Iron Mountain mine in Iron County during 2023. Production in 2023 was less than in 2022, however mining was consistent through 2023 with no major interruptions and is expected to continue in 2024 at similar or slightly greater levels.
- **Molybdenum:** Bingham Canyon is the only producer of molybdenum in Utah. In 2023 molybdenum production decreased substantially due to mining shifts towards higher grade copper ore. The price of molybdenum increased modestly from 2022 to 2023, partially offsetting production decrease.
- **Beryllium:** Beryllium ore is mined at the Spor Mountain mining district. Production increased modestly from 2022 to 2023, but notably the price of beryllium increased by more than twofold. The increase in price resulted in beryllium having the largest increase in production value from 2022 to 2023. The increase in price is likely due to beryllium’s use in aerospace and defense products, as well as its potential in new energy technologies.
- **Magnesium (metal):** The price of magnesium metal decreased significantly (34%) from 2022 to 2023. Since 2022, US Magnesium has experienced mechanical

difficulties with their magnesium circuit and it is currently down. When in production, magnesium metal is produced by electrolytic conversion of magnesium chloride concentrate that is produced from Great Salt Lake brines through evaporation.

Mining Operation Updates

- **Bingham Canyon:** The Bingham Canyon mine is an open-pit porphyry copper mine located west of Salt Lake City and ore is processed on site through a series of smelter and refining processes, producing copper, molybdenum, gold, and silver as well as byproducts such as platinum, palladium, lead carbonate, rhenium, and tellurium. In 2023, Bingham Canyon accounted for approximately 80% of Utah's total metalliferous mineral production value. Also in 2023, Bingham Canyon completed the largest rebuild of the smelter and refinery facilities in the operation's history, a \$300 million project which required an extended shutdown of the ore processing stream through summer and fall 2023 (Rio Tinto, 2024). A failure in the overland conveyor belt that transports ore from the pit to the concentrator also impacted mined copper production from spring to fall 2023. In June 2023 Rio Tinto announced a \$498 million investment in developing underground mining infrastructure for the North Rim Skarn, which they anticipate to start mining in 2025 and produce 250,000 tons of copper in the next ten years, supplementing open-pit mining. Underground mining at the Lower Commercial Skarn was approved in 2022 and mining commenced in 2023. Phase two of the south wall pushback, which was funded at \$1.8 billion in 2019, received an additional \$300 million in 2023 to address an area of geotechnical risk within the pit.
- **Lisbon Valley:** Lisbon Valley copper mine is a sediment-hosted copper deposit located in San Juan County, Utah. Open-pit mining is heap leached and copper cathode is produced onsite through solvent extraction electro-winning process. Open-pit mining at the Centennial pit continued in the first half of 2023, before transitioning to the GTO pit in the last half of the year.
- **Trixie:** The Trixie underground gold mine is located in the East Tintic district, Utah County. High-grade underground gold mining at Trixie commenced in 2020 using the mine elevator that limited production, but a decline to the underground workings was completed in 2023, providing additional access for mining (Lewis et al., 2024).
- **Iron Mountain:** The Iron Mountain mine in Iron County is an open-pit magnetite skarn deposit. Ore is processed onsite using ball and semi-autogenous grinding (SAG) mills and a magnetic separator. Mining was continuous throughout 2023 in the Comstock Mountain Lion (CML) pit with no major interruptions.
- **Spor Mountain:** The Spor Mountain mine is a series of open-pits accessing volcanogenic beryllium mineralization in the Spor Mountain Tuff. Ore is blended and stockpiled onsite then trucked to Delta, Utah, where it is processed to an intermediate beryllium hydroxide product. Mining continued throughout 2023 in the South Wind pit area with no major interruptions. The ore reserves at Spor Mountain are estimated to be capable of supporting average production for a minimum of 75 years (Materion, 2024).
- **Kiewit:** The Kiewit mine is located in western Tooele County and is a low sulfidation epithermal vein to stock-work system. The mine is an open-pit operation with onsite heap leach and carbon in leach (CIL) tanks. An expansion permit was received for the operation in late 2022, and the first half of 2023 was spent removing waste from the new mining area. However, earthworks and mining were suspended mid-year due to funding issues. Heap leaching and processing were continued through the rest of the year.

Exploration and Development

The following section provides details on some of Utah's larger exploration programs during 2023 (Figure 7). The information presented here is not an exhaustive list of all exploration being conducted in Utah, rather it represents significant exploration progress from companies who have made their projects public.

- **Main Tintic, Juab County (Main Tintic district):** Main Tintic is a carbonate replacement deposit (CRD) and porphyry-prospective district held by Ivanhoe Electric. In 2023, Ivanhoe drilled eleven diamond core holes totaling over 35,500 ft, likely the largest drilling program in the state for 2023. The target for drilling was to delineate any porphyry system at depth. Ivanhoe also flew 85 mi² of hyperspectral imaging over the district in 2023 (SRK Consulting, 2024).
- **Deer Trail project, Piute County (Mount Baldy–Ohio district):** Deer Trail is a CRD and deep porphyry exploration project operated by MAG Silver via DT Mining LLC. In 2023 DT Mining reported full results of Phase 2 drilling from 2022, including 13 ft averaging 2.2 g/t Au, 2.2% Cu, and 29 g/t Ag. Phase 2 drilling delineated an additional three mineralization zones in addition to the 2022 discovery of the Carissa zone. Phase 3 drilling began mid-year and more than 18,000 ft of diamond drilling was completed in 2023, and the program continues into 2024 (MAG Silver Corp, 2024).
- **Trixie mine, Juab and Utah Counties (East Tintic district):** Trixie mine is a high-grade epithermal deposit operated by Osisko Development. In 2023 Osisko completed 73 holes (19,800 ft) of underground exploration and delineation diamond core drilling in preparation for a new mineral resource estimate. Major intercepts included 1.5 ft of 610 g/t Au and 1523 g/t Ag and 4 ft of 264 g/t Au and 511 g/t Ag (Lewis et al., 2024).

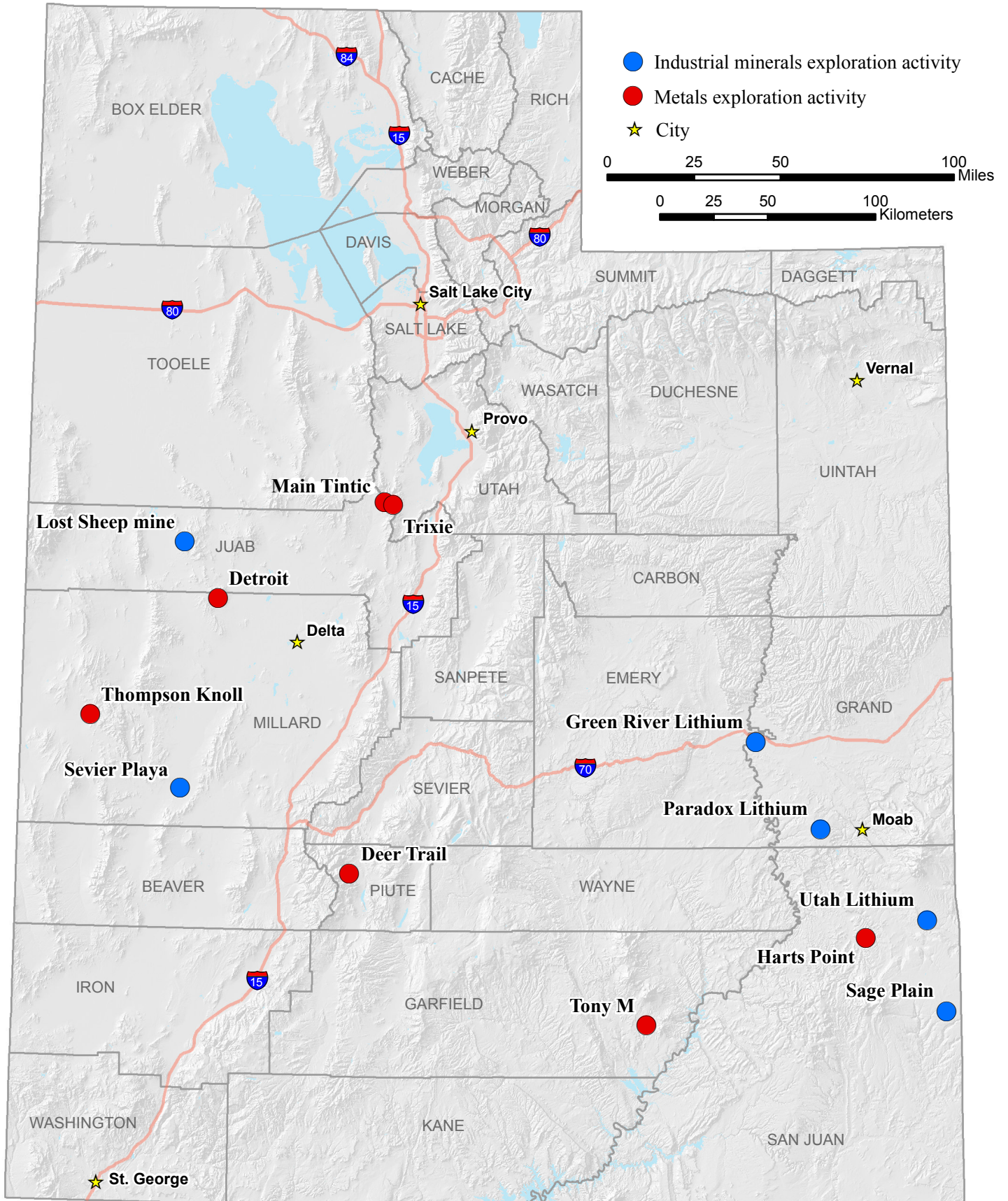


Figure 7. Select metal and industrial mineral exploration and development activity locations in Utah.

- Detroit project (including Mizpah, Drum, and Basin Complex targets), Juab and Millard Counties (Drum Mountain district): Detroit is a distal-disseminated oxide gold project in the historic Drum Mountain area operated by Alderan Resources. In 2023, Alderan drilled 22 reverse circulation (RC) holes, totaling 5900 ft. The drilling targeted near-surface oxide gold mineralisation and intercepted an average of 0.58 g/t Au along 28 ft average intercept length. The highest grade intercepted was 5.23 g/t (Alderan Resources, 2023).
- Thompson Knolls project, Millard County (Kings Canyon district): Thompson Knolls is a porphyry copper target explored by BCM Resources Corp. In 2023, BCM continued a Phase 3 drilling program, with five diamond holes reported to date. Drillhole TK8 intercepted an extended run of elevated copper over 510 ft averaging 0.66% Cu, 0.12 g/t Au, and 7.4 g/t Ag. Within the overall run, eight individual 80-ft intervals contained grades of over 1% Cu (BCM Resources, 2023).

INDUSTRIAL MINERALS

Production

Industrial mineral production in Utah during 2023 had an estimated value of \$1.9 billion, which was 4.2% higher than the revised 2022 value (Figure 3). The largest contributor was the construction aggregate (sand and gravel, crushed stone) and dimension stone group. These products had a combined value of \$570 million (a 3.1% increase from 2022) and accounted for 31% of Utah's total industrial mineral production value in 2023. The second largest contributor was the potash, salt, and magnesium chloride group, which are all brine- and evaporite-derived commodities. These products had a combined value of \$560 million in 2023 (a 3.3% decrease from 2022) and accounted for 30% of the industrial mineral total. The third-largest contribution to the value of industrial minerals production came from the Portland cement, pozzolan, lime, and limestone product group. These products had a combined value of nearly \$310 million in 2023, a 1.6% increase from 2022, and accounted for 17% of the total industrial mineral value. Together, these three commodity groups contributed 78% of the total 2023 value of industrial minerals produced in Utah. The remaining value came from phosphate, uintaite, clay and shale, silica and industrial sand, lithium, and gypsum.

Sand and Gravel, Crushed Stone, and Dimension Stone

Sand and gravel, crushed stone, and dimension stone are produced by many private and government entities. Given the numerous producers of this commodity group, the UGS does not survey all the operators. However, we compile data from selected operators and use USGS data for production and value estimates. During 2023, approximately 38 Mt of sand and gravel was produced in Utah, which was 5.8% less than the revised 2022 production estimate and worth \$430 million (U.S. Geological Survey, 2024b). About 13 Mt of crushed stone worth

\$140 million (U.S. Geological Survey, 2024b) represented an 8.5% production decrease from revised 2022 estimates. Several thousand tons of dimension stone were also produced. Sand and gravel and crushed stone are construction aggregates used in applications such as concrete aggregate, asphalt aggregate, and road base. A strong construction market in Utah has kept construction aggregate demand relatively high for the past several years (Figure 8).

Potash, Salt, and Magnesium Chloride

The brine- and evaporite-derived commodities produced in Utah include potash, salt (NaCl), and magnesium chloride. Potash is produced as potassium sulfate (sulfate of potash or SOP) and potassium chloride (muriate of potash or MOP). Potash production in Utah totaled 350,000 t and was valued at approximately \$220 million in 2023 (Figure 9). Compass Minerals produces potassium sulfate from Great Salt Lake brine, Intrepid Potash-Wendover produces potassium chloride from shallow brines in the Great Salt Lake Desert, and Intrepid Potash-Moab produces potassium chloride from a solution mining operation targeting deep, subsurface evaporites of the Pennsylvanian-age Paradox Formation (Figure 2). Potassium sulfate generally has a higher (+\$260 per ton in 2023) market value than potassium chloride, but the primary use of both types of potash is fertilizer. Potash prices rose dramatically during 2022 and decreased during 2023, but still remained higher than 2021 prices. The 2022 price increase was due to the war in Ukraine, as Russia and Belarus are among the top global potash producers.

About 4.2 Mt of salt was produced in Utah in 2023, with an estimated production value of \$290 million (Figure 9). Salt production was about 11% higher than 2022. About 80% of the salt was produced from Great Salt Lake brine by four operators: Compass Minerals, Cargill Salt, US Magnesium, and Morton International (Figure 2), in descending production order. The remainder was from Redmond Minerals, Intrepid Potash-Moab, Intrepid Potash-Wendover, and Willow Creek Salt (in descending production order). Redmond Minerals operates an underground mine near Redmond in Sanpete County (Figure 2) that produces salt from the Jurassic-age Arapien Shale. Willow Creek Salt operates a surface mine east of Redmond that also produces salt from the Arapien Shale. Salt produced in Utah is used for various purposes including road deicing, water treatment, agricultural supplements, and industrial applications. Redmond Minerals and Morton International also produce food-grade salt from their respective facilities at Redmond and Great Salt Lake.

In 2023, magnesium chloride brine production in Utah increased slightly to 890,000 t and had an estimated production value of about \$49 million. The magnesium chloride brine was produced by Intrepid Potash-Wendover and Compass Minerals; the latter also produced small amounts of magnesium chloride flake. Magnesium chloride is commonly used as a premium road deicer and as a dust suppressant for unpaved roads.

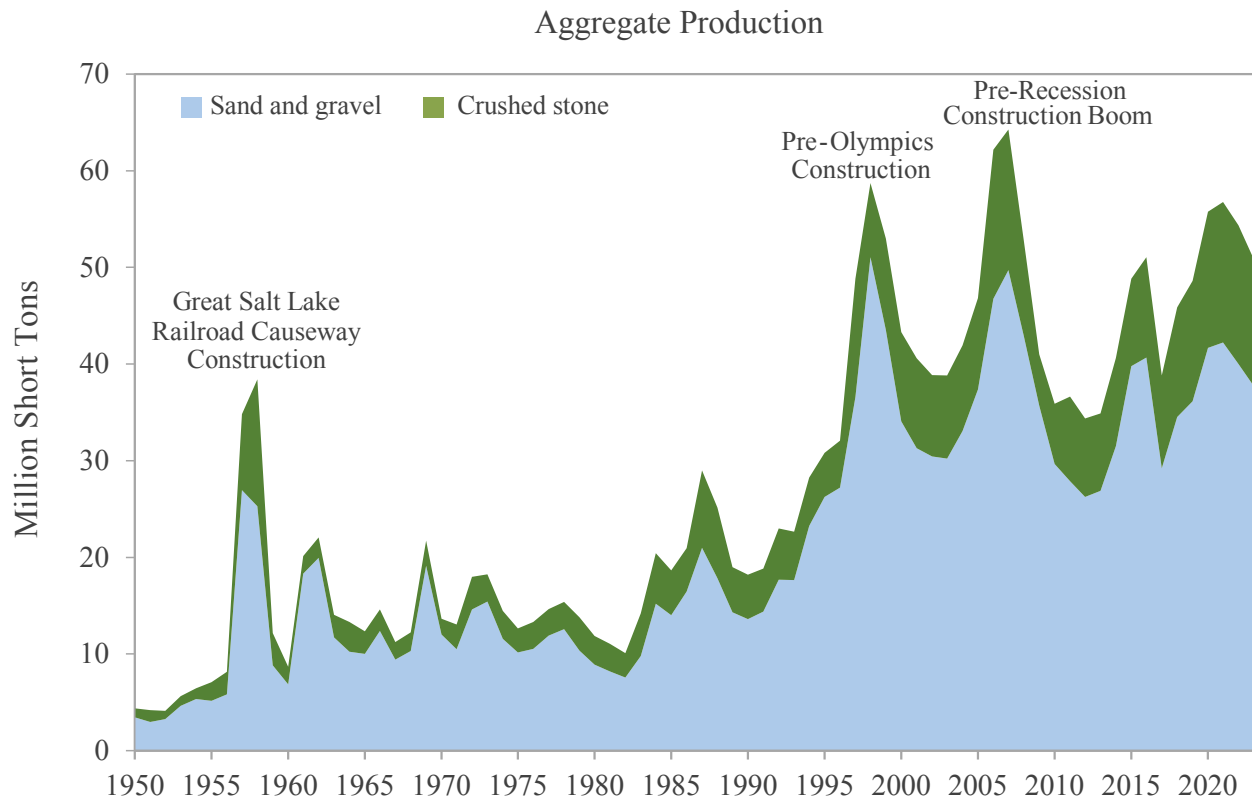


Figure 8. Utah aggregate production, 1950–2023. Source: U.S. Geological Survey.

The most significant source of brine-derived products in Utah is Great Salt Lake. An estimated 3.8 Mt of total material was produced from Great Salt Lake brine in 2023, including salt, potash, magnesium chloride, and magnesium metal. Production in 2023 was slightly higher than our 2022 estimate of 3.6 Mt. These estimates do not account for all byproducts, such as chlorine gas, so the actual total production was slightly higher. The estimated value of mineral and brine production (including salt, potash, magnesium chloride, magnesium metal, and lithium carbonate) from Great Salt Lake in 2023 was about \$490 million.

Portland Cement, Pozzolan, Lime, and Limestone

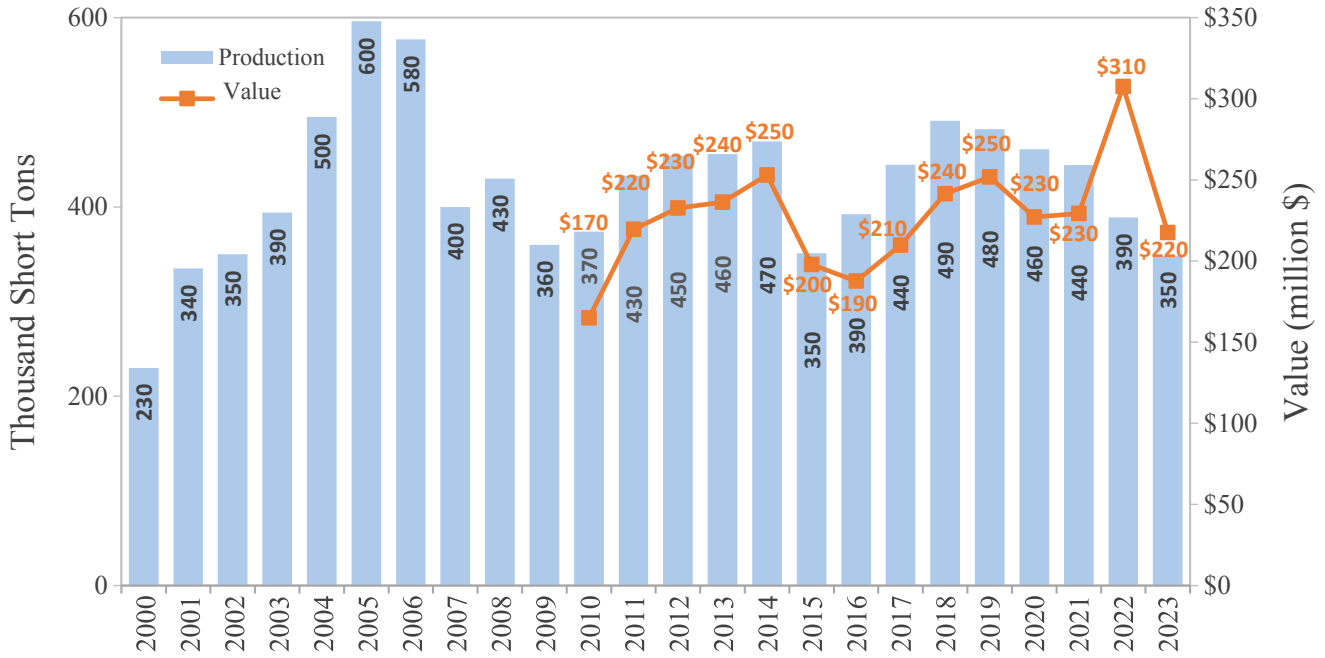
Together, Ash Grove Cement and Holcim produced about 1.7 Mt of portland cement in Utah during 2023, having an estimated value of \$230 million. Ash Grove Cement operates the Leamington quarry and plant east of Leamington in Juab County, and Holcim operates the Devil's Slide quarry and plant east of Morgan in Morgan County (Figure 2). Portland cement production and value have been fairly stable for the past several years. Besides limestone for portland cement, Ash Grove and Holcim also produce smaller amounts of sandstone, clay, and shale, which supplement their limestone feedstock at their cement plants.

Pozzolan materials are typically high in silica and alumina and have cementitious properties that are useful to extend and/or enhance portland cement. Other benefits of pozzolans, compared to conventional cement production, include reduced manufacturing cost and reduced greenhouse gas emissions. Geofortis is producing pozzolan at their mine in Rush Valley at Faust, Tooele County. Their pozzolan resource is a tephra (volcanic ash) in the Tertiary-age Salt Lake Formation, and they expanded their production by about 15% from 2022 to 2023.

During 2023, Graymont Western U.S. remained the sole producer of lime in Utah and increased their production by about 1.7%. Graymont produces high-calcium quicklime and dolomitic quicklime from their quarry and plant in the Cricket Mountains about 35 miles southwest of Delta in Millard County (Figure 2). Lime is used for flue gas desulfurization, steel production, and a variety of other construction, chemical, and industrial applications.

In Utah, limestone is produced for both crushed stone and specialty purposes. Limestone produced for crushed stone is used for common construction aggregate and is included in the sand and gravel, crushed stone, and dimension stone commodity group tally. During 2023, several million tons

Utah Potash Production (MOP + SOP)



Utah Salt Production

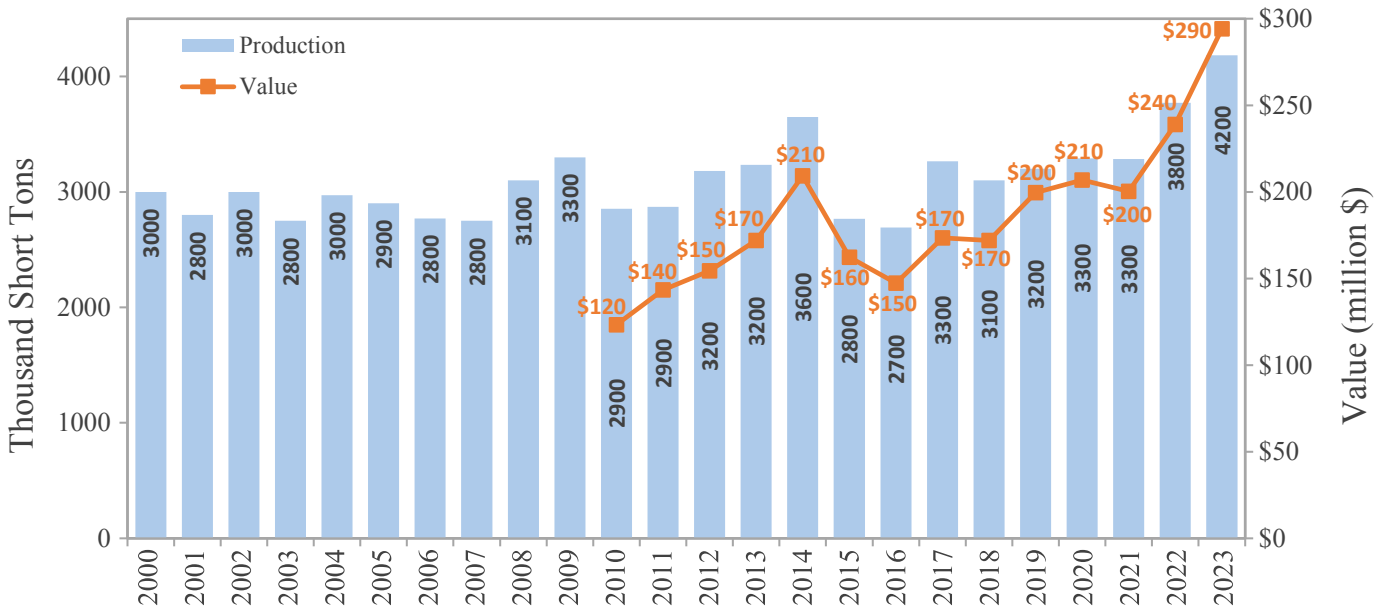


Figure 9. Production (since 2000) and value (since 2010) of potash (all types) and salt. Values in nominal dollars. Data source: Utah Geological Survey.

of limestone was produced for specialty purposes; most of this production was used to manufacture cement and lime (discussed above). However, a few smaller operations, such as Diamond Mountain Resources in Uintah County, intermittently produce limestone for flue-gas desulfurization at coal-fired power plants or other uses such as “rock dust” for coal mines.

Phosphate

Simplot Phosphates continues to be the major phosphate producer in Utah and mines ore from the Meade Peak Member of the Permian-age Phosphoria Formation. Their phosphate operation is located 12 miles north of Vernal in Uintah County (Figure 2). In 2023, the mine produced nearly 3.2 Mt of ore. The ore yielded about 1.2 Mt of phosphate concentrate (about 30% P_2O_5) after processing. The concentrate is transported in slurry form through a 96-mile underground pipeline to the Simplot fertilizer plant near Rock Springs, Wyoming. More than 95% of the phosphate rock mined in the United States is used to manufacture phosphoric acids to make ammonium phosphate fertilizers and animal feed supplements (U.S. Geological Survey, 2024a).

Since 2020, phosphate has also been produced at the Diamond Creek mine near Diamond Fork in Utah County. Keras Resources mined 3000 tons of organic phosphate in 2023, adding to an inventory of over 9000 tons of previously mined material. They intend to extract a few thousand tons of phosphate rock per year from a roughly 7-ft-thick zone of the Meade Peak Member of the Permian-age Phosphoria Formation.

Uintaite (Gilsonite®)

Uintaite (also spelled “Uintahite” and commonly referred to as Gilsonite, which is a trademarked name) is a shiny, black, solid hydrocarbon that occurs in a swarm of narrow, but laterally and vertically extensive, veins in the Uinta Basin. It has been mined since the late 1880s, mostly in Utah with some minor production in the Colorado part of the basin. The largest producer of uintaite is American Gilsonite Company, with mines and processing facilities in southeastern Uintah County (Figure 2). Table Rock Minerals, LLC, also produced uintaite at the TRM #1 mine that is on a UTLA lease in the Uinta Basin south of Ouray in Uintah County. Over the past several years, uintaite production from the Uinta Basin has ranged up to about 85,000 t per year, depending on market conditions (specific production and price data are proprietary). Utah is the only place in the world that contains large deposits of uintaite, which has been shipped worldwide for use in numerous and diverse products including asphalt paving mixes, coatings, inks, and paints (Boden and Tripp, 2012). More recently, the oil and gas industry has used uintaite as an additive in drilling fluids. Uintaite helps control fluid loss and seepage, increase wellbore stability, prevent loss of circulation, and stabilize shale formations.

Clay and Shale

A few hundred thousand tons of clay and shale were produced in Utah in 2023 including bentonite, common clay, high-alumina clay, and expanded shale. Clay is produced at various small and large mines, often on an intermittent basis. Consequently, year-over-year production and value estimates are subject to significant change. Some of the largest producers of clay and shale products are Utelite (expanded shale), Interstate Brick (common clay), Ash Grove Cement (high-alumina clay), and LafargeHolcim (high-alumina clay). Bentonite was produced by Western Clay and Redmond Minerals in central Utah (Sanpete and Sevier Counties). Uses for bentonite include well drilling and foundry operations, various civil engineering applications, and as litter-box filler. Common clay is largely used to make bricks, whereas most high-alumina clay from Utah is used to make portland cement. Applied Minerals Inc. intermittently produces a small amount of specialty clay (halloysite) and iron oxide from the Dragon mine in the Tintic Mountains. They have been researching potential applications and markets for halloysite over the past several years.

Expanded shale in Utah is produced by Utelite at their quarry and plant near Wanship in Summit County (Figure 2). Expanded shale is a lightweight aggregate, sometimes called “bloated shale,” mainly used by the construction industry. It is produced by rapidly heating high-purity shale, derived from the Cretaceous-age Frontier Formation, to about 2000°F causing it to expand and vitrify. The resulting aggregate is durable, inert, uniform in size, and lightweight, having a density about one-half that of conventional aggregates. The material is used in roofing tile, concrete block, structural concrete, and horticultural additives, as well as for highway construction and geotechnical fill. Roughly half of Utelite’s production is used locally along the Wasatch Front and the rest is shipped out of state.

Silica and Industrial Sand

Silica and industrial sand production in Utah during 2023 had an estimated value of about \$130 million. Production of these commodities increased by about 84% from 2022 to 2023. On Stansbury Island, Bolinder Resources mines quartzite from the Devonian-Mississippian-age Stansbury Formation as a source of industrial silica that is used as a flux at the Kennecott smelter. Some of the quartzite is also used as construction aggregate. North of Vernal, Ramsey Hill Exploration produces frac sand from the Triassic-Jurassic-age Nugget Sandstone and unconsolidated Quaternary mixed alluvial and eolian deposits (Figure 2). Frac sand is relatively pure silica sand that is used for hydraulic fracturing stimulations in oil and gas wells, and Ramsey Hill is supplying this sand for local use in the Uinta Basin.

Gypsum

Four operators reported combined gypsum production in Utah of about 730,000 t in 2023, a 7.7% decrease from the 2022 reported production. The estimated value of 2023 gypsum production is

\$10 million. The four Utah gypsum producers were Progressive Contracting, Inc., Diamond K Gypsum, Sunroc Corp., and United States Gypsum Co. (in descending production order). Utah gypsum is commonly used in raw or crude form by regional cement companies as an additive to retard the setting time of cement and by the agriculture industry as a soil conditioner. Lesser amounts of higher value calcined gypsum are used to make wallboard by United States Gypsum, which operates a wallboard plant near Sigurd in Sevier County (Figure 2). Most of the gypsum extracted in Utah is from the Jurassic-age Carmel Formation or the Arapien Shale.

Lithium

Utah entered its third year of lithium production in 2023. US Magnesium has worked towards producing lithium as a byproduct for many years (Tripp, 2002) and commercial production began in 2020. Lithium is concentrated along with magnesium in US Magnesium's solar evaporation ponds and subsequently recovered during the magnesium refining process. US Magnesium has been stockpiling lithium from this process for many years. Their target capacity

for lithium production is about 10,000 t of lithium carbonate per year and in mid 2024 US Magnesium announced that they had employed new DLE (direct lithium extraction) processing technology to increase production. The DLE technology is from International Battery Metals and will produce a high-grade lithium chloride for producing battery-grade lithium.

Exploration and Development

Significant exploration and development activities for industrial minerals in Utah have centered on lithium with additional activity on fluorspar and potash resources (Table 2). This summary generally excludes the activities of smaller aggregate or construction material operations, which are difficult to track but are often a significant part of industrial mineral exploration and development. The information for this section is largely from company websites, press releases, OGM records, and personal communications. Several companies are pursuing lithium in Utah, primarily in brines, and hold land positions in a variety of places in Utah including the Paradox Basin and the Great Salt Lake Desert (e.g., the Bonneville Salt Flats, Pilot Valley). Because of the high magnesium content

Table 2. Select industrial mineral exploration and development projects in Utah, 2023.

Project	Commodity; Deposit	Location	County	Company	Progress
Green River Lithium	Lithium; brine	Paradox Basin (near Green River)	Grand	Anson Resources Ltd	Drilled a new well and reported Li concentrations up to 139 ppm in Mississippian units; intends to put demonstration plant near new well
Utah Lithium	Lithium; brine	Paradox Basin (Lisbon Valley area)	San Juan	Mandrake Resources	Re-entered five oil and gas wells to test brine for lithium content; reported lithium concentrations up to 147 mg/L
Lost Sheep mine	Fluorspar; breccia pipes	Spor Mountain district	Juab	Ares Strategic Mining	Plans to begin production in the near future; continuing construction of processing facilities; conducted mine development and drilling in early 2024
Paradox Lithium	Lithium; brine	Paradox Basin (near Moab)	Grand	Anson Resources Ltd	Acquired additional lands and updated JORC resource estimate to 1.7 million tons of LCE
Sage Plain	Potash; Paradox Fm. evaporites	Paradox Basin	San Juan	Sage Potash	Released an updated technical report that includes resource estimate of land holdings for potash in cycle 18 of the Paradox Fm.
Wendover Mine	Lithium; brine	Great Salt Lake Desert	Tooele	Intrepid Potash	Announced that they were evaluating lithium at their Wendover mine; noted that concentrations of over 1500 ppm have been measured in their final byproduct brine
Sevier Playa	Potash (SOP); shallow brine	Sevier Playa/Dry Lake	Millard	Peak Minerals	Received new funding in 2023 to pursue development

Note: LCE - lithium carbonate equivalent; JORC - Joint Ore Reserves Committee

of Utah's brines, DLE technology would likely be needed to exploit lithium from any of Utah's brine deposits. Multiple DLE technologies are in development, but wide deployment of DLE technology has yet to be realized. For additional information on Utah lithium and potash, please see Mills and Rupke (2020), Mills and Rupke (2023), Rupke (2022), and Rupke and Boden (2023).

Notable exploration and development updates are below. The relevant commodity is noted at the beginning of each bullet point.

- (Lithium) Intrepid Potash-Wendover announced in late 2023 that they were evaluating possible lithium production from their facility near Wendover in the Great Salt Lake Desert. Their announcement reported that Intrepid's final byproduct brine, that has been through multiple evaporation stages, can reach concentrations of over 1500 ppm lithium.
- (Lithium) In mid-2021, Compass Minerals, a Great Salt Lake mineral producer, announced the identification of a lithium resource with intent to develop production. Since then, Compass has prepared two technical reports describing their potential lithium resource. In the most recent, they reported an in-place indicated and inferred resource of 2.7 Mt of LCE within the interstitial brine of salts accumulated in their evaporation ponds and in the waters of Great Salt Lake (2.56 Mt) (Havasi, 2022). However in February 2024, Compass ended their lithium program citing increased regulatory risk around the project.
- (Lithium) Anson Resources has been pursuing lithium resources in subsurface brines in the Paradox Basin within two large blocks of claims near Moab (Paradox Lithium project) and Green River (Green River Lithium project) in Grand County (Figure 7). In 2023 Anson expanded their land position for their Paradox Lithium project and released an updated Australasian Joint Ore Reserves Committee (JORC)-compliant resource estimate that contains an in-place indicated and inferred 1.7 Mt of LCE in brine in the Pennsylvanian Paradox Formation and underlying Mississippian carbonates (Anson Resources, 2023). The average lithium grade of these brine resources is estimated to range from 86 to 176 ppm depending on the geological horizon containing the brine. Anson acquired their Green River Lithium project in 2023 which extends from the town of Green River to several miles to the south. They drilled a well near Green River (Bosydaba#1 well) in early 2024 and reported lithium grades up to 139 ppm in the brine encountered in Mississippian units. They intend to use this new well for a demonstration plant for their extraction process. Anson is also evaluating coproduct/byproduct bromine, boron, and iodine and reported an estimated bromine resource of 8.4 Mt of in-place indicated and inferred resource (Anson Resources, 2023).
- (Lithium) In late 2023, Mandrake Resources re-entered five wells in the Lisbon Valley area of the Paradox Basin to test brine for lithium content as part of their Utah Lithium project. Similar to Anson, they are targeting the Pennsylvanian Paradox Formation and the underlying Mississippian Leadville Limestone. The reported lithium concentrations in the collected samples ranged from 19 to 147 mg/L, but they noted that some of the lower concentrations may have been diluted due to well conditions.
- (Lithium) Waterleaf Resources, a subsidiary of Lilac Solutions (a company that produces lithium extraction technology), has indicated interest in producing lithium from Great Salt Lake using a DLE process. They hope to do pilot testing of their technology by processing north arm water and develop a first phase of commercial production at 3300 t per year of lithium carbonate by 2026.
- (Fluorspar) Ares Strategic Mining has been working towards reopening the Lost Sheep fluorspar mine in the Spor Mountain district in Juab County (Figure 7), and hopes to begin production in the near future. Historically, the Lost Sheep mine was the most productive fluorspar mine in Utah and has produced about 170,000 t of fluorspar from a series of mineralized breccia pipes. The mine has an active small mine permit from OGM. Since 2020, Ares has completed exploration drilling, geophysical surveys, and geologic mapping to delineate the fluorspar resources of their land holdings which consist of nearly 6000 acres of claims; their holdings span much of the Spor Mountain area. In 2023, Ares continued work on a fluorspar processing plant in Delta, Utah. In early 2024, Ares commenced additional drilling in their primary mine area, expanded their fluorspar target, and worked on mine development in anticipation of production. Fluorspar is considered a critical mineral and the United States is almost completely import reliant for the mineral; consequently, if the Lost Sheep mine resumes production it would be the most significant fluorspar producer in the United States.
- (Potash) In early 2023, Sage Potash released an updated NI 43-101 for their Sage Plain project in the Paradox Basin in an area east of Monticello, Utah, on the Colorado border (Figure 7). They are targeting deep, subsurface evaporites within the Pennsylvanian Paradox Formation. Sage Potash reported an inferred potash resource of 176 Mt at 27% K₂O and 132 Mt at 23% K₂O in the upper and lower beds, respectively, of cycle 18 of the Paradox Formation (Thorson, 2023). Sage Potash has also indicated an interest in lithium within their land holdings by forming a subsidiary company (Sage Lithium Corp.) to pursue that possibility.

- (Potash) A project that was previously close to development was a potassium sulfate project at Sevier Lake/Playa (Figure 7). Crystal Peak Minerals had delineated a resource (Brebner and others, 2018) and received necessary permits and approvals for development, but was unable to raise sufficient capital to advance the project. In 2023, Peak Minerals announced new monetary investment to develop the Sevier Lake/Playa potassium sulfate project.

URANIUM

Production

In December 2023, Energy Fuels Inc. announced it was recommencing uranium mining at the La Sal/Beaver and Pandora mines in San Juan County, Utah (Energy Fuels Inc., 2024). Production from these mines can reach approximately 4000 tons of uranium/vanadium ore per month per mine (8000 tons total) at full production capacity. Combined with production from the Pinyon Plain mine in Arizona, Energy Fuels expects to produce approximately 1.1 to 1.4 million pounds U_3O_8 per year. Mined ore is processed at the White Mesa Mill in Blanding, Utah, the only active conventional uranium mill in the United States. Energy Fuels anticipates stockpiling ore for a period before starting to process material through the mill in 2024 or 2025. The White Mesa Mill has a separate vanadium recovery circuit and is building a rare earth element (REE) oxide separation circuit, which is already active on a test scale. In 2023, the mill recovered approximately 285 tons of rare earth carbonate from monazite ore sourced outside of Utah. Also in 2023 Energy Fuels completed rehabilitation of the Whirlwind mine decline which will enable mining to restart under favorable economic conditions.

Exploration and Development

The following section provides details on some of Utah's significant uranium exploration programs during 2023 (Figure 7). The information presented here is not an exhaustive list of all exploration being conducted in Utah, rather it represents significant exploration progress from companies who have made their projects public.

- Tony M, Garfield County (South Henry Mountains district): Tony M is a sandstone-hosted uranium deposit in the Salt Wash Member of the Morrison Formation. In 2023, Consolidated Uranium drilled 21 holes (combined rotary and core drilling) for a total of approximately 16,240 ft (IsoEnergy Ltd., 2024). Drilling was intended to increase density of drill data to upgrade areas from inferred to indicated mineral resources, and to evaluate the potential for high-grade vanadium mineralization. A hypothesized inverse relationship between low-grade uranium mineralization and high-grade vanadium mineralization was not supported by the drilling, but high-grade vanadium mineralization was intercepted. The best intercept was 4 ft

averaging 0.4% U_3O_8 and 1.023% V_2O_5 . Consolidate Uranium was acquired by IsoEnergy in late 2023.

- Harts Point, San Juan County: Harts Point is a sediment-hosted uranium-vanadium project targeting mineralization in the Triassic-age Chinle Formation and is operated by Atomic Minerals Corp. and Kraken Energy. The companies received drill permits in 2023 and initiated Phase 1 drilling, which was suspended shortly after (Atomic Minerals Corp., 2023). Drilling recommenced in early 2024.

COAL

Production and Distribution

Five Utah coal operators produced 7.0 Mt of coal valued at \$314 million from five underground mines and one surface mine in 2023, the lowest production total since 1975 (Figures 10-12; Table 3). Production in 2023 decreased by 35% compared with 2022, mostly due to the closing of the Lila Canyon mine early in the year, the idling of the Coal Hollow surface mine, and reduced production at Wolverine Fuels' Sufco mine. Minor production declines were also reported for the Emery and Gentry mines. The only mine that increased production from 2022 to 2023 was the Skyline mine. Average annual employment at active or recently active mines dropped only slightly in 2023, down to 1323 from 1361 recorded in 2022, but does not yet reflect the idling of the Lila Canyon and Coal Hollow mines (Figure 10). Employment is expected to decrease to about 1270 in 2024; not as dramatic as predicted since Sufco added nearly 70 miners to its employment ranks in the first half of 2024 and several miners were hired to help start up the new Fossil Rock mine. Coal mining productivity, the amount of coal produced in tons per employee hour, peaked in 2002 at 8.0 tons/employee hour, but has averaged only about 4.4 tons/employee-hour during the past five years (Figure 10). Productivity dropped to 2.5 tons/employee-hour in 2023 as production significantly declined.

Demand at Utah coal-fired power plants was fairly stable from 2000 to 2015 at about 15.2 Mt a year, but dropped to an average of 11.6 Mt between 2016 and 2021, including a dip in 2020 to 10.5 Mt due to the COVID-19 pandemic (Figure 13). Utah power plant consumption dropped significantly again in 2022, to 10.2 Mt, and again in 2023, down to 7.5 Mt, as the Intermountain Power Plant continues to ramp down operation and less coal was used at Hunter, Huntington, and Bonanza (burns Colorado coal) as these plants flex power output based on availability of new solar energy resources. Power flexing or closure at other U.S. coal-fired power plants has reduced domestic demand for Utah coal, but recently Utah operators could take advantage of a stronger foreign export market, sending an estimated 2.8 Mt of coal per year overseas to Asia between 2017 and 2022; however, foreign exports decreased to only 386,000 t in 2023 (Figure 13).

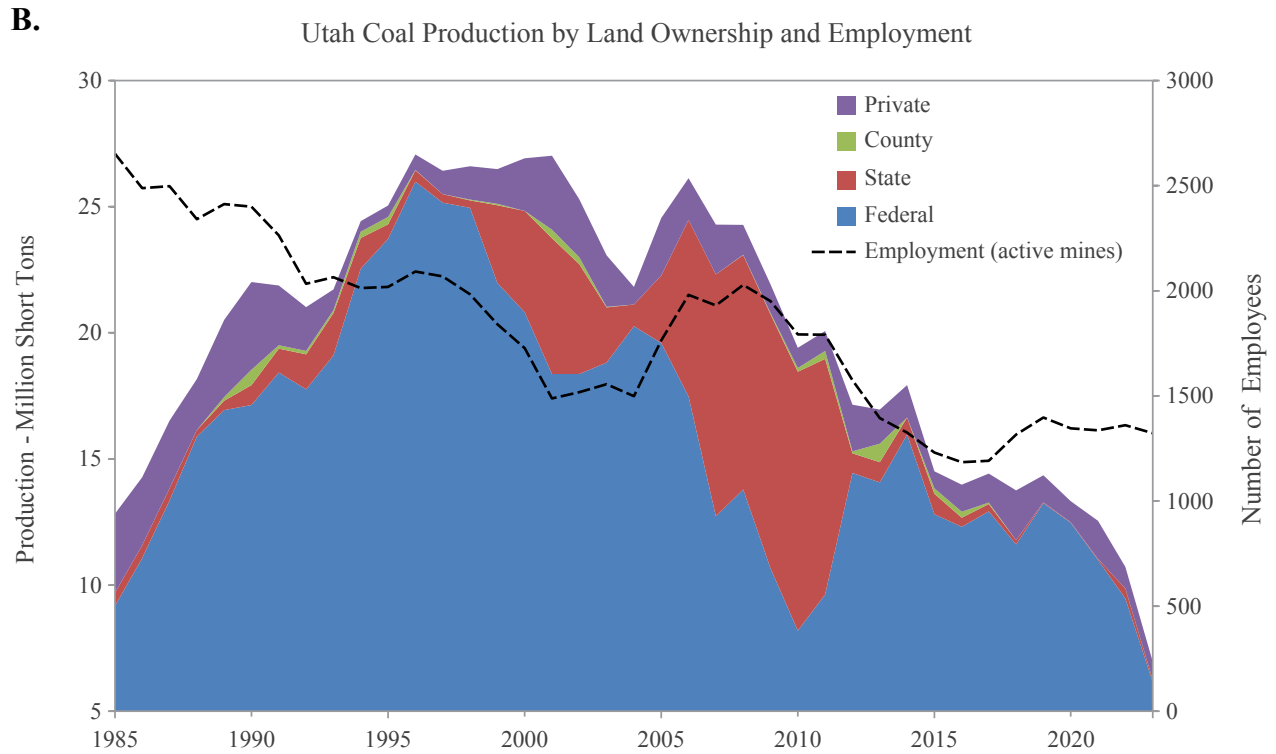
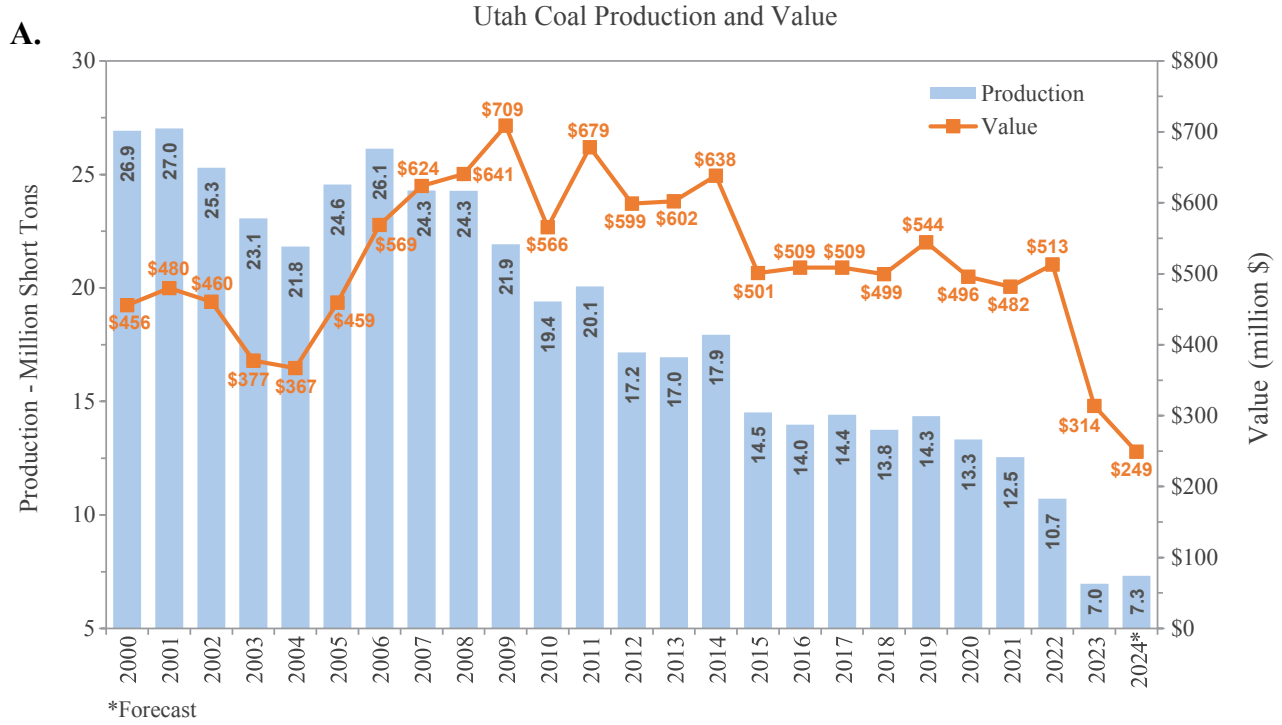


Figure 10. (A) Utah coal production and value in nominal dollars, 2000–2024. Data source: Utah Geological Survey and U.S. Energy Information Administration. **(B)** Utah coal production by land ownership and employment at active mines, 1985–2023. Data source: Utah Geological Survey and Mine Safety and Health Administration.

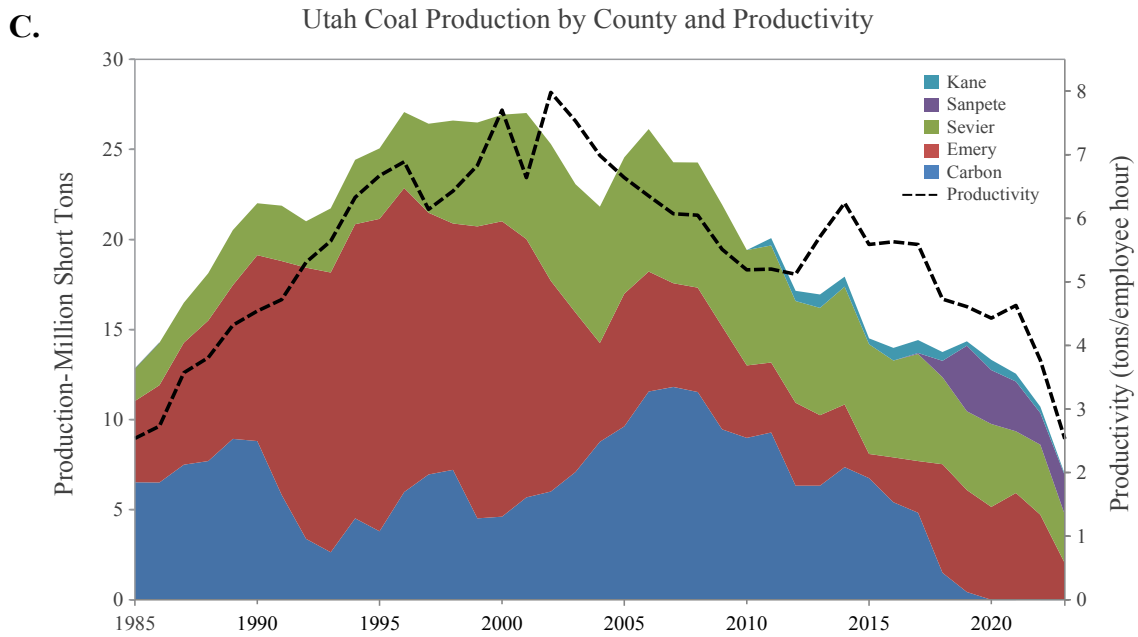


Figure 10 Continued. (C) Utah coal production by county and coal mining productivity, 1985–2023. Data source: Utah Geological Survey and Mines Safety and Health Administration.

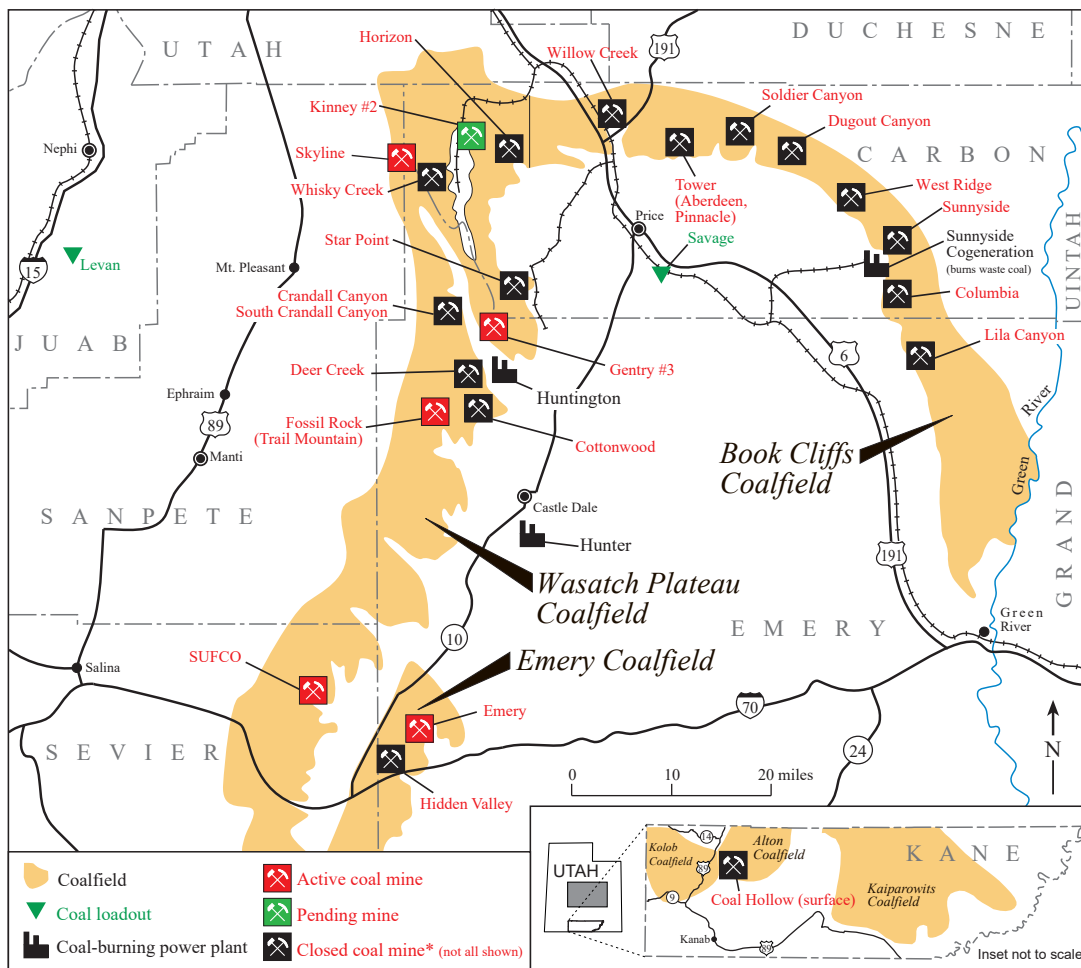


Figure 11. Location and status (at time of publication) of Utah coal mines and associated facilities

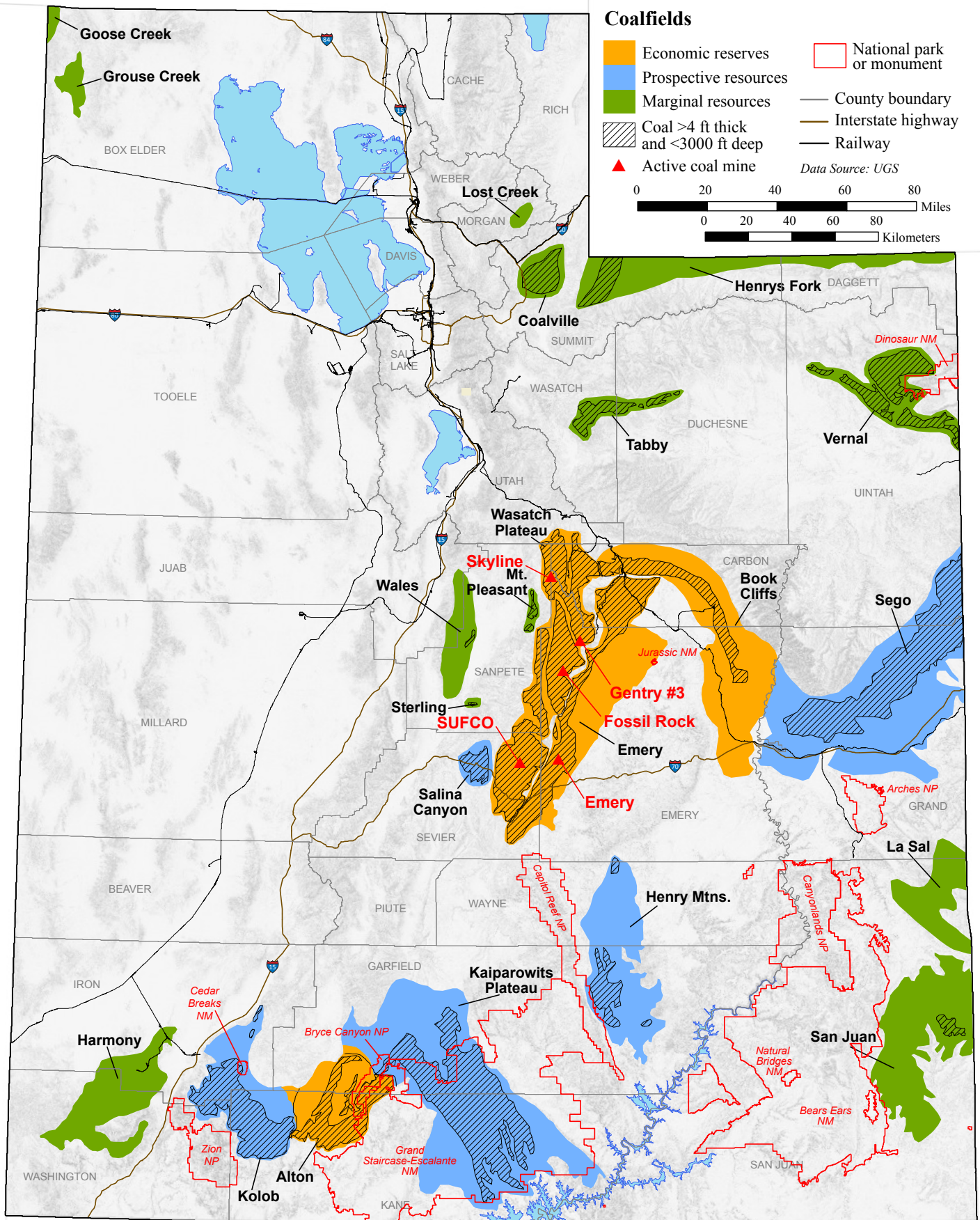


Figure 12. Location of active Utah coal mines and coalfields.

Table 3. Coal production in Utah by coal mine, 2010–2024.

Company	Mine ¹	County	Coalfield	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024*
thousand short tons																		
Canyon Fuel Company, LLC - Wolverine Fuels, LLC ²	Dugout Canyon	Carbon	Book Cliffs	2307	2395	1588	561	676	763	650	626	557	430	--	--	--	--	--
	Skyline #3	Carbon/ Sanpete/ Emery ³	Wasatch Plateau	3050	2950	1954	3135	4170	4409	4767	4389	3614	3896	3713	3530	2521	2830	3100
	SUFCO	Sevier	Wasatch Plateau	6398	6498	5651	5959	6539	6095	5375	5947	4842	4374	4601	3425	3882	2692	2800
Fossil Rock Resources, LLC - Wolverine Fuels LLC ⁴	Fossil Rock (Trail Mtn.)	Emery	Wasatch Plateau	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25
Bronco Utah Operations, LLC ⁵	Emery	Emery	Emery	999	--	--	4	--	--	--	135	442	694	474	1171	1063	798	1000
Gentry Mountain Mining, LLC - COP Coal Development Co. ⁶	Gentry #3	Emery	Wasatch Plateau	--	--	--	--	--	218	170	205	102	562	660	511	600	420	400
	Gentry #4	Emery	Wasatch Plateau	--	592	1004	875	1061	757	724	754	893	488	11	--	--	--	--
East Mountain Energy - PacifiCorp	Deer Creek	Emery	Wasatch Plateau	2954	3143	3295	2785	2083	15	--	--	--	--	--	--	--	--	--
Hidden Splendor Resources, Inc. - America West Resources, Inc.	Horizon	Carbon	Wasatch Plateau	270	370	210	--	--	--	--	--	--	--	--	--	--	--	--
Utah Land Resources, Inc. - ACNR Holdings, Inc. ⁷	West Ridge	Carbon	Book Cliffs	3355	3566	2579	2629	2514	1580	--	--	--	--	--	--	--	--	--
Emery County Coal Resources - ACNR Holdings, Inc. ⁷	Lila Canyon	Emery	Book Cliffs	72	157	304	257	335	350	1587	1638	2816	3664	3296	3471	2299	159	--
Alton Coal Development, LLC	Coal Hollow	Kane	Alton	--	403	570	747	555	316	671	724	488	240	569	434	354	67	--
	Burton #1	Kane	Alton	--	--	--	--	--	11	34	--	--	--	--	--	--	--	--
Total				19,405	20,074	17,155	16,953	17,933	14,513	13,978	14,417	13,753	14,347	13,325	12,542	10,719	6966	7325

Source: UGS coal company questionnaire

*Forecast

¹All mines are underground except Coal Hollow, which is a surface mine.²Bowie Resources bought Canyon Fuel from Arch Coal in summer 2013. In late 2018, Bowie changed their name to Wolverine Fuels.³2023 production by county: Sanpete = 2,179,666 tons; Emery = 650,486 tons. 2022 production by county: Sanpete = 1,758,956 tons; Emery = 762,244 tons. 2021 production by county: Sanpete = 2,750,773 tons; Emery = 778,989 tons. 2020 production by county: Sanpete = 3,000,319 tons; Emery = 712,681 tons. 2019 production by county: Sanpete = 3,645,133 tons; Emery = 250,695 tons. 2018 production by county: Sanpete = 906,716 tons; Emery = 1,765,410 tons; Carbon = 941,447 tons. 2017 production by county: Sanpete = 43,949 tons; Emery = 136,203 tons; Carbon = 4,208,538 tons. 2010-2016: all production in Carbon County.⁴Wolverine is working to reopen the closed Trail Mountain mine (last production was 2001), first CM mining is expected in late 2024.⁵Bronco bought the Emery mine from CONSOL Energy in 2015.⁶COP bought the Castle Valley mines when Rhino went into bankruptcy in late 2020, mines were renamed Gentry. In summer 2010, Rhino bought the Castle Valley mines from C.W. Mining (Co-op); mines were formerly called Bear Canyon.⁷ACNR Holdings, Inc. was previously Murray Energy.

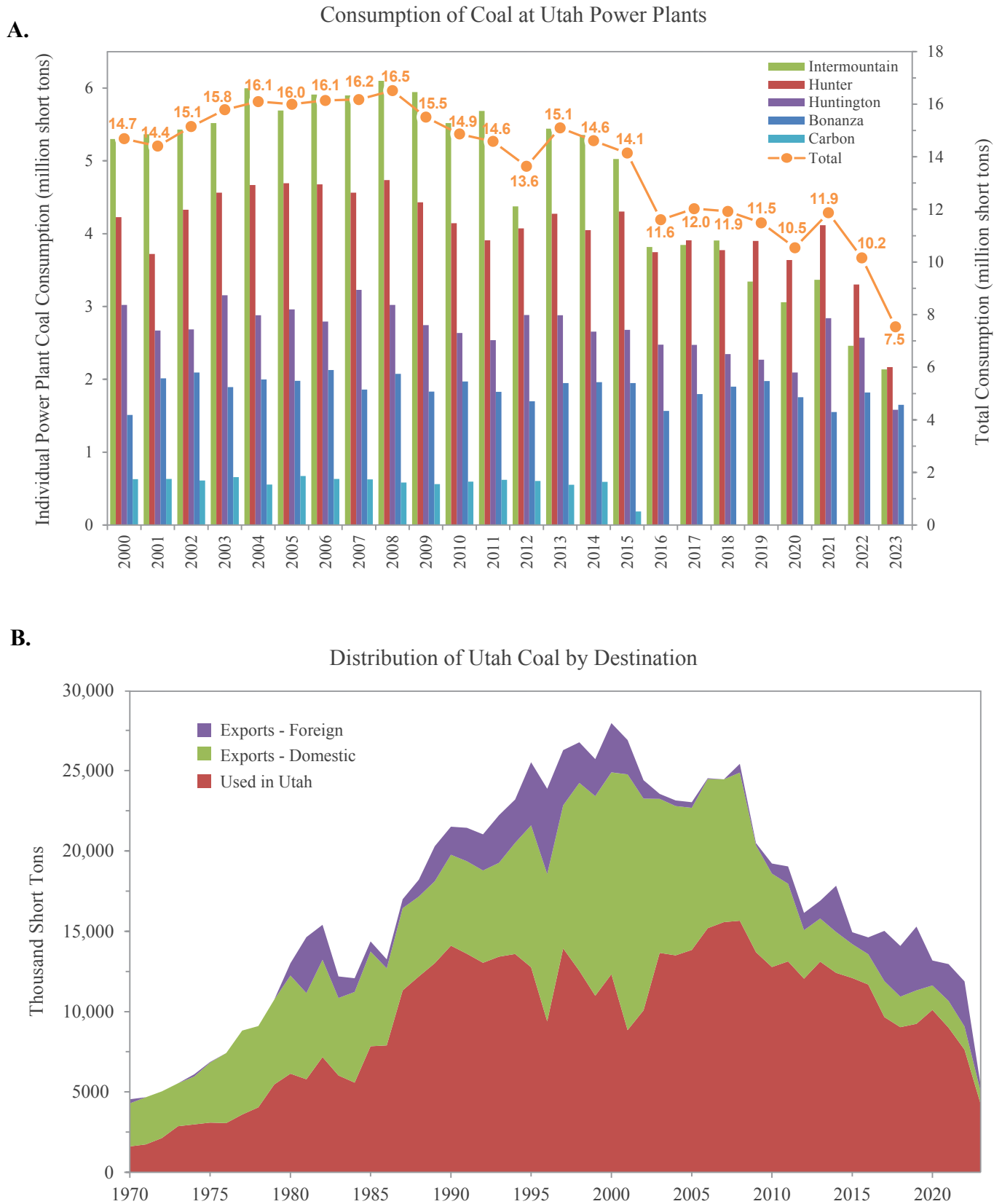


Figure 13. (A) Consumption of coal at Utah power plants, 2000–2023. Data source: U.S. Energy Information Administration. Notes: (1) A generator at the Intermountain Power Plant was offline for several months in 2012, resulting in decreased coal consumption. (2) The Bonanza power plant in Uintah County gets its coal from the Deserado mine just over the border in Colorado. (3) The Carbon plant, Carbon County, shut down in spring 2015. (4) The Sunnyside plant in Carbon County is not included since it burns waste coal. **(B)** Distribution of Utah coal by final destination, 1970–2023. Data source: Utah Geological Survey and U.S. Energy Information Administration.

C.

Consumption of Coal in Utah by End Use

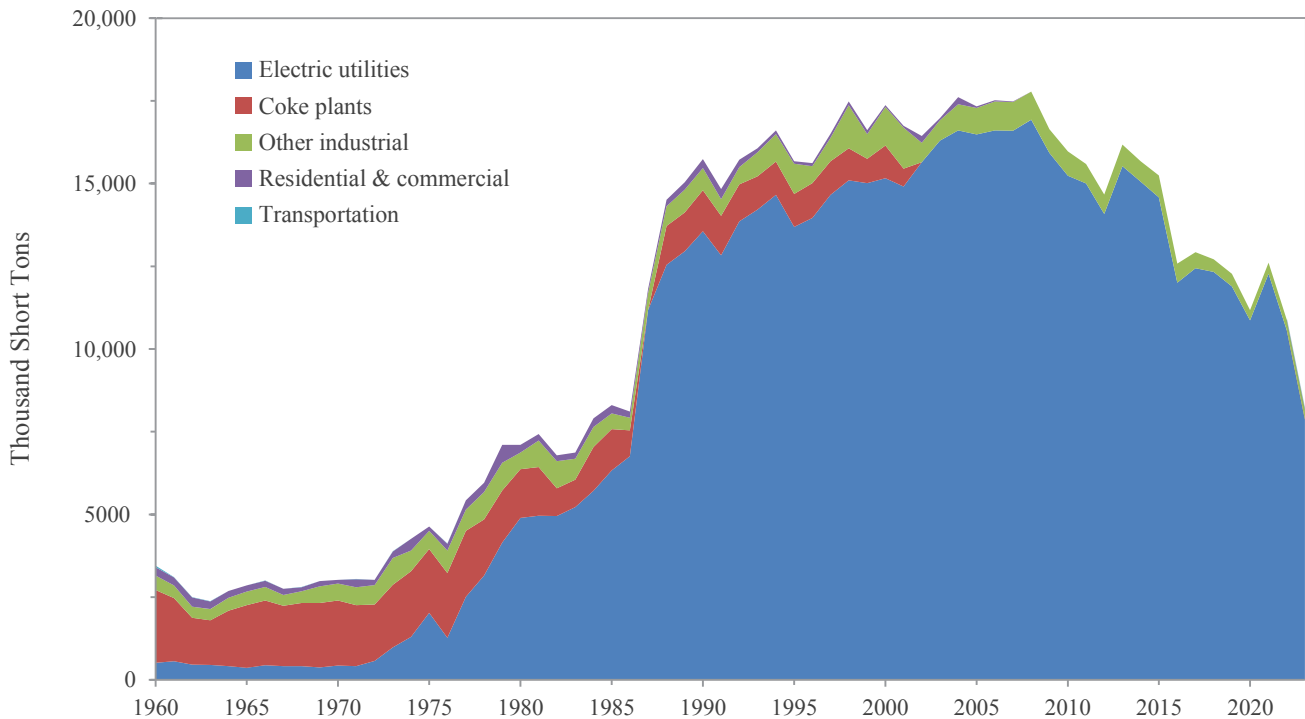


Figure 13 Continued. (C) Consumption of coal in Utah by end use, 1960–2023. Data source: U.S. Energy Information Administration. Notes: Electric utilities includes waste coal burned at Sunnyside.

During our annual coal mine visits in spring 2024, all mine operators reported strong demand for Utah coal, both domestically (the closure of Lila Canyon created localized shortages) and internationally, but meeting this new surge in demand has been challenging to nearly impossible. However, even with strong demand, prices have cooled from highs seen in 2022. The western U.S. spot prices were above \$40 per ton in fall 2022 but then decreased into the upper \$20 per ton range by winter 2024. Prices on the international spot market exceeded \$400 per ton in summer/fall 2022, but have more recently settled into the \$130 to \$140 per ton range in late 2024 (U.S. spot prices from EIA and international spot prices from ICE Newcastle). Labor shortages were again cited as a significant obstacle holding back Utah production. As a result, when the Lila Canyon mine moved to “indefinitely idled” status in late 2023, the operator indicated that all miners that wanted new jobs found them with other mines. The defunding of the coal industry has also affected the ability for operators to finance new mine equipment and improvements, and coupled with continued difficult mining conditions at remaining mines and a burdensome regulatory environment, the Utah coal industry will continue to struggle to maintain current activities. However, Wolverine Fuels began rehabilitation of the old Trail Mountain mine in 2023 (now called Fossil Rock), where they will access the state-owned Cottonwood coal tract.

Wolverine even recorded some minor production in the third quarter of 2024 as redevelopment commenced, making Fossil Rock Utah’s first new active coal mine since 2017. Even with this new mine opening and continued strong demand, Utah coal production is expected to increase only slightly in 2004 to 7.3 Mt.

For the first time in the history of Utah’s coal industry (except for maybe the very early days), after the idling of the Dugout Canyon mine in 2019, coal is no longer produced in Carbon County (Figure 10). In contrast, Sanpete County hosted significant coal production for the first time starting in 2017 when operations at the Skyline mine moved to the southwestern Flat Canyon area. Coal production in 2023 came from Emery (2.0 Mt, 29%), Sevier (2.7 Mt, 39%), Sanpete (2.2 Mt, 31%), and Kane (67,000 t, 1.0%) Counties.

In 2023, the majority of Utah coal, 5.9 Mt, was produced from the Wasatch Plateau coalfield; 159,000 t came from one mine (Lila) in the Book Cliffs coalfield, 798,000 t from the Emery mine in the Emery coalfield, and 67,000 t from the Coal Hollow mine in the Alton coalfield (Table 3). However, with operations ceasing at both the Lila Canyon mine and the Coal Hollow mine, there will be no production from the Book Cliffs or Alton coalfields in 2024. This will mark the

first time in the history of Utah coal mining where the historic Book Cliffs coalfield will record zero coal production. In addition, nearly all Utah coal production in 2023, 88% (6.2 Mt), was produced from federal land, whereas only 100,000 t (1.4%) was from state-owned land (Figure 10). Federal coal production has dominated in Utah since 2012, when the now-closed Deer Creek mine's state-owned Mill Fork coal tract reverted back to federal ownership after a 22 Mt coal production threshold was reached. This reversion dramatically increased the amount of coal produced on federal land, from 48% in 2011 to 84% in 2012. The remainder of Utah's 2023 coal production came from private lands (10.3%, 716,000 t) at the Gentry, Emery, and Coal Hollow mines. Once the Fossil Rock mine begins production in the Cottonwood tract, state-owned production will significantly increase.

The now idled Lila Canyon mine and active Emery mine will both have changes to surrounding land ownership when the John D. Dingell, Jr. Conservation, Management, and Recreation Act is finalized. Significant coal resource tracts near both mines will convert from federal ownership to state (UTLA) ownership, facilitating a more streamlined permitting process for future mining. This transfer could happen as soon as late 2024 or early 2025.

The total amount of Utah coal distributed to the U.S. market in 2023 was 5.0 Mt, over 4.0 Mt less than 2022 (Figure 13). As recently as 2008, Utah operators distributed 25 Mt of coal; over 9.2 Mt was exported to other states and 16 Mt was used in-state. In 2023, only 777,000 t of Utah coal was shipped to other states, whereas 4.2 Mt was used locally. The vast majority of Utah coal, about 81% (4.1 Mt), went to the electric utility market, mainly within the state. Utah coal deliveries to the industrial sector totaled 958,000 t in 2023, which is significantly less than peak deliveries of 4.4 Mt in 2003. Consumption of coal in Utah is now higher than in-state distribution, indicating that coal imports to Utah were significantly higher than in previous years. Utah power plants consumed 7.9 Mt of coal in 2022 (this includes about 334,000 t of waste coal burned at the Sunnyside power plant) and about 308,000 t used at industrial facilities, the latter being significantly lower than in the 1990s to mid-2010s (Figure 13).

The demand for Utah coal has sharply decreased over the past several years as coal-fired power plants have closed or switched to natural-gas-fired generation. Nationally, operators have retired 37 gigawatts of coal-fired power plant capacity, about 17% of the coal-fired fleet, since 2021 (U.S. EIA, 2024b). Within Utah, the Carbon coal-fired power plant outside the town of Helper closed in April 2015 because it was cost prohibitive to retrofit the old plant with new emission-reducing technology. This closure removed about 600,000 t of coal from the Utah market. Between 2016 and 2022, consumption of coal at Utah's remaining coal-fired power plants averaged 11.4 Mt, a 26% decrease from

pre-2016 consumption (Figure 13). In 2023, consumption dropped to only 7.5 Mt, the lowest level since the Intermountain Power Plant (IPP) was built in 1987. A significant portion of this reduction occurred at IPP near the town of Delta (peak consumption occurred in 2008 at 6.1 Mt whereas 2023 consumption was only 2.1 Mt) as the City of Los Angeles, California, the majority owner, has purchased less electricity from the plant due to favoring mostly renewable energy sources. In fact, Los Angeles plans to no longer purchase any coal-fired electricity from IPP after its power purchase agreement expires in 2025, at which time a new plant, currently under construction, will burn a combination of natural gas and "green/blue" hydrogen. In addition, starting in 2016, as new solar-generated electricity (mostly from California and Nevada, but also from Utah) floods the grid during the day, Utah's Hunter and Huntington coal-fired power plants have been forced to lower their output during these peak solar times, thus consuming less coal. Coal demand at Hunter and Huntington significantly decreased in 2023 to only 2.2 Mt and 1.6 Mt, respectively, a total of about 2.1 Mt less than 2022. Although Rocky Mountain Power has backed off their announcement that it will close the Hunter and Huntington power plants by 2032, plans for the power plants beyond this timeline are unclear. Overall, reductions in coal demand have had a profound impact on Utah coal mining operations, and low demand and uncertainty will continue into the future.

Foreign exports of Utah coal averaged 2.9 Mt per year in the 1990s, peaking at 5.3 Mt in 1996 (Figure 13). Beginning in the early 2000s, foreign exports dropped dramatically, with no exports reported in 2007. Starting in 2008, Utah coal exports revived, reaching 2.9 Mt in 2014, before dropping again in 2015 to only about 0.7 Mt and 1.0 Mt in 2016. However, a recently expanding foreign export market has provided new opportunities for Utah coal operators. With diminished port capacity on the West Coast of the United States, Utah operators have sought out alternate port facilities (e.g., Gulf of Mexico) to send their coal overseas. Utah operators have exported between 1.6 and 4.0 Mt per year for the past five years, but only shipped about 386,000 t of coal in 2023, most likely due to the strong in-state demand.

For detailed statistics on Utah's coal industry (including information previously published in the annual Utah Coal Report), refer to the data tables located on the UGS's Utah Energy and Mineral Statistics website: <http://geology.utah.gov/resources/energy/utah-energy-and-mineral-statistics/>.

Exploration/Development Updates for 2023/2024

- Lila Canyon mine: Production halted in September 2022 when a "thermal event" was detected in a mined-out area of the underground workings. After extensive work to extinguish the fire, miners re-entered the mine in early 2023, but rehabilitation efforts were unsuccessful. The mine was "indefinitely idled" in late 2023 after

minor production of 159,000 t for the year. Significant coal reserves are still present in the area, most notably the Williams Draw tract (soon to transfer to state ownership via the Dingell Act) to the south.

- Gentry mine: COP Coal Development, LLC, bought the Castle Valley mines when Rhino Resources went into bankruptcy in late 2020—the mines were renamed Gentry. Gentry mine #4 was closed in early 2020 and all mining now takes place in the Gentry #3 mine, currently from the Hiawatha seam. Challenging geology will keep production somewhat lower than previous years, with production expected to reach 400,000 t in 2024.
- Emery mine: Production at the Emery mine more than doubled in 2021 as four continuous miner machines were brought online and this level of production continued into 2022 (about 1.1 Mt), but decreased slightly in 2023 to 798,000 t. Emery is waiting for the finalization of the Dingell Act before leasing/permitting new coal reserves that will soon be under state (UTLA) jurisdiction.
- Sufco mine: Longwall development shifted to the federal Greens Hollow tract while production finished in the federal Pines district to the northeast (finished in spring 2023). Longwall production in Greens Hollow started in 2024 with total production for the year predicted to be about 2.8 Mt, a bit less than typical due to challenging geologic conditions.
- Skyline mine: Operations at the Skyline mine shifted to the Lower O'Connor B seam in the Flat Canyon area in 2017. Complicated geology (e.g., faults, water infiltration, etc.) was the cause for less production in 2022, down about 1 Mt from 2021, but production rebounded back to 2.8 Mt in 2023 and is expected to increase again in 2024 to about 3.1 Mt. After several more small longwall panels in the current seam, plans call for ramping down to the Lower O'Connor A seam.
- Fossil Rock/Trail Mountain/Cottonwood Tract: Owned by Fossil Rock Resources, LLC, a subsidiary of Wolverine Fuels, this UTLA coal tract contains nearly 50 Mt of mineable coal in the Hiawatha seam. Wolverine re-entered the closed Trail Mountain mine in 2023 and completed necessary rehabilitation in mid-2024. A small amount of coal was produced in the third quarter of 2024 (about 8600 t) as continuous miner machines started development in the new workings. Full-scale longwall production could start in 2026 yielding up to 3 Mt of coal per year.
- Coal Hollow mine: Alton Coal Development has completed mining on the northern private lease as well as the areas to the south which are private surface, but federal coal. The mine was idled in mid-2023 (and remains idle to date) after producing only 67,000 t due to delays in permitting an additional federal block to the west of the current facilities.

UNCONVENTIONAL FUELS

Oil Shale

The upper Green River Formation in the Uinta Basin of Utah contains one of the largest deposits of oil shale in the world. The deposit contains an estimated in-place resource of 1.3 trillion barrels (bbls) (USGS Oil Shale Assessment Team, 2011) and a potential economic resource of 77 billion bbls (Vanden Berg, 2008). The richest Green River oil shale horizon is the Mahogany zone, where individual beds can yield up to 80 gallons of oil per ton of rock. The Mahogany zone is 70 to 120 ft thick and is accessible via extensive outcrops along the eastern and southern flanks of the basin.

The outcrop accessibility, gentle dip, and shallow cover of Utah oil shale deposits make conventional surface/underground mining and surface retort the preferred technology to recover oil from the shale. Currently, at least three companies have interests in Utah's oil shale resources: Enefit American Oil, Red Leaf Resources, and TomCo Energy. These companies all hold land (mostly UTLA leases) in the southeastern Uinta Basin but have reported limited activity in recent years. Notably in 2023, Enefit American Oil relinquished their UTLA leases as well as their federal RD&D lease, and in 2024, they put their private land holdings (the Skyline property, ~17,000 acres) up for sale indicating their abandonment of the project.

Oil Sand

North America has the largest oil sand (also known as tar sand or bituminous sand) resources in the world, the vast majority of which are in Canada. Utah oil sand deposits, though small compared to Canadian resources, contain the largest resource in the United States. The deposits hold roughly 23 to 29 billion bbls of in-place bitumen. The Uinta Basin of northeast Utah has 25 oil sand deposits containing an estimated 9 to 11 billion bbls. Twenty-two oil sand deposits containing another roughly estimated 14 to 18 billion bbls are in the central-southeast part of the state, and six minor deposits containing negligible oil occur in other parts of the state (Ritzma, 1979). Similar to oil shale, conventional mining methods would likely be used to mine the oil sand for further processing. Given the relative ease of recent oil production from tight oil reservoirs, less incentive exists to improve bitumen extraction and refining techniques to efficiently and sustainably develop Utah's oil sand. Challenges facing oil sand extraction in Utah have included permitting and legal challenges, process efficiency, site accessibility, adequate infrastructure, water availability, environmental concerns, and the heterogeneity of deposits.

Despite these challenges and competition from traditional drilling, a few companies continue to pursue development of Utah's oil sand deposits. One Utah oil sand deposit that consistently generates interest is Asphalt Ridge because of its proximity to Vernal, Utah.

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