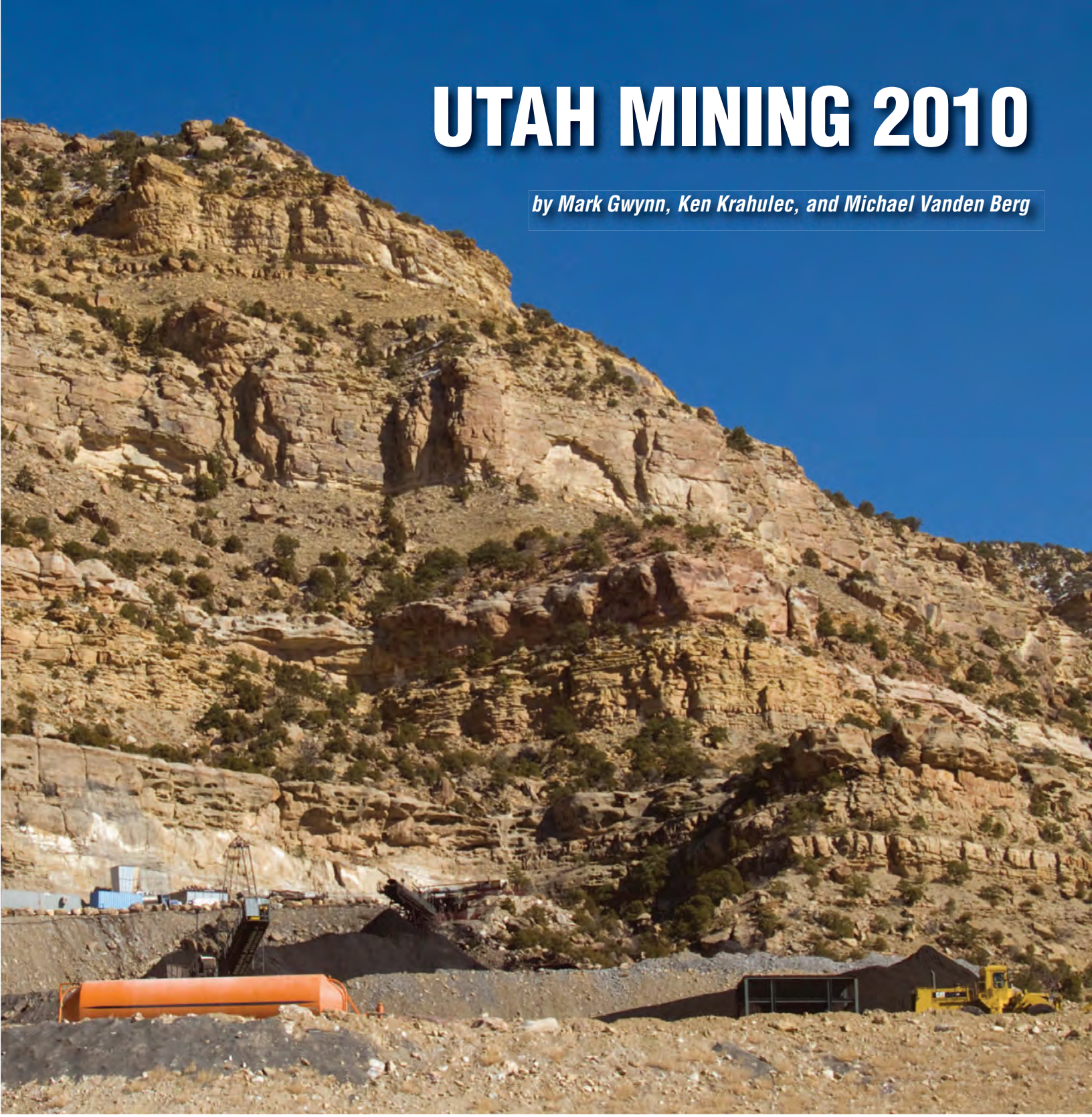
UTAH MINING 2010

by Mark Gwynn, Ken Krahulec, and Michael Vanden Berg



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Cover photo: *View of the Lila Canyon mine, Utah's newest coal mine. Initial development of the mine began during the spring of 2010 and will continue into 2014. The mine is located south of Horse Canyon in the Book Cliffs coalfield in Emery County, Utah.*

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ABSTRACT

Utah mineral and energy companies produced a gross value of $8.44 billion in energy and mineral commodities in 2010. On an inflation-adjusted basis, this is $1.12 billion (15%) more than in 2009, but $1.14 billion (12%) less than the record high of $9.58 billion reached in 2008. Mineral production (excluding oil and gas) totaled $4.89 billion, including base-metals production of $2.75 billion, industrial-minerals production of $0.86 billion, precious-metals production of $0.66 billion, and energy-minerals (coal and uranium) production of $0.63 billion. Preliminary 2010 national rankings prepared by the U.S. Geological Survey place Utah 3rd in the value of nonfuel mineral production, accounting for roughly 6.9% of the national total. Utah remained the only state that produced beryllium concentrates, gilsonite, and magnesium metal. Mineral exploration increased in 2010 with 31 Exploration Notices of Intent being filed with the state compared to 18 in 2009. The number of new federal unpatented mining claims recorded by the U.S. Bureau of Land Management increased from about 1400 in 2009 to approximately 1460 in 2010 for a total of nearly 20,000. Most exploration in 2010 was focused on copper, gold, silver, uranium, and potash. Two new coal mines are in various stages of development and will help maintain annual production at 18–21 million metric tons (20–23 million short tons) for the foreseeable future.

INTRODUCTION

Background

The Utah Geological Survey (UGS) has compiled Utah mineral activity summaries annually since 1989. Roger Bon (now retired) was the principle author of these summaries from 1989 to 2009. With the approval of Mr. Bon and UGS management, the general format and style used in recent editions of this report will be continued in order to maintain uniformity and continuity. However, the title was changed from the *Summary of Mineral Activity in Utah* to *Utah Mining 2010* to highlight the mining emphasis. These summaries were also published in the May issues of *Mining Engineering*, a publication of the Society for Mining, Metallurgy, and Exploration, Inc. until 2008. The 1996–2010 Utah mineral/mining summaries are available on the UGS website at http://geology.utah.gov/utahgeo/rockmineral/index.htm#minactivity.

Since 1993, the summaries have categorized mineral values and production into four broad segments of Utah's mineral industry. These segments are: base metals, precious metals, industrial minerals, and energy minerals (coal and uranium). Previously, the UGS published a separate Annual Utah Coal Report in addition to the Mineral Activities Summary; this marks the first year where these two reports are combined into one mining activity summary. Much of the data presented in this report were compiled through close cooperation with the U.S. Geological Survey (USGS) and the Utah Division of Oil, Gas, and Mining (DOGM). Additional data were obtained from individual operator surveys. Company websites, trade industry publications, and personal correspondence constitute additional sources of information included in this report.

Historical Context

The abundant mineral resources in Utah have proved to be a great benefit to the people here and to the entire United States for over 160 years. The production of salt from Great Salt Lake and lime products were some of the first commercial operations begun after the pioneers arrived in the Salt Lake Valley in 1847 (Powell, 1994). Most of the buildings built after 1872 at Fort Douglas were constructed of sandstone from nearby Red Butte Canyon, and many other homes and buildings throughout the state were constructed of various types of stone from other quarries (Powell, 1994). Commercial-scale production of metals, consisting primarily of gold and silver, began in 1865 and was valued at about $56,000. Copper and lead production reached commercial levels in 1870 and together with the precious metals reached a total value of over a million dollars that year (Butler and others, 1920). After the transcontinental railroad was completed in 1869, a number of branch lines were developed and each one contributed to an increase in metal production that pushed total values to over $100 million by 1917 (Stowe, 1975). Simultaneously, a number of large smelters were constructed in the Salt Lake Valley mostly just after the turn of the century, which, along with the improved infrastructure, helped establish Utah as a major regional mining and smelting center by the early 1900s (Powell, 1994).

The total value of all minerals produced in Utah and sold commercially continued to grow to more than $500 million by 1969 (Stowe, 1975) and surpassed $1 billion in 1988 (Walker and Smith, 1989). Data from the USGS and other data sources compiled by the UGS show that the nominal value of all minerals, natural gas, and oil produced in Utah increased to a record high of $9.45 billion in 2008. The global economic downturn that began in 2008 severely impacted Utah's mining industry, resulting in a substantial decrease in mineral val-

ues in 2009. Fortunately, the ongoing economic recovery is reflected by a moderate increase in the value of most energy and mineral commodities produced in Utah in 2010.

The contribution of the mining industry to the Utah Gross Domestic Product (GDP) from 2000 to 2010 is relatively small, but has been steadily increasing over the years from 1.4% in 2000 to 2.7% in 2010 (U.S. Bureau of Economic Analysis, 2011). The demand, and consequently the prices, for many of the commodities produced by Utah's mining industry will continue to rise well into the 21st century, thereby ensuring that mining will remain an important economic contributor to the state. Because some commodities, such as beryllium and magnesium metals, are critical to the security and prosperity of the United States and are produced only in Utah, the importance of the mining industry extends well beyond the state's borders.

Industry Overview

The estimated gross value of all energy and mineral commodities produced in Utah in 2010 is $8.44 billion, representing a 15% increase over the 2009 inflation-adjusted value of $7.32 billion (figure 1). The 2010 value of industrial minerals and coal dropped from 2009 levels, but marginal to substantial increases in the other commodities were more than able to compensate for these losses. Despite the overall increase, the total 2010 production value trails the revised and inflation-adjusted record of $9.58 billion set in 2008.

The value of Utah's mineral production (excluding oil and natural gas) in 2010 is estimated to be $4.89 billion (figure 2; table 1), approximately 12% higher than the revised 2009 value of $4.38 billion. Contributions from each of the mineral segments were approximately: base metals, $2.75 billion (56% of total); industrial minerals, $0.86 billion (18% of total); precious metals, $0.66 billion (13% of total); and solid energy minerals, $0.63 billion (13% of total) (figure 2; table 1). Compared to 2009, the 2010 values of base metals increased $609 million (28%), industrial minerals decreased $94 million (10%), energy minerals decreased $24 million (4%), and precious metals increased $22 million (4%).

After a five-year run-up, commodity prices in general peaked in mid-2008, before collapsing late in the year. Prices for many mineral commodities, especially metals, rebounded slowly throughout 2009 and into 2010 with some increasing sharply late in 2010. However, many industrial mineral prices remained low as a result of a recession-related decrease in construction activity in the U.S. These low prices effectively limited the value of industrial minerals as a group in 2010, despite production increases for many of the individual commodities. In contrast, decreased production of many metals was compensated for by substantially higher prices leading to

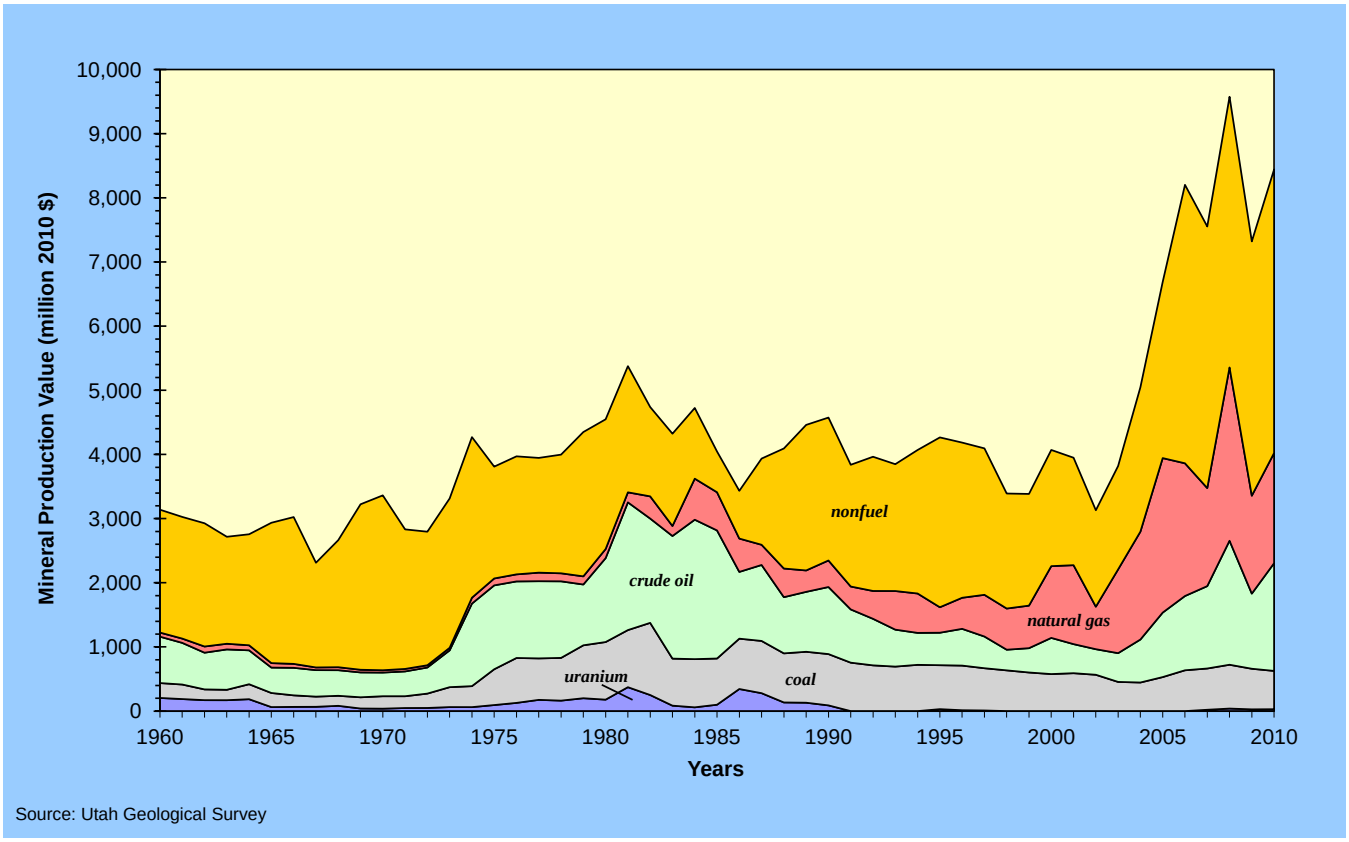

Figure 1. *Total annual value of Utah's energy and mineral production, inflation adjusted to 2010 dollars, 1960–2010.*

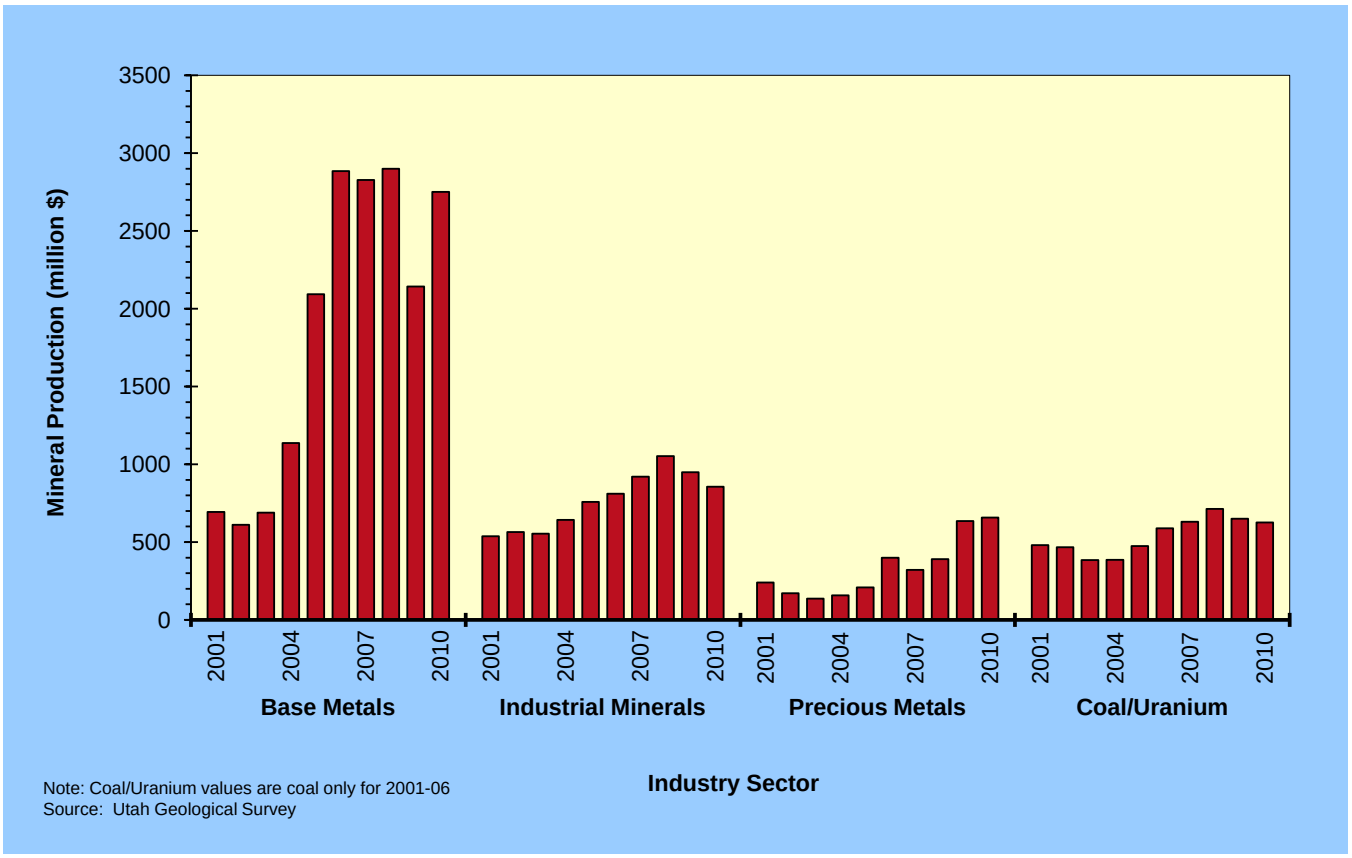

Figure 2. *Value of Utah's annual mineral production in nominal dollars, by industry sector, 2001–2010.*

Table 1. *Utah estimated mineral production values in nominal dollars, by industry segment, 2001–2010. Values are in millions.*

Year	Base Metals	Industrial Minerals	Precious Metals	Energy Minerals (coal & uranium)	Total Value
2001	$693	$538	$240	$480	$1951
2002	$612	$565	$172	$467	$1815
2003	$690	$555	$136	$384	$1765
2004	$1136	$643	$158	$386	$2324
2005	$2093	$759	$209	$475	$3536
2006	$2885	$811	$400	$588	$4684
2007	$2827	$921	$322	$631*	$4701*
2008	$2900	$1053	$390	$713*	$5057*
2009	$2142*	$949*	$635	$650*	$4376*
2010	$2751	$856	$658	$626	$4890

Note: Totals may not equal the sum of individual parts due to rounding.
* = Revised Data.

record highs for precious metals. Uranium oxide spot prices rose from about $18/kg ($8/lb) in 2001 to a high of $300/kg ($136/lb) in June 2007 before dropping to around $88/kg ($40/lb) in early 2010. The low price remained relatively stable through much of 2010 before climbing to about $119/kg ($54/lb) at the end of the year. Because uranium exploration and development activity closely tracks the spot price, a number of mines that were rehabilitated when prices were high in 2007 were idled after prices dropped in 2010. Temporary shutdowns, indefinite idling, and scheduled maintenance at several coal mines, combined with decreased demand, resulted in 2010 production being the lowest since 1988, despite a healthy price of about $34/metric ton (t) or $31/short ton (st).

The number of mining leases issued by the Utah School and Institutional Trust Lands Administration (SITLA) more than doubled in 2010. The Utah Division of Oil, Gas, and Mining noted a 52% increase in small and large mine Notice of Intent (NOI) applications and a 72% increase in Exploration NOIs in 2010 compared to the previous year. A smaller increase was also seen in the number of unpatented mining claims filed with the Bureau of Land Management (BLM). Base-metal exploration in 2010 was dominated by major companies performing brownfield exploration in the Bingham and Tintic mining districts. Escalating precious-metals prices in 2010 prompted renewed gold and silver exploration activity largely focused in the eastern Basin and Range Province of western Utah. Increased exploration for industrial minerals was observed in 2010. The largest of these efforts include potash exploration in the Paradox Basin of southeastern Utah and around Sevier Lake (dry) in Millard County. The uranium industry also expanded in 2010 as two companies acquired new properties and another proposed to construct a new uranium mill near Green River, Utah. Recently, two new coal mines began development and minor production, the Lila Canyon mine in the southern portion of the Book Cliffs coalfield in Emery County and the Coal Hollow surface mine in the Alton coalfield in Kane County.

Outlook for 2011

Nearly 75% of the companies surveyed for this report plan to duplicate 2010 production in 2011 and another 19% project slight to moderate production increases. Therefore, the overall economic value of most nonfuel mineral commodities in 2011 will be strongly dependent on prices. Late 2010 price increases for many base and precious metals suggest overall value will rise in 2011. After a one-year idle period, Utah's lone iron mine returned to active mining in 2010 with projections for substantial ore production in 2011 that should further boost base metal values. Industrial mineral production will probably remain stable or increase slightly in 2011, but prices for most industrial minerals appear unlikely to make any substantial gains. Consequently, the overall value for industrial minerals will likely remain flat. Substantial increases in uranium spot prices during the last half of 2010 and early 2011 initially suggested that several idle uranium mines might reopen in 2011, thereby increasing both uranium and byproduct vanadium production and overall mineral values. However, spot price declines after the March 2011 earthquake in Japan, which heightened concerns about the future of nuclear power, likely mean that any gains in uranium and vanadium production and value will be marginal. With a return to full-year production at the Deer Creek and Dugout Canyon mines, as well as the reopening of the Castle Valley mine (formally the Bear Canyon mine), Utah's coal production should increase to 18.4 million t (20.3 million st) in 2011. The price for coal in 2011 is predicted to rise slightly to $35/t ($32/st) and along with a modest increase in production, the overall value of coal could reach about $650 million.

The expected value increase in metals, which accounted for over 79% of the total value of nonfuel minerals and uranium in 2010, will likely compensate for the predicted flat to moderate growth in the value of industrial minerals and uranium, as it did in the previous year. Consequently, a modest overall value increase for all nonfuel minerals and uranium may be expected in 2011.

The 2010 increase in exploration activities, as suggested by the substantial increase in mining leases, claims, permits, and NOIs, can be expected to continue in 2011. A large percentage of exploration activities in 2010 were focused on base and precious metals, so it is likely that the upward trend in exploration for these commodities will continue if prices rise.

NATIONAL RANKINGS

Preliminary 2010 data from the USGS data rank Utah 3rd nationally for the value of nonfuel mineral production, with 6.9% of the United States total. The data also show that Utah's nonfuel mineral production value climbed from $3.90 billion in 2009 to an estimated record high of $4.42 billion in 2010 (USGS, 2011a). According to the USGS, the value of nonfuel mineral production between 2001 and 2010 grew from a low of $1.24 billion (2002) to the new 2010 record while the state of Utah's national rank climbed from 11th to 3rd place (figure 3). The USGS data indicate that Utah is still the only state producing beryllium concentrates and magnesium metal. Based on annual production data from the U.S. Energy Information Administration (2011), Utah ranked 15th in the total amount of coal produced in 2010.

BASE- AND PRECIOUS-METAL PRODUCTION

The value of base and precious metals produced in Utah during 2010 is estimated to be $3.41 billion, which is about 80% of the total value of all nonfuel minerals produced in Utah. Overall, the values of Utah metals production increased about 23% from 2009.

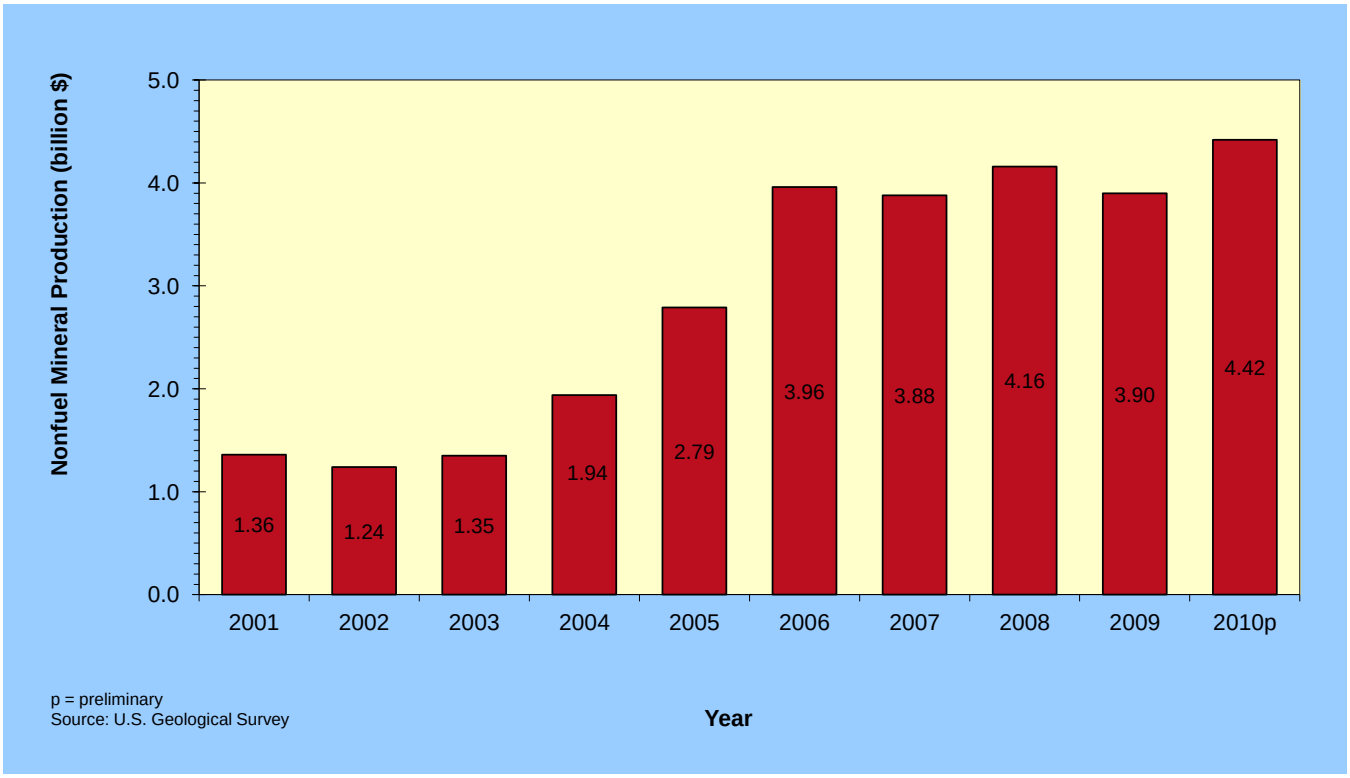

Figure 3. *Total annual value of Utah's nonfuel mineral production in nominal dollars, 2001–2010. Source: U.S. Geological Survey.*

Base metal production in 2010 is estimated at $2.75 billion and constitutes about 65% of the total value for all nonfuel mineral production in Utah (figure 2; table 1). Base metal values climbed about 28% over the 2009 figures, based primarily on increasing unit prices and to a lesser extent on increased production of some commodities. Three metals account for roughly 98% of the total base metal value: copper, molybdenum, and magnesium. Beryllium, vanadium, and iron constitute the remaining 2% of the total base metal value.

Precious metal values totaled $658 million, distributed between gold (87%) and silver (13%) (figure 2; table 1). Overall, precious-metal values in 2010 were almost 4% higher than in 2009. Both gold and silver production declined substantially in 2010, so the increased value is the direct result of soaring precious metal prices.

Kennecott Utah Copper Corp.'s (KUCC) Bingham Canyon mine, located about 32 km (20 mi) southwest of Salt Lake City in Salt Lake County, produces the majority of Utah's copper, gold, and silver. The Bingham Canyon mine is the only source of molybdenum in Utah. Kennecott also produces a relatively small quantity of gold at the Barneys Canyon facility about 4 km (2.5 mi) north of the Bingham Canyon operation. At approximately $3.04 billion, the combined value of metals produced by KUCC in 2010 was about 71% of the total value of all nonfuel minerals produced in the state.

Copper

Copper was the largest contributor to the value of nonfuel minerals in 2010 with a value estimated at over $1.98 billion. Copper production at KUCC's Bingham Canyon mine totaled about 250,000 t (276,000 st) in 2010, a substantial decrease from the 304,000 t (335,000 st) produced in 2009, but still slightly above 2008 production (Rio Tinto, 2010). However, the decreased 2010 production was offset by a significant price increase that boosted copper production values by 17% from 2009.

Lisbon Valley Mining Co. initiated copper mine development about 48 km (30 mi) southeast of Moab in San Juan County in 2005. A number of problems prevented any substantial copper production until mid-2009. About 7,080 t (7,800 st) of copper cathode were produced in 2010.

Copper is used to produce a wide range of products including electrical wiring, electronic components, and pipe for plumbing, heating, and refrigeration systems. Copper is also combined with a number of metals, especially zinc and tin, to create alloys for a wide variety of applications.

Molybdenum

At $455 million, molybdenum was the second-largest contributor to the value of base metals in 2010. Approximately

12,900 t (14,200 st) of byproduct molybdenum were recovered at KUCC's Bingham Canyon mine in 2010, approximately 14% more than the previous year (Rio Tinto, 2011). Increased production and a price jump yielded a 2010 production value roughly 86% higher than in 2009. According to the USGS, the Bingham Canyon mine is one of five domestic copper mines that recovered molybdenum as a byproduct in 2010, while three other mines produced it as a primary ore. The USGS also reports that the total U.S. mine output of molybdenum in concentrate increased approximately 17% over 2009 (USGS, 2011a). Approximately 75% of the molybdenum is combined with other metals to produce various alloys (USGS, 2011a).

Magnesium

Magnesium metal was the third-largest contributor to the value of base metals in 2010. An electrolytic process is used to produce magnesium metal from Great Salt Lake brines at a plant operated by US Magnesium, LLC. The plant is located at Rowley in Tooele County and is the only primary magnesium processing facility in the United States. According to the USGS (2009), annual production capacity at the plant is approximately 52,000 t (57,000 st). Overall consumption of magnesium metal in the U.S. can be attributed to aluminum-based alloys (41%), structural uses such as castings (32%), desulfurization of iron and steel (13%), and various other uses (14%) (USGS, 2011a). Magnesium production in 2010 was somewhat higher than in 2009 and is projected to experience an additional, but smaller, increase in 2011. The average price for magnesium metal increased from $5.07/kg ($2.30/lb) in 2009 to $5.73/kg ($2.60/lb) in 2010 (USGS, 2011a).

Beryllium

Utah remains the nation's sole producer of beryllium concentrates, the fourth-largest contributor to 2010 base metal values. Materion Natural Resources, Inc., formerly Brush Resources, operates a beryllium (bertrandite) mine about 68 km (42 mi) northwest of Delta in Juab County and a mill 18 km (11 mi) north of Delta in Millard County where it converts the bertrandite ore, along with imported beryl and beryl from the National Defense Stockpile, into beryllium hydroxide. The beryllium hydroxide is then shipped to a refinery and finishing plant in Ohio operated by Materion Corp. (the parent company) where it is further processed into beryllium-copper master alloy, metal, and oxide. Beryllium is used in various electronic devices, industrial components, and aerospace/defense components. About 14,000 t (15,400 st) of ore was mined in 2010. The USGS (2011a) estimated 2010 beryllium concentrate production to be about 170 t (187 st), an increase of 50 t (55 st) over 2009 production. Proven reserves of bertrandite from the Spor Mountain area in Utah are about 15,900 t (17,500 st) of contained beryllium (USGS, 2011a). A rebound in many of the markets using beryllium and a substantial price increase significantly enhanced the beryllium value in 2010. Approximately 65% of the output from the facility is intended for defense/governmental use with the remaining portion going to the private sector (USGS, 2011a).

Vanadium

Vanadium, in the form of vanadium pentoxide (V_2O_5), is co-produced with uranium during the milling of uranium ore. Vanadium ranked fifth as a contributor to Utah's base metal values in 2010. Denison Mines (USA) Corp. produced about 943 t (1040 st) of vanadium in 2010. Average vanadium pentoxide prices, which experienced a sharp decline in 2009 to $11.97/kg ($5.43/lb), rebounded slightly to an estimated $14.11/kg ($6.40/lb) in 2010. Vanadium is a ferroalloy closely tied to the steel industry, which consumes the majority of annual vanadium production (USGS, 2011a). The uranium section of this report contains additional information on the uranium-vanadium mines.

Iron Ore

Iron ore production was reinitiated at the Iron Mountain mine in the last quarter of 2010 with the shipment of approximately 190,000 t (209,000 st) of ore by CML Metals, Inc., the sole producer in the state. The mine is located about 30 km (19 mi) west of Cedar City in Iron County. The ore had been stockpiled since mining ceased in 2009. The mine reopened in mid-2010 and production reached roughly 50,000 t (55,000 st) per month by the end of the year. Production was expected to increase to about 100,000 t (110,000 st) per month early in 2011. Construction of a magnetic concentrator is planned to begin in early 2011 and the unit is expected to be fully operational in early 2012. The concentrator will have a planned capacity of about 167,000 t (184,000 st) per month (CML Metals, 2011).

Gold

Over 468,000 troy ounces (oz) of gold were produced in Utah in 2010, approximately 116,000 troy oz less than in 2009 (Rio Tinto, 2011). Most of this gold is recovered as a byproduct of the copper operation at KUCC's Bingham Canyon mine. The Barneys Canyon mine, also owned by KUCC, exhausted its economic ore reserves and ceased active mining in late 2001. Since then, gold has been produced from residual leaching of existing heaps at a declining rate that amounted to about 2400 troy oz in 2010. Despite the decreased gold production, substantial price increases in 2010 raised the value about 2% to around $575 million.

Silver

Silver is another byproduct metal from the Bingham Canyon mine. Silver production decreased by about 23% to around 3.75 million troy oz in 2010 (Rio Tinto, 2011). However, climbing silver prices resulted in an overall value of about $82.6 million, which is 15% higher than in 2009. Several other small mines in Utah may produce small quantities of gold

and silver, but production is not reported nor would it make any substantial impact on the above totals.

INDUSTRIAL-MINERALS PRODUCTION

At an estimated value of $856 million, industrial-minerals production was the second- largest contributor to the total value of minerals produced in Utah during 2010 (figure 2; table 1). Industrial minerals constitute 20% of the total value of nonfuel mineral production in 2010. Industrial mineral values decreased about $94 million (10%) in 2010 compared to 2009, but the difference was less pronounced than the 2008 to 2009 drop. Industrial mineral values more than doubled between 2000 and 2008 when a record-breaking high of $1.05 billion was reached. Since then, industrial mineral values have steadily declined to a pre-2007 level. The economic downturn severely impacted the construction industry, a major consumer of industrial minerals, and is a major reason for the decline. Despite the decreases of the last three years, the industrial mineral value in 2010 is still about 59% higher than in 2001.

Brine-derived products, including salt, magnesium chloride, and potash, were the largest contributors to the value of industrial-minerals production in Utah in 2010, with a combined value of $370 million, about $75 million (17%) less than in 2009. Sand and gravel, crushed stone (including limestone and dolomite), and dimension stone contributed the second-largest share of the overall value of industrial minerals produced in Utah during 2010, with an estimated value of $201 million, a $9 million (4%) decrease from 2009. Portland cement and lime products were the third-largest contributors to the 2010 value of industrial minerals with a combined value of $156 million, roughly $10 million (6%) less than in 2009. These three commodity groups contribute about 85% of the total value of industrial minerals produced in Utah. Most of the remainder of the value of industrial minerals in Utah are shared, in descending order of value, by phosphate; gilsonite; bentonite, common clay, and kaolin; expanded shale; and gypsum. Most industrial mineral producers expect to mirror their 2010 production in 2011, but a significant number expect increased production.

Salt, Magnesium Chloride, and Potash

Great Salt Lake is an important resource for the production of salt and other brine-derived commodities, including magnesium chloride and potash in the form of potassium sulfate. Operations in other areas of the state produce potash in the form of potassium chloride along with lesser amounts of magnesium chloride and salt. Additionally, Mineral Resources International, Inc. (NorthShore Limited Partnership) produces a small amount of concentrated magnesium brine for use in nutritional supplements.

Estimated salt production in 2010 was 2.5 million t (2.8 million st), a decrease of about 0.5 million t (0.6 million st) from the previous year. Three operators processing brine from Great Salt Lake are responsible for 76% of salt production in Utah. These operators are, in descending order of production, (1) Great Salt Lake Minerals Corp., (2) Cargill Salt Co., and (3) Morton International. The remaining salt production comes from Redmond Minerals, Inc. near Redmond in Sanpete County, Intrepid Potash-Wendover, LLC near Wendover in Tooele County, and Intrepid Potash-Moab, LLC near Moab in Grand County.

Magnesium chloride production in Utah decreased slightly in 2010 compared to 2009. Magnesium chloride is produced by Great Salt Lake Minerals on the east side of the Great Salt Lake and Intrepid Potash-Wendover, LLC.

Potash production in 2010 totaled approximately 339,000 t (374,000 st), about 10 t (11 st) more than in 2009. The potassium chloride form of potash is produced by Intrepid Potash-Wendover, LLC and Intrepid Potash-Moab, LLC, while Great Salt Lake Minerals Corp. produces the potassium sulfate variety.

Sand and Gravel, Crushed Stone, and Dimension Stone

More than 150 active pits and quarries across the state produce sand and gravel, dimension stone, and crushed stone. These materials are produced by commercial operators as well as various county, state, and federal agencies. The UGS does not send annual production questionnaires to the producers of this commodity group due to the sheer numbers involved. The USGS does, however, compile data and track this industry. In 2010, Utah operators produced approximately 28.4 million t (31.3 million st) of sand and gravel valued at $155 million (USGS, 2011b). Additionally, about 32,000 t (35,000 st) of industrial silica sand was produced in Utah during 2010. The USGS (2011b) estimates that about 5.3 million t (5.8 million st) of crushed stone valued at $43 million was produced in the state in 2010, along with approximately 8,700 t (9,600 st) of dimension stone with a value of $674,000. As a group, these commodities reflect a decrease in production of about 970,000 t (1.1 million st) and a $4 million drop in value, primarily due to decreased production of sand and gravel in the 2nd and 3rd quarters of 2010 compared to the same time frame in 2009 and slightly lower unit prices (USGS, 2011b). The continuing depression of the regional and local construction industries is the main cause of these decreases.

Portland Cement, Lime, and Limestone

Portland cement is produced in Utah by Holcim, Inc. and Ash Grove Cement Co. Holcim operates the Devils Slide plant and mine located east of Morgan in Morgan County and Ash Grove Cement operates the Leamington plant and mine east

of Lynndyl in Juab County. Cement production in 2010 was about 88% of the 2009 level and well below the maximum combined potential of over 1.4 million t (1.5 million st). Ash Grove Cement also mines some shale and sandstone that are used in cement manufacturing.

Lime is typically produced by two companies in Utah. Graymont Western US, Inc. produces high-calcium quicklime and dolomitic quicklime at a plant in the Cricket Mountains approximately 56 km (35 mi) southwest of Delta in Millard County. Lhoist North America also produces dolomitic quicklime as well as hydrated dolomitic lime at their plant about 13 km (8 mi) northwest of Grantsville in Tooele County. However, the Lhoist plant was idled by the previous owner (Chemical Lime of Arizona) in 2008 and will likely remain closed through at least 2011. When both plants are operating, the annual production capacity for lime exceeds 900,000 t (1.0 million st). Lime production in 2010 surpassed 2009 production by about 13%.

Over 2.8 million t (3.1 million st) of limestone was produced in Utah in 2010. Most limestone is used in the manufacture of cement and lime products and is mined by Graymont Western US, Inc., Ash Grove Cement Co., and Holcim, Inc. Lesser quantities of limestone are used in other aspects of the construction industry and for flue-gas desulfurization in coal-fired power plants. Some of the high-calcium limestone used for flue-gas desulfurization is produced by Cotter Corp. in San Juan County and Diamond Mountain Resources in Uintah County. Small quantities of limestone are also pulverized and sold to the coal mining industry as “rock dust.”

Phosphate

Simplot Phosphates, LLC is the only active phosphate producer in Utah. The mine produced about 3.4 million t (3.7 million st) of ore in 2010, nearly the same as in 2009. Simplot’s phosphate operation is located 19 km (12 mi) north of Vernal in Uintah County. About 2.7 to 3.6 million t (3.0–4.0 million st) of ore is mined annually. Processing of the ore yields approximately 0.9 to1.8 million t (1.0–2.0 million st) of phosphate concentrate, which is then transported in slurry form through a 155 km (96 mi) underground pipeline to the company's fertilizer plant near Rock Springs, Wyoming.

Gilsonite

Gilsonite is a shiny, black, solid hydrocarbon that has been mined in Utah since the late 1800s. Gilsonite is an important industrial mineral that is shipped worldwide for use in over 150 diverse products ranging from printing inks to explosives. American Gilsonite Co. and Ziegler Chemical and Minerals Co. both mined gilsonite in 2010. All of the gilsonite mines are located in southeastern Uintah County. American Gilsonite accounted for most of the gilsonite mined in 2010. Gilsonite production was about 5% higher in 2010 than in 2009.

Common Clay, Bentonite, and High-Alumina Clay

Nearly 243,000 t (268,000 st) of common clay, bentonite, and high-alumina clay were mined in Utah during 2010, about 22% more than was produced in 2009. Many small and large mines produce these commodities although some only operate intermittently. The three largest producers of common clay, in descending order of production, were Interstate Brick Co., Interpace Holdings, LLC, and Holcim (U.S.) Inc. Together they produced about 110,000 t (121,000 st) of common clay, which is primarily used to manufacture bricks. Western Clay Co. and Redmond Minerals, Inc. together produced well over 100,000 t (110,000 st) of bentonite. Bentonite is used in many applications in civil engineering, well drilling and foundry operations, and as litter-box filler. High-alumina clay production in 2010 was minimal, as the primary producers from previous years reported little or no new production. High-alumina clays are mainly used as Portland cement raw material in Utah.

Expanded Shale

Expanded shale production in Utah was about 15% lower in 2010 compared to the previous year. Utelite, Inc. is the only expanded shale producer in Utah, operating a mine and plant near Wanship in Summit County. Expanded shale, sometimes called “bloated shale,” is a lightweight aggregate used primarily in the construction industry. High-purity shale from the Cretaceous Frontier Formation is heated to about 1100° C (2000°F), causing it to expand and vitrify. The resulting aggregate is stable, durable, and lightweight with a density of only about one half that of conventional aggregates used in various construction, geotechnical, and horticultural applications.

Gypsum

Roughly 167,000 t (184,000 st) of gypsum was produced by four operators in 2010. Although this quantity represents a 20% increase over the previous year, 2010 saw the second-lowest gypsum production of the past 15 years. Utah gypsum producers, in descending order of production, were (1) Sunroc Corp., (2) United States Gypsum Co., (3) Diamond K Gypsum, Inc., and (4) Nephi Gypsum. Utah has two wallboard plants, both near the town of Sigurd in Sevier County. The United States Gypsum plant was active in 2010, but the Georgia Pacific plant was not due to economic considerations. This plant was closed from 2002 to 2006, closed again in 2008, and is now expected to remain idle for the foreseeable future. Most Utah gypsum is used in wallboard although some is used as a cement additive or soil conditioner. Decreased gypsum production can be traced to the continuing depression of the housing and construction industry.

ENERGY MINERALS PRODUCTION

Coal

Six Utah coal operators produced 17.6 million t (19.4 million st) of coal valued at $597 million from eight underground mines in 2010 (figures 4 and 5). This production was 2.3 million t (2.5 million st) (11.5%) less than in 2009. The majority of this drop was attributed to the Deer Creek mine shutting down production for three months to refurbish their longwall mining machine, the several-month shutdown at Dugout Canyon due to mining problems, and the closing of the Bear Canyon mine during its pending sale (table 2). In addition to these mining-related production losses, demand for coal, especially at electric utilities, is down because of a recession-related drop in demand for electricity. Utah's 2011 coal production should increase to 17.8 million t (19.6 million st) due to increased production at the West Ridge and Horizon mines, a return to full-year production at the Deer Creek mine, and the re-opening of the Bear Canyon mine (now called Castle Valley) (table 2). However, some production gains will be offset by the December 2010 idling of the Emery mine, which had produced about 0.9 million t (1.0 million st) each year.

In 2010, the majority of Utah coal, 11.5 million t (12.7 million st), was produced from the Wasatch Plateau coalfield. An additional 5.2 million t (5.7 million st) was produced from mines in the Book Cliffs coalfield and 906,000 t (999,000 st) came from the Emery mine in the Emery coalfield. For the first time in history, the majority of Utah coal, 52.8% (9.3 million t, 10.3 million st) was produced on state-owned land, with only 42.2% (7.4 million t, 8.2 million st) from federal land. The remainder was produced from private (4.1%, 728,000 t, 802,000 st) and county (0.8%, 136,000 t, 150,000 st) land. In 2011, production from federal land should once again be the dominant source.

As a result of steady reserve depletion and difficult mining conditions, coal operators periodically look to new areas to replenish their reserve base. For the first time in several years, two new coal mines are in various stages of development. UtahAmerican Energy commenced development of the Lila Canyon mine in the southern portion of the Book Cliffs coalfield in Emery County. Miners entered the coal seam in June 2010, producing 65,300 t (72,000 st) for the year, and are expected to produce about 127,000 t (140,000 st) of coal throughout 2011 while developing the mine for longwall production—full production, about 4.1 million t (4.5 million st) per year, at Lila Canyon is still several years away. In addition, Alton Coal Development acquired the necessary permits to produce coal from an open-pit mine on private land in southern Utah's Alton coalfield—mine development is currently underway and the company could produce about 363,000 t (400,000 st) in 2011. In the meantime, the BLM continues to make progress on an Environmental Impact Statement (EIS), which is needed before Alton Coal Development can lease surrounding federal coal. To increase its reserve base, Canyon Fuel Co. recently leased the state-managed Cottonwood tract in the Wasatch Plateau coalfield (which was recently sold to PacifiCorp) and has nominated for lease the large Greens Hollow tract near the company's SUFCO mine. Production from these new operations and lease areas could offset declining production from existing mines and keep Utah's production between 18 and 21 million t (20 to 23 million st) for the foreseeable future.

The total amount of Utah coal distributed to market is proportional to the amount of Utah coal produced. With production dropping in 2010, distribution of Utah coal also declined to 17.3 million t (19.1 million st), 84% of which goes to the electric utility market. As a result of the slowed U.S. economy, demand for electricity decreased, resulting in a 26% drop in the demand for Utah coal at electric generating facilities between 2008 and 2010, from 19.5 million t (21.5 million st) in 2008 to 14.5 mil-

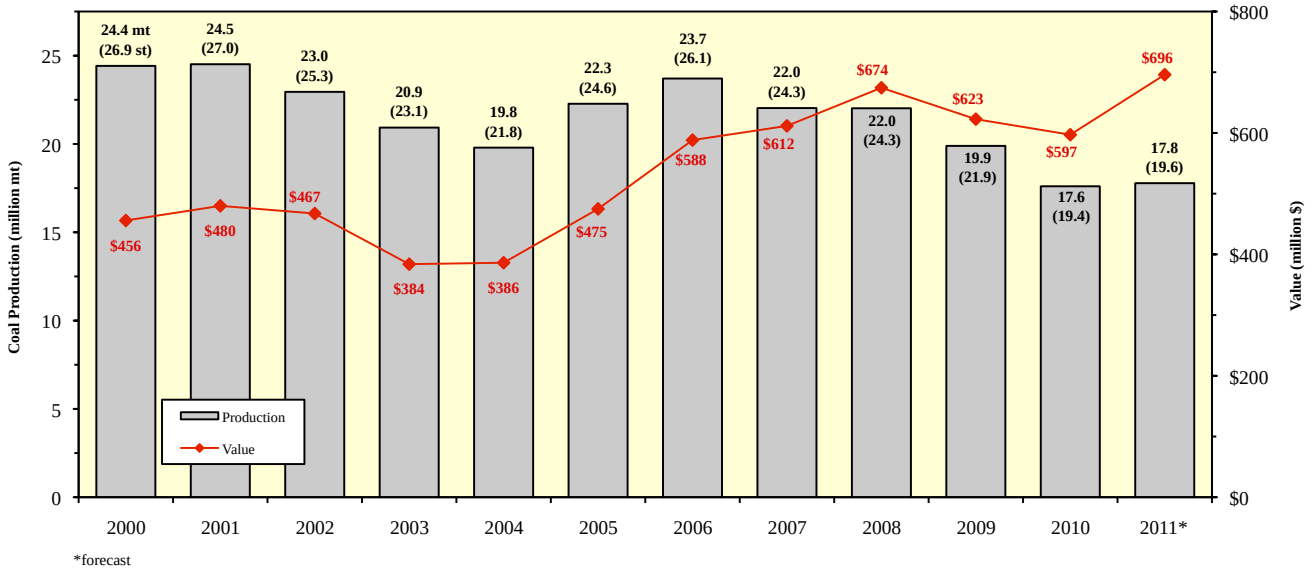

Figure 4. *Utah's annual coal production and value in nominal dollars, 2000–2011.*

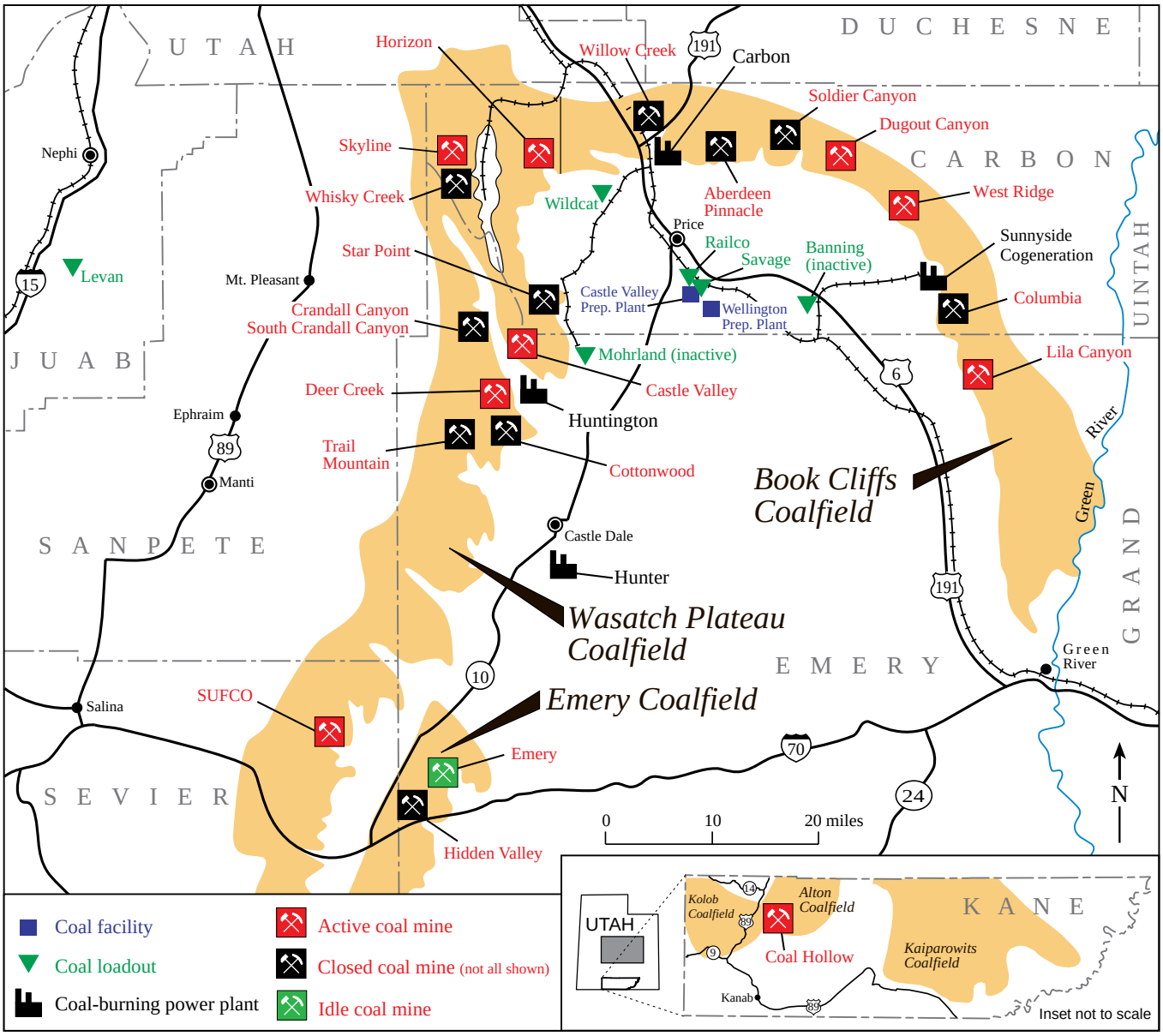

Figure 5. *Location and status (at time of printing) of Utah's coal mines and associated facilities.*

lion t (16.0 million st) in 2010. The economic recession also slowed demand for Utah coal in the industrial sector; deliveries dropped from 2.9 million t (3.2 million st) in 2008 to 2.3 million t (2.5 million st) in 2010, the lowest level since 1987. Coal deliveries in 2011 are expected to rebound slightly to 17.9 million t (19.7 million st) following a predicted increase in Utah coal production and a steadily recovering economy. Utah operators rely on out-of-state demand and foreign export markets for consumption of roughly one-third of Utah's annual coal production.

For detailed statistics on Utah's coal industry (including information previously published in the Annual Utah Coal Report), please refer to the abundant data tables located on the UGS's Utah Energy and Mineral Statistics website: http://geology.utah.gov/emp/energydata.

Uranium

Denison Mines (USA) Corp. and Utah Energy Corp. (a subsidiary of White Canyon Uranium Ltd.) were responsible for most uranium production in Utah during 2010. Together they produced about 280 t (310 st) of uranium oxide with a value of approximately $28 million from three mines in southern Utah. The uranium and byproduct vanadium ore mined by the companies was hauled to Denison's White Mesa mill about 10 km (6 mi) south of Blanding in San Juan County for processing into uranium oxide (U_3O_8) and vanadium pentoxide (V_2O_5). The sharp decline in uranium spot prices after the mid-2007 high of $300/kg ($136/lb) extended through the first half of 2010, resulting in less intensive uranium exploration and production. The spot price recovery that began in the

Table 2. *Coal production in Utah by mine, 2009–2011.*

Company	Mine	County	Coalfield	2009		2010		2011*	
				thousand mt	thousand st	thousand mt	thousand st	thousand mt	thousand st
UtahAmerican Energy, Inc.–Murray Energy Corp.	Lila Canyon	Emery	Book Cliffs	--	--	66	72	127	140
Canyon Fuel, LLC–Arch Coal, Inc.	Dugout Canyon	Carbon	Book Cliffs	2985	3291	2093	2307	2268	2500
	Skyline #3	Carbon	Wasatch Plateau	2640	2910	2767	3050	2631	2900
	SUFCO	Sevier	Wasatch Plateau	6122	6748	5804	6398	5534	6100
CONSOL Energy	Emery	Emery	Emery	1123	1238	907	999	--	--
Castle Valley Mining[1]–Rhino Resources	Castle Valley #4	Emery	Wasatch Plateau	590	651	--	--	454	500
Energy West Mining Co.	Deer Creek	Emery	Wasatch Plateau	3477	3833	2680	2954	2540	2800
Hidden Splendor Resources, Inc.–America West Resources, Inc.	Horizon	Carbon	Wasatch Plateau	176	194	245	270	363	400
WEST RIDGE Resources, Inc.–UtahAmerican Energy, Inc.–Murray Energy	West Ridge	Carbon	Book Cliffs	2779	3063	3043	3355	3538	3900
Alton Coal Development	Coal Hollow	Kane	Alton	--	--	--	--	363	400
Total				19,892	21,927	17,605	19,406	17,817	19,640

Source: UGS coal company questionnaires

[1]Formerly owned by C.W. Mining (until summer 2010)–mines formerly called Bear Canyon

* = Forecast

last half of 2010 was the primary reason that production and value increased by about 6% and 5% respectively from 2009.

EXPLORATION AND DEVELOPMENT ACTIVITY

Mineral exploration and development work continued at a slow pace similar to 2009 through the first three quarters of 2010 before rapidly picking up late in the year. Most of these exploration efforts focused on copper, gold, silver, and potash. Commodity prices generally peaked in July 2008, collapsed late that year, then gradually rebounded throughout 2009 and 2010. The information in this section is largely derived from numerous individual mining company websites and press releases as well as the DOGM website (www.ogm.utah.gov/minerals). A map showing the location of selected exploration areas in 2009 is shown in figure 6.

Claims, Leases, and Mine Permits

The number of new unpatented mining claims filed in Utah rose dramatically from a low of 508 in 2001 to over 7900 in 2007. More than 1460 new claims were staked in Utah during 2010. Beaver (Cu), Tooele (Cu, Au), Juab (Au, Be, REE), San Juan (U), and Garfield (U) Counties each recorded over 100 new mining claims. At the end of 2010, the BLM had a total of nearly 20,000 unpatented mining claims filed in Utah (Opie Abeyta, Utah BLM, written communication, March 2011).

SITLA, which manages about 1.8 million hectares (4.4 million acres) of state-owned lands in Utah, issued leases and/or contracts on 124 tracts in 2010, more than double the 61 in 2009. These were divided among the following commodities: metals (60), potash (26), sand and gravel (20), geothermal (3), coal (2), clay (2), gemstone/fossil (1), humic shale (1), and other (9) (William Stokes, SITLA, written communication, March 2011).

DOGM received eight new Large Mine Notice of Intent (NOI) applications and 21 new Small Mine NOI applications in 2010. This is an increase of four Large Mine NOI applications and an increase of six Small Mine NOI applications compared to 2009. The number of DOGM NOIs to explore on public lands rebounded, with 31 being filed in 2010 compared to just 18 in 2009. The 2010 Exploration NOIs included 11 for base and precious metals, 10 for uranium, 6 for industrial minerals, 2 for oil sands/oil shale, and 2 for other commodities.

Base and Precious Metals

Base metals had a very strong year in 2010. The Bingham Canyon mine continued to produce near-record profits, a sediment-hosted copper solvent extraction-electrowinning (SX-EW) operation in Lisbon Valley ramped back up toward full production, and the Iron Mountain mine resumed production in 2010. Base-metal exploration in 2010 was dominated by major companies doing brownfield exploration in the Bingham and Tintic mining districts.

Strong, escalating precious-metal prices in 2010 also prompted renewed exploration activity for Au and Ag in Utah, particularly in the final quarter of 2010, following on the heels of the recession in 2009. Precious-metal exploration was largely focused in the eastern Basin and Range Province of western Utah.

Bingham Canyon

Kennecott Utah Copper Corp.'s (KUCC) Bingham Canyon porphyry Cu-Mo-Au-Ag mine (figures 6 and 7), Salt Lake County, was again the largest producer of Cu and the second-largest producer of Mo in the U.S. in 2010. Kennecott also continued an aggressive development program with efforts concentrated on extending the mine life past the current 2019 planned end. The Cornerstone project (southwest pushback), if approved, will extend the mine life to 2028 while maintaining other long term development options. Kennecott has begun construction of a $340 million molybdenum autoclave process (MAP) facility scheduled to begin production in late 2012. The new facility will have the capacity to produce 13.6 million kg (30 million pounds) of Mo products and an additional 4090 kg (9000 pounds) of rhenium per year.

During 2010, KUCC brownfield exploration in the Oquirrh Mountains included adding 77 magnetotelluric stations to the existing grid and the completion of 13 deep core holes totaling 15,851 m (52,004 ft), principally within 4 km (2.5 mi) of the Bingham pit. One other hole was drilled (1557 m [5107 ft]) in the southwestern Oquirrh Mountains (Russ Franklin, Kennecott Exploration Company, written communication, March 2011).

Lisbon Valley Copper

The Lisbon Valley Mining Co., LLC began copper mine (figure 6) and leach pad development in San Juan County in 2005 with plant construction at the open-pit, heap leach, SX-EW Cu operation completed the following year. Following some startup problems, the Lisbon Valley Mining Co. mine became fully operational in 2009. Lisbon Valley copper production in 2010 is estimated at 7100 t (7800 st) of Cu and year-end reserves are roughly estimated at 30 million t (33 million st) averaging 0.5% Cu.

Iron Springs

The Iron Mountain mine (formerly the Comstock-Mountain Lion open pit), Iron County, was acquired by Palladon Iron Corp. in 2005 (figure 6). The company was restructured into CML Metals Corp. in early 2010. The ore occurs as a massive

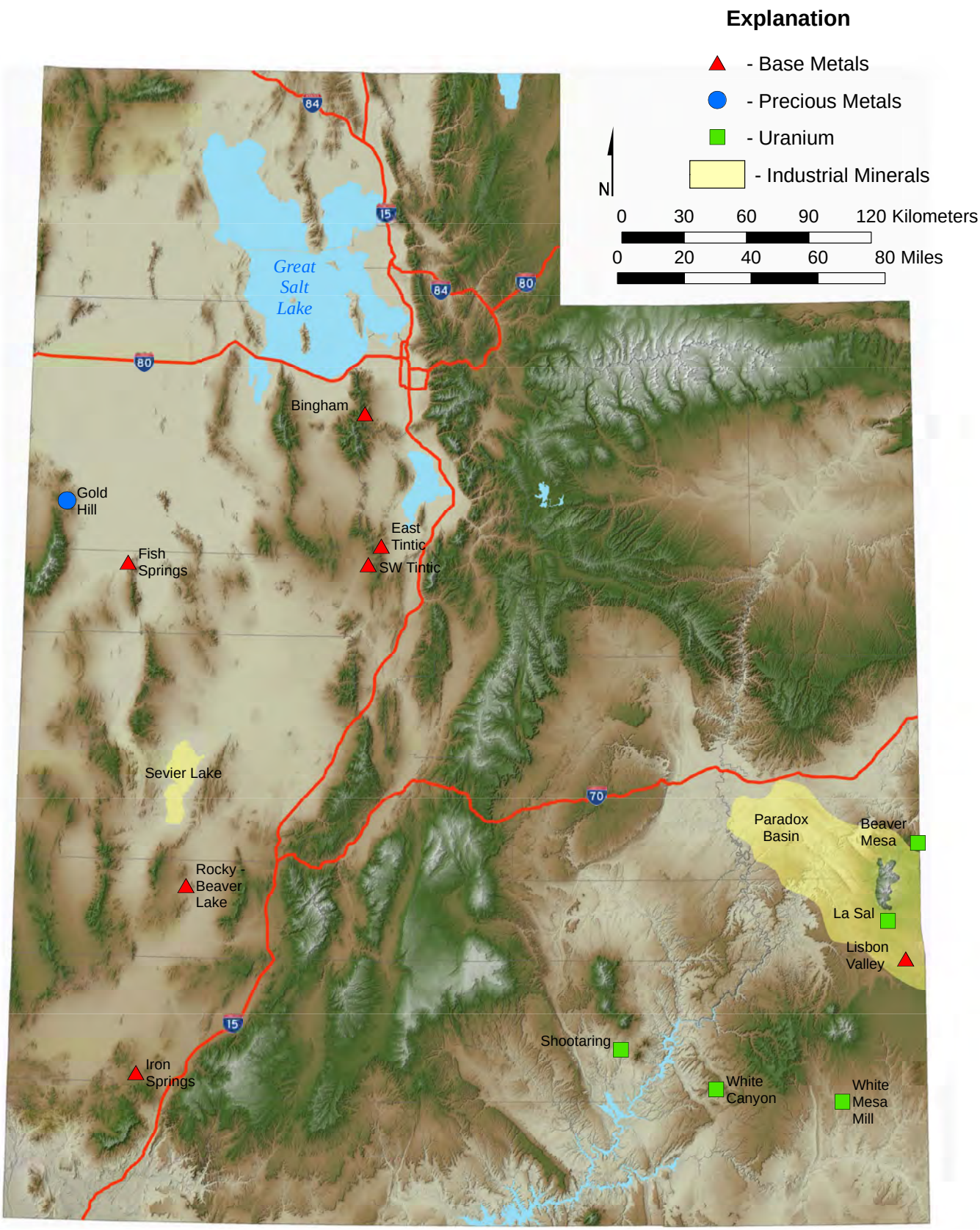

Figure 6. *Major mining exploration areas in Utah in 2010.*

Figure 7. *Southwest view of the Kennecott Utah Copper Corp. Bingham Canyon mine.*

magnetite skarn/replacement deposit adjacent to Miocene laccoliths. Mining by Palladon was initiated in 2008, but ceased in 2009 due to instability in the iron ore market and logistical problems. In 2009, Palladon completed a Canadian National Instrument (NI) 43-101 compliant resource estimate on the Comstock-Mountain Lion deposit showing a resource of 28.44 million t (31.35 million st) averaging 48.6% Fe (SRK Consulting, 2009). Mining was restarted in July 2010 and about 217,700 t (234,500 st) of ore were mined. The previously stockpiled run-of-mine ore and some of the new ore was shipped out of the new rail load-out at the mine by Union Pacific Railroad to the port of Richmond, California, for overseas transport to China. CML was mining at a rate of approximately 45,000 t (50,000 st) per month at the end of 2010 and has initiated construction of a new concentrator to produce a high-grade Fe concentrate. The concentrator is scheduled for completion in early 2012 and is expected to help increase annual production to 1.8 million t (2 million st).

Tintic District

Andover Ventures Inc. purchased approximately 78% of Chief Consolidated Mining Co. in 2008. Chief Consolidated's main assets are in the East Tintic district (figure 6), Utah County. Andover drilled three holes (totaling 1,555 m [5,100 ft]) in the Burgin Extension deposit to begin to convert a historic resource of 1.34 million t (1.48 million st) containing 550 gpt (16 troy oz/st) Ag, 19.6% Pb, and 6.3% Zn into a Canadian NI 43-101 compliant reserve. This historic resource contains an in-place value of well over a billion dollars at year-end 2010 metal prices.

Quaterra Resources, Inc. acquired about 1300 ha (3200 acres) of patented and unpatented mining claims covering the Southwest Tintic porphyry Cu system (figure 6), Juab County, in 2007. The property hosts a known resource of approximately 360 million t (400 million st) of 0.33% Cu and 0.01% Mo. This property was joint ventured with Freeport-McMoRan Exploration Corp. in 2009 and Freeport began an integrated program of geological mapping, geochemical sampling, and geophysical surveying. In 2010, Freeport completed a 5-hole, 3390-m (11,122 ft) drilling program and further drilling is anticipated in 2011.

In addition, Kennecott Exploration Co. (KEC), through a joint venture with Andover, optioned a porphyry Cu lithocap target on Big Hill near the center of the East Tintic district (figure 6), Utah County. KEC began work by running a series of geophysical surveys including a magnetotelluric grid (155 MT stations), six lines of induced polarization (IP), and a helicopter-borne, high-resolution aeromagnetic survey (801 line-km [498 line-mi]). The program also consisted of geologic/alteration mapping and collection of about 200 rock samples (Russ Franklin, KEC, written communication, March 2011). Drill testing is scheduled to begin in 2011.

Miscellaneous Base- and Precious-Metal Developments

Lithic Resources Ltd. acquired the Crypto Zn ±Cu ±In skarn in the Fish Springs mining district (figure 6) of western Juab County in 2005. In 2009, Lithic completed a 10,000-m (33,000 ft) core drilling program aimed at defining a new mineral resource within the skarn. New resource estimates (indicated and inferred) show a shallow oxide resource of 1.8 million t (2.0 million st) averaging 8.73% Zn, 0.38% Cu, and 14.82 ppm In, and a deep sulfide resource of 8.7 million t (9.6 million st) averaging 7.56% Zn, 0.41% Cu, and 46.82 ppm In. Metallurgical studies show the indium is contained in sphalerite in the sulfide resource (Tietz and others, 2009).

Clifton Mining Co. and Desert Hawk Gold Corp. have agreed to develop Clifton's mineral properties in the Gold Hill district (figure 6), Tooele County. The initial plan is to put the Yellow Hammer Cu-Au-Ag mine into production. This small open pit is developed on a very unusual, structurally controlled, hydrothermal alteration "pipe" in a Jurassic granodiorite stock. Primary ore-controlling structures are reportedly

intersecting north-south and east-west faults. Copper pitch-malachite-scheelite-molybdenite mineralization is associated with locally very coarse grained actinolite, black tourmaline, garnet, orthoclase, titanite, apatite, and magnetite in very strongly altered granodiorite. Desert Hawk completed 116 shallow holes totaling about 1,830 m (6,000 ft) on the Yellow Hammer in 2009–10. The ore will be processed in the rehabilitated 180 t per day (200 st/d) Cactus gravity/flotation mill 8 km (5 mi) to the north at Gold Hill. About 3600 t (4000 st) of ore were mined for pilot scale testing at the mill in 2010. Future plans include a heap leach operation at the Kiewit low-sulfidation, quartz-carbonate-adularia stockwork Au deposit. The Kiewit deposit is known to contain a crudely estimated 1.5 million t (1.7 million st) averaging about 1 gpt (0.03 troy oz/st) Au. Permitting of the Kiewit open pit and heap leach site is in progress.

Copper King Mining Corp., through its wholly owned subsidiary, Western Utah Copper Co., controls about 6200 ha (15,000 acres) in the Rocky and Beaver Lake mining districts (figure 6), Beaver County. These districts host seven partially defined Cu skarn and breccia pipe deposits. In 2009, Copper King completed construction of a flotation mill and started open pit mining the Hidden Treasure Cu skarn. The mill began production at about 1100 t per day (1200 st/d) in May 2009 and produced a limited amount of copper concentrate. A separate magnetite concentrate was produced and sold to a coal wash plant in the fall of 2009. The mill experienced less than 20% Cu recovery due to the mixed oxide-sulfide nature of the skarn ore and operations were halted near the end of 2009; however, a final batch of approximately 18 t (20 st) of Cu concentrate was shipped in 2010. The future of the operation remains uncertain until Chapter 11 bankruptcy proceedings are resolved.

Silver Verde May Mining Co. (Golden Eagle Mining Co.) acquired 78 claims and a 259 ha (640 acre) state lease covering a porphyry Cu-Mo system in the West Tintic mining district, Juab County. West Tintic is a historic Pb-Au-W-Ag skarn and replacement district in carbonate sedimentary rocks. Silver Verde has concentrated its exploration efforts on Au with rock, soil, and Bulk Leach Extractable Gold (BLEG) sampling on the district margins. Silver Verde also controls 20 unpatented claims and a 271-ha (670 acre) state lease on a sediment-hosted Au target on the south flanks of Maple Peak, Juab County 7.2 km (4.5 mi) east of West Tintic. The Au prospect occurs in the Chiulos Member of the Mississippian Great Blue Limestone, and jasperoid samples are anomalous in Au-Ag-As-Sb-Hg (Peter Maciulaitis, written communication, March 2011).

Silver Verde also controls the Blood Mine Spring Au project on the north slopes of Kingston Canyon, Piute County. The Silver Verde property position covers approximately 595 ha (1470 acres) consisting of unpatented mining claims and a state lease. The property hosts high-sulfidation veins in Miocene volcanic rocks. The veins are anomalous in Au-As-Sb-Hg and numerous rock samples contain from 0.5 to over 1 gpt (0.01–0.03 troy oz/st) Au (Peter Maciulaitis, written communication, March 2011).

Grand Central Silver Mines, Inc. continued work on two Utah properties. Grand Central owns a 46-ha (114 acres) tract on the southwestern fringe of the Bingham district (figure 6), Salt Lake County, where they have completed 13 reverse-circulation holes totaling 4980 m (16,340 ft) and one deep vertical core hole to 830.6 m (2725 ft). Intersections include 12.19 m (40 ft) 159 ppb Au, 25 ppm Ag, and 0.23% Zn in hole 13. Grand Central also controls a large 1934-ha (4779 acre) Cave mine property position in the southern Mineral Mountains of Beaver County. The Cave mine targets include Cu-Au skarns and high-grade, precious-metal-rich, polymetallic carbonate replacement deposits, like the old Cave mine itself. Initial work included surface and underground geological mapping and geochemical sampling along with a 150 line-km (93 line-mi) ground magnetometer survey and some induced polarization surveying.

Inland Explorations Ltd. was formed in 2006 to conduct base-metal exploration in Utah. The company pursued a grassroots exploration program and has acquired four properties to date: Thompson Knoll, Keg, Dugway, and Dunes (Sand Mountain).

High Desert Gold Corp. controls a 2430-ha (6000 acre) block of ground in the Gold Springs mining district on the Utah-Nevada border, Iron County. In 2010, High Desert drilled 11 reverse-circulation holes totaling 1823 m (5980 ft) on a swarm of low-sulfidation, volcanic-hosted, Au-Ag veins. Drill intersections include up to 18.3 m (60 ft) of 0.84 gpt (0.024 troy oz/st) Au and 12.2 gpt (0.356 troy oz/st) Ag (Hole J-10-3).

Renaissance Gold Inc. has signed Newmont to an earn-in agreement on their Wildcat sedimentary-rock-hosted Au property in the Drum Mountains, Juab County. The property consists of 176 ha (434 acres) of unpatented mining claims. The property was explored by Gold Fields Mining Corp. in the early 1990s. Gold Field's drilling cut intervals of up to 22.9 m (75 ft) of 1.27 gpt (0.0370 troy oz/st) Au (hole DM-27).

Cadillac Mining Corp. acquired 1540 ha (3800 acres) covering the historic mining area of the Goldstrike sedimentary-rock-hosted Au-Ag mining district, Washington County. Production in the 1980s and 1990s totaled approximately 210,000 troy oz of Au and 198,000 troy oz of Ag (Willden, 2006). The company is consolidating, digitizing, and compiling the historic data on the district.

Tonogold Resources Inc. acquired 1590 ha (3940 acres) covering the Mineral Mountain (Treasure Chest) sedimentary-rock-hosted Au-Ag prospect, Washington County. The property hosts a known resource of about 3.1 million t (3.4 million st) at 0.42 gpt (0.012 troy oz/st) Au (Puchlik, 2010).

Invenio Resources Corp. acquired the Kings Canyon sedimentary-rock-hosted Au-Ag property in southwestern Millard County and controls approximately 930 ha (2300 acres). The property was explored in the early 1990s, primarily by Crown Resources. The property contains several known Au zones and the largest defined resource is about 6.2 million t (6.8 million st) averaging roughly 1 gpt (0.03 troy oz/st) Au.

IBC Advanced Alloys Corp. acquired 371 claims adjacent to Materion's (Brush-Wellman's) Spor Mountain Be mine, the largest Be producer in the world. IBC completed a 7495 line km (4657 line mi) airborne magnetic and radiometric survey of the property. The survey was processed and potential targets delineated.

In other metal developments in Utah: (1) Metamining of Utah shipped 8670 t (9560 st) of 22% Mn ore from the Black Boy mine stockpile, Juab County, to China, (2) Great Western Minerals is exploring the 171-sq-km (66 sq mi) Deep Sands REE-Fe beach sands project in western Juab County, (3) Redhill Resources Corp. acquired the 517-ha (1280 acres) Honeycomb Hills REE-Be-Li project in Juab County, (4) RTM Exploration and Holdings LLC controls about 780 ha (1,920 acres) of sediment-hosted Cu-Mo-Ag prospects in the Uinta Basin, and (5) Unico, Inc. continued work on their Deer Trail Zn-Pb-Ag mine and small mill near Marysvale in Piute County.

Industrial Minerals

Utah also experienced increasing industrial minerals exploration activity, principally for potash, in 2010. American Potash LLC, Mesa Uranium Corp. (now Mesa exploration Corp.), Ringbolt Ventures Ltd., Transit Holdings Ltd., and Universal Potash Corp. have applied for, or acquired, parcels totaling over 500 sq km (200 sq mi) of land and are exploring for potash deposits in the Paradox Basin of southeastern Utah. These parcels are primarily located in Grand and San Juan Counties. In addition, Mesa announced that it has acquired approximately 2400 ha (6000 acres) of property at their Green Energy lithium brine project, which is also in the Paradox Basin.

The BLM and SITLA have initiated potash leasing on Sevier Lake (dry) in Millard County. These leases consist of 64 parcels totaling 50,894 ha (125,762 acres). Sevier Lake mining has the potential to produce both potash and salt.

Coal

Murray Energy Corp. – UtahAmerican Energy, Inc.

The new Lila Canyon mine is located south of Horse Canyon in the Book Cliffs coalfield in Emery County. In the spring of 2010, the company finished tunneling upward on 366-m-(1200 ft) long rock slopes and began development work in the Sunnyside coal bed, producing 65,000 t (72,000 st) of coal in 2010. Development work will continue until about 2014 when the first longwall mining is scheduled to begin. Coal production during the next few years of development will average about 91,000 t (100,000 st) per year. By the time the mine is at full capacity, it could employ up to 200 people and produce up to 4.1 million t (4.5 million st) of coal per year. Coal will be mined from federal leases where the merged upper and lower Sunnyside bed is about 4.0 m (13 ft) thick. Between 24 and 36 million t (26 and 40 million st) of recoverable coal are under lease, with recovery largely dependent on the cutting height of the equipment that will be used. Approximately 45 million t (50 million st) of additional federal coal are available to the south of current leases.

The West Ridge mine, operated by WEST RIDGE Resources, a subsidiary of UtahAmerican Energy, began operating in 1999 in the Book Cliffs coalfield with production from the lower Sunnyside bed. The West Ridge mine produced 3.0 million t (3.4 million st) of coal in 2010, up from 2.8 million t (3.1 million st) in 2009. Production in 2011 is expected to again increase to 3.5 million t (3.9 million st). UtahAmerican estimates that the West Ridge mine has 9.6 million t (10.6 million st) of recoverable coal under lease.

Arch Coal – Canyon Fuel Co.

The Dugout Canyon mine, located in the Book Cliffs coalfield, produced 2.1 million t (2.3 million st) of coal from the Gilson bed in 2010, down 30% from the 3.0 million t (3.3 million st) produced in 2009. This production decrease was the result of a several month shutdown due to elevated carbon monoxide levels related to a thermal heating event. Dugout's production is expected to recover only slightly in 2011 to about 2.3 million t (2.5 million st). Dugout operators recently announced that the mine will go idle after completion of the next longwall panel (early 2012). Coal production from the Rock Canyon bed ended in February of 2004, after which longwall equipment was moved to the stratigraphically lower Gilson bed. Canyon Fuel estimates that the Dugout mine has 9.8 million t (10.8 million st) of recoverable coal remaining under lease.

Canyon Fuel Company's Skyline mine, located in the Wasatch Plateau coalfield, is currently mining in the Lower O'Connor 'A' bed on their North lease (Winter Quarters lease) in Carbon County. Production from this bed increased slightly in 2010 to 2.8 million t (3.1 million st) with 2011 production expected to be slightly less at 2.6 million t (2.9 million st). Canyon Fuel estimates that 15.5 million t (17.1 million st) of coal can be recovered from current leases.

SUFCO is Utah's largest coal producer and the sixth-largest underground coal mine in the United States. It is also the only active coal mine in Sevier County. SUFCO produced 5.8 million t (6.4 million st) of coal in 2010 from the upper Hiawatha

bed, 19.1% less than record high production of 7.2 million t (7.9 million st) achieved during 2006. Production at SUFCO is expected to decrease to about 5.5 million t (6.1 million st) in 2011. Canyon Fuel estimates that roughly 51.3 million t (56.5 million st) of reserves remain under lease in the upper and lower Hiawatha beds.

Canyon Fuel has nominated for leasing the federal Greens Hollow tract, located northwest of the already acquired Quitchupah lease. A draft leasing EIS was issued in the spring of 2009 and the BLM is currently addressing comments received in preparation for the final EIS, expected to be released during summer 2010. The Greens Hollow tract is thought to contain approximately 66 million t (73 million st) of reserves within the lower Hiawatha bed.

On December 31, 2007, SITLA held a sale of the Cottonwood Competitive Coal Leasing Unit. The tract was awarded to Ark Land Co., which is a subsidiary of Arch Coal, Inc., also the owner of the Canyon Fuel Co. Two coal leases were issued, one for 3320 ha (8204 acres) covering lands within the 1998 land exchange Cottonwood Coal Tract and the other for 243 ha (600 acres) within an adjacent SITLA section. Total recoverable coal in the Hiawatha bed for the combined leases is estimated to equal 44 million t (49 million st). This tract was sold to PacifiCorp in the fall of 2011.

CONSOL Energy

CONSOL Energy's Emery mine, their only mine in the western United States, has produced just over one million st each year from the Ferron Sandstone I bed since being restarted in 2005. The mine produced about 0.9 million t (1.0 million st) of coal in 2010. However, CONSOL indefinitely idled the mine in December 2010, citing lack of coal demand. Emery coal miners used a combination of three continuous miners to produce the shallow-cover coal. CONSOL estimates recoverable reserves under lease to total 8 million t (9 million st), but significant unleased reserves can be found adjacent to the mine. In addition, the company owns coal near the undeveloped Hidden Valley mine to the south of the Emery mine.

Rhino Energy

Rhino Energy purchased the Bear Canyon mines from C.W. Mining (Co-Op) in 2010, renaming the mines Castle Valley. No coal was produced from the property in 2010, but Rhino estimates 2011 production will total about 454,000 t (500,000 st) using only continuous miner machines in the Tank bed. Full-scale production could reach about 770,000 t (850,000 st) by 2012. Roughly 45.9 million t (50.6 million st) of recoverable reserves are still available in the Tank, Blind Canyon, and Hiawatha beds in the surrounding area.

Energy West Mining Co. (PacifiCorp)

Operators at the Deer Creek mine scheduled longwall maintenance for the second half of 2010, which resulted in annual production only reaching 2.7 million t (3.0 million st). Production will remain below average in 2011 (2.5 million t, 2.8 million st) due to several longwall moves and difficult mining conditions. Energy West estimates that the Mill Fork tract (which has recently reverted from a state-owned lease back to a federal lease), where production began in 2005, contains roughly 21.4 million t (23.6 million st) of remaining coal. Five longwall panels were successfully developed within the Hiawatha bed before production shifted in February 2008 to the stratigraphically higher Blind Canyon bed. Production in the Blind Canyon was completed in mid-2010 and production shifted back to the Hiawatha bed.

America West Resources, Inc.

The Horizon mine, located approximately 18 km (11 mi) west of Helper in the Wasatch Plateau coalfield, is owned and operated by Hidden Splendor Resources, a fully owned subsidiary of America West Resources. Since Hidden Splendor's acquisition of the mine in 2003, annual production with one continuous miner has averaged 236,000 t (260,000 st), with 2010 production up slightly to 245,000 t (270,000 st). Horizon added a second continuous miner in 2011 and projects production for the year to reach about 363,000 t (400,000 st). America West estimates that 15.4 million t (17.0 million st) of coal remain under lease.

Alton Coal Development, LLC

Alton Coal Development, LLC has started development of a new coal mine, named the Coal Hollow mine, in the Alton coalfield in southern Utah's Kane County. Alton Coal plans to produce 1.8 million t (2.0 million st) of coal annually from a surface mine on 178 ha (440 acres) of private land and 1457 ha (3600 acres) of unleased federal land located south of the town of Alton. The BLM is currently preparing a draft EIS for the proposed federal leasing action. In June of 2006, DOGM began processing Alton Coal Development's application to start mining on private land. On October 15, 2009, DOGM declared the company's permit application complete, but subsequent legal challenges delayed the permit. In fall 2010, the DOGM board upheld the original decision, and mine development began in early 2011, with projected production totaling about 363,000 t (400,000 st) for the year. Alton's private lease is estimated to contain about 4.5 million t (5.0 million st) of recoverable coal, while reserves on the combined private and federal mining areas are estimated between 36 and 41 million t (40 and 45 million st). The Coal Hollow surface mine produces subbituminous Dakota Formation coal from the Smirl bed, which ranges from 9500 to 10,000 Btu per pound, and averages about 1% sulfur and 9% ash.

Uranium

Historically, Utah is the third-largest uranium producing state, with the majority of its production from the Colorado Plateau. The spot price of U_3O_8 rose dramatically from a low of about $18/kg ($8/lb) in 2001 to $300/kg ($136/lb) in June 2007. However, the price fell to under $100/kg ($45/lb) by the end of 2009 and remained there through July 2010 before rising to over $132/kg ($60/lb) at year end. Uranium (U) exploration and development in Utah has waxed and waned with these spot prices. Long-term contract U_3O_8 prices, in contrast, have remained at approximately $148/kg ($67/lb). In 2010, the U industry in Utah underwent a period of consolidation with both Energy Fuels and Denison Mines acquiring new properties. Mancos Resources has applied for water permits for a proposed U mill near Green River. The following paragraphs report the major uranium events in Utah in 2010, and table 3 summarizes miscellaneous uranium activities.

Denison Mines (USA) Corp.

Denison Mines (USA) Corp. owns five permitted mines in Utah as well as the 1800 t per day (2000 st/d), dual-circuit (uranium-vanadium [U-V]) White Mesa mill near Blanding (figure 6). The mill processes both U ore and alternate feed waste material. The mill began operating on stockpiled ore from Denison-owned mines in 2008, and began accepting ore from other companies for toll milling in 2009. The mill has the capacity to produce about 1.36 million kg (3 million lb) of U_3O_8 and 2 million kg (4.5 million lb) of V_2O_5 annually. Uranium recoveries from ore average over 90%.

In late 2006, Denison's Pandora mine, in the eastern La Sal district (figure 6), San Juan County, became the first Utah U property in production since 1991. The Pandora mine currently ships about 180 t per day (200 st/d) 110 km (70 mi) south to the White Mesa mill. Reserves at the Pandora mine are estimated to be 263,000 t (290,000 st) at 0.22% U_3O_8 and 1.1% V_2O_5. In 2009, Denison reopened the Beaver mine, 3 km (2 mi) west of the Pandora mine. The Beaver is producing about 170 t per day (185 st/d) from a resource estimated at 680,000 t (750,000 st) at 0.2% U_3O_8 and 1.25% V_2O_5. Denison production in 2010 amounts to approximately 168,600 kg (371,700 lbs) U_3O_8 and 943,500 kg (2,080,000 lbs) V_2O_5. The La Sal district uranium ores are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation.

Denison's Henry Mountains Complex (Tony M mine and Bullfrog properties) in the Shootaring Canyon district (figure 6), Garfield County, hosts the largest known uranium resource in Utah, estimated to be about 1.528 million t (1.684 million st) averaging 0.24% U_3O_8 (Underhill and Roscoe, 2009). The mine was developed in 1977, and when it was shut-down in 1985, had nearly 27 km (17 mi) of underground workings. The mine was rehabilitated and random room-and-pillar mining resumed in late 2007, ramping up toward 520 t per day (575 st/d). However, declining uranium prices and lower than anticipated head grades forced its closure in November 2008. The mine has a 197 km (122 mi) haul to the White Mesa mill.

In 2008, production began at Denison's Rim mine in the Dry Valley (East Canyon) district of San Juan County. The Rim mine began operating at about 45 t per day (50 st/d) with reserves estimated at 136,000 t (150,000 st) at 0.22% U_3O_8 and 2% V_2O_5. However, the Rim mine was put on standby in March 2009 and did not operate in 2010. Both the Shootaring and Dry Valley district uranium ore bodies are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation.

White Canyon Uranium Ltd.

White Canyon's Daneros mine in the White Canyon district (figure 6), San Juan County was permitted in May 2009, development began in July, and production started in December 2009. The Daneros ore body has an estimated resource of 190,000 t (210,000 st) at 0.3% U_3O_8 hosted by the basal Shinarump Conglomerate Member of the Upper Triassic Chinle Formation and also contains about 1% Cu. The mine is accessed by twin declines, developed by room and pillar methods, and is ramping up production to 160 t per day (180 st/d). Ore is shipped 100 km (62 mi) to the White Mesa mill for toll milling. In 2010, the Daneros produced 41,866 t (46,149 st) averaging about 0.26% U_3O_8.

Energy Fuels, Inc.

Energy Fuels, Inc. is exploring and rehabilitating their historical U mines. The Whirlwind mine on Beaver Mesa straddles the Utah-Colorado border about 45 km (28 mi) northeast of Moab in Grand County (figure 6). The property began limited production in 2009, but has been on standby since then. The Whirlwind resource is about 149,000 t (164,000 st) of ore averaging 0.20% U_3O_8 and 0.66% V_2O_5 (Peters, 2008a). Energy Fuels anticipates mining 45 to 180 t per day (50 to 200 st/d) when mining resumes.

In 2007, Energy Fuels acquired the 284-ha (702 acre) Energy Queen mine, in the La Sal district (figure 6), San Juan County and began rehabilitation. The mine has an estimated resource of 234,000 t (258,000 st) of ore averaging 0.24% U_3O_8 and 0.96% V_2O_5, with access via an existing 229-m-deep (750 ft) lined shaft (Peters, 2008b). Both the Whirlwind and Energy Queen U ores are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation. Energy Fuels also continues to advance the permitting for a new dual circuit U-V mill to be built near Naturita, Colorado.

Uranium One, Inc.

Uranium One, Inc. acquired the uranium assets of the U.S. Energy Corp. in 2006 and Energy Metals in 2007. These assets include the Velvet mine with a resource of about 64,260

Table 3. *Uranium projects in Utah, 2010.*

Property	District	County	Company	Progress
San Rafael	San Rafael River	Emery	Energy Fuels, Inc.	Indicated resource: 758,050 tons @ 0.23% U_3O_8
Frank M	Henry Mountain	Garfield	Uranium One, Inc.	Resource: 1.5 M tons @ 0.12% U_3O_8
North Wash	Henry Mountain	Garfield	Vane Minerals Plc.	29 holes drilled, including 9.5 ft @ 0.36% U_3O_8
Tony M/Bullfrog	Henry Mountain	Garfield	Denison Mines Corp.	Permitted resource: 1.527 M tons @ 0.24% U_3O_8
Whirlwind	Beaver Mesa	Grand	Energy Fuels, Inc.	Permitted resource: 656,000 lb U_3O_8
Thompson Project	Thompson	Grand	Denison Mines Corp.	Acquired 6672 acres
Dunn Mine	Dry Valley	San Juan	Midasco Capital Corp.	Resource: 143,400 tons @ 0.12% U_3O_8
Rim-Columbus	Dry Valley	San Juan	Denison Mines Corp.	Permitted resource: 660,000 lb U_3O_8
Marcy-Look	Elk Ridge	San Juan	Denison Mines Corp.	Acquired 907 acres
Blue Jay	Fry Canyon	San Juan	Denison Mines Corp.	Acquired 289 acres
Energy Queen (Hecla Shaft)	La Sal	San Juan	Energy Fuels, Inc.	Permitted resource: 1.2 M lb U_3O_8
North La Sal	La Sal	San Juan	Vane Minerals Plc.	Acquired 80 acres
North Alice Extension	La Sal	San Juan	Vane Minerals Plc.	Resource: 43,000 tons @ 0.14% U_3O_8
Pandora/Snowball	La Sal	San Juan	Denison Mines Corp.	In production: 1.2 M lb U_3O_8 reserve
Dar	Lisbon Valley	San Juan	Mesa Uranium Corp.	1000 acre property
Lisbon mine	Lisbon Valley	San Juan	Mesa Uranium Corp.	22 holes (~60,000 ft), including 3.5 ft @ 0.28% U_3O_8
Velvet	Lisbon Valley	San Juan	Uranium One, Inc.	Permitted resource: 580,000 lb U_3O_8
Calliham (J.H. Ranch)	Ucolo	San Juan	Energy Fuels, Inc.	Resource: 170,000 tons @ 0.20% U_3O_8
Crain	Ucolo	San Juan	Uranium Energy Corp.	Resource: 33,000 tons @ 0.21% U_3O_8
Daneros (Lark Royal)	White Canyon	San Juan	Denison Mines Corp.	In production: 1.2 M lb U_3O_8 resource
Geitus	White Canyon	San Juan	Denison Mines Corp.	Resource: 40,000 ton @ 0.3% U_3O_8
Happy Jack	White Canyon	San Juan	Vane Minerals Plc.	22 holes completed, including 1.5 ft @ 0.39% U_3O_8
LaSal	Lisbon Valley	San Juan	Laramide Resources Ltd.	Resource: 440,000 tons @ 0.31% U_3O_8

t (70,850 st) averaging 0.41% U_3O_8 and 0.57% V_2O_5 in the Lisbon Valley district (figure 6) (Beahm and Hutson, 2007). The Velvet has the highest grade U resource known in the state and is hosted in the Lower Permian Cutler Group sandstone. Other assets include the large, albeit low grade, Frank M underground U resource and nearby inactive 680 t per day (750 st/d) Shootaring Canyon (Ticaboo) uranium mill in the Henry Mountains, Garfield County.

NEW MINERALS INFORMATION

The following recent publications provide new information on the mineral resources of Utah. These and others publications are available through the Utah Department of Natural Resources Map and Bookstore (http://mapstore.utah.gov/). Additional geographic information system (GIS) data on Utah is available for free download at http://agrc.its.state.ut.us/ and http://geology.utah.gov/databases/index.htm.

Gwynn (2010) provides 24 data folders containing industry results from the Sunnyside tar sand deposit, Carbon County, Utah. An analysis of the quality of Alton coalfield was published by Quick (2010). The USGS completed an assessment of oil shales of the Eocene Green River Formation of the Uinta Basin of eastern Utah and western Colorado (U.S. Geological Survey Oil Shale Assessment Team, 2010).

Bon and Krahulec (2010) report on the exploration, development, and production of U and non-fuel minerals in Utah for 2009. Krahulec and Schroeder (2010) provide road logs, papers, and *Economic Geology* reprints on the porphyry systems in the Bingham and Tintic mining districts.

The UGS maintains a comprehensive repository for Utah energy and mineral data at http://geology.utah.gov/emp/energy-data. The website contains over 130 tables and 50 figures (in both Excel and PDF formats) in nine chapters that are continuously updated as new data becomes available.

RECLAMATION AND THE ENVIRONMENT

The U.S. Department of Energy (DOE) and the state of Utah agreed to move the 10.8 million t (11.9 million st) of Atlas uranium mill tailings located along the Colorado River near Moab. The tailings will be moved 48 km (30 mi) north to a site near Crescent Junction. DOE will transport the tailings by rail to a 100-ha (250-acre) disposal cell developed in the Cretaceous Mancos Shale. The project began shipping tailings in April 2009 and had moved approximately 2.5 million t (2.7 million st) by the end of 2010.

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