



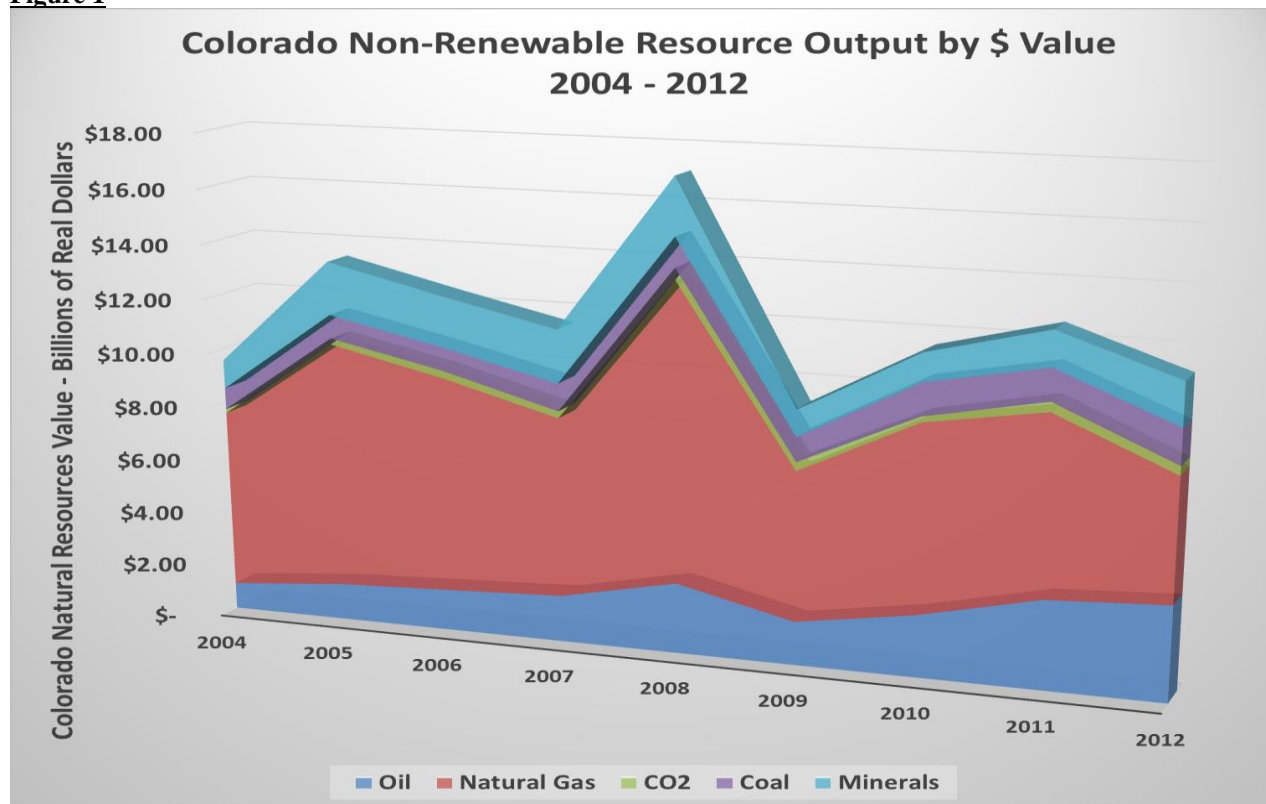
Colorado Non-Renewable Resources Update

Summary: This report reviews important non-fuel minerals and energy production trends and data in Colorado. Its principal focus is to identify how Colorado's extensive mineral and energy industry is faring vis-à-vis other states, how it fits into national and global energy markets, and how Colorado's non-renewable resource intensive regions and counties are performing.

Colorado Non-Renewable Resource Output

In 2013, Colorado mineral and energy output remains consistent with the state's reputation as resource abundant. From a total energy production basis, Colorado is the seventh-largest producer overall, producing 2,747 trillion British Thermal Units. Only Texas, Wyoming, Louisiana, Pennsylvania, West Virginia, and Kentucky exceed Colorado's production. In 2011 the U.S. Energy Information Agency (EIA) ranked Colorado 7th in natural gas and 9th in petroleum reserves¹. Colorado is one of the leading producers of coal as well as the non-fuel minerals of gold and molybdenum.

Figure 1



Sources: Colorado Oil & Gas Conservation Commission, Colorado Geological Survey, Colorado Business Economic Outlook Committee

¹ EIA. (2013) U.S. Crude Oil and Natural Gas Proved Reserves, 2011.

<http://www.eia.gov/naturalgas/crudeoilreserves/pdf/uscrudeoil.pdf>

Figure 1 displays the total value of non-renewable resource production in Colorado. After peaking in 2008, Colorado production fell significantly with the onset of the global economic recession, which greatly lowered demand and prices for non-renewable resources. After abruptly hitting a low point in 2009, mineral and energy prices have steadily recovered, with output correspondingly resuming an upward trend. However, by 2012, as most non-renewable resource prices have stagnated or declined, save for oil, the total value of Colorado output has dipped. Only global oil prices and Colorado oil production has remained resilient since 2011. A deeper examination of these trends is provided below.

Petroleum

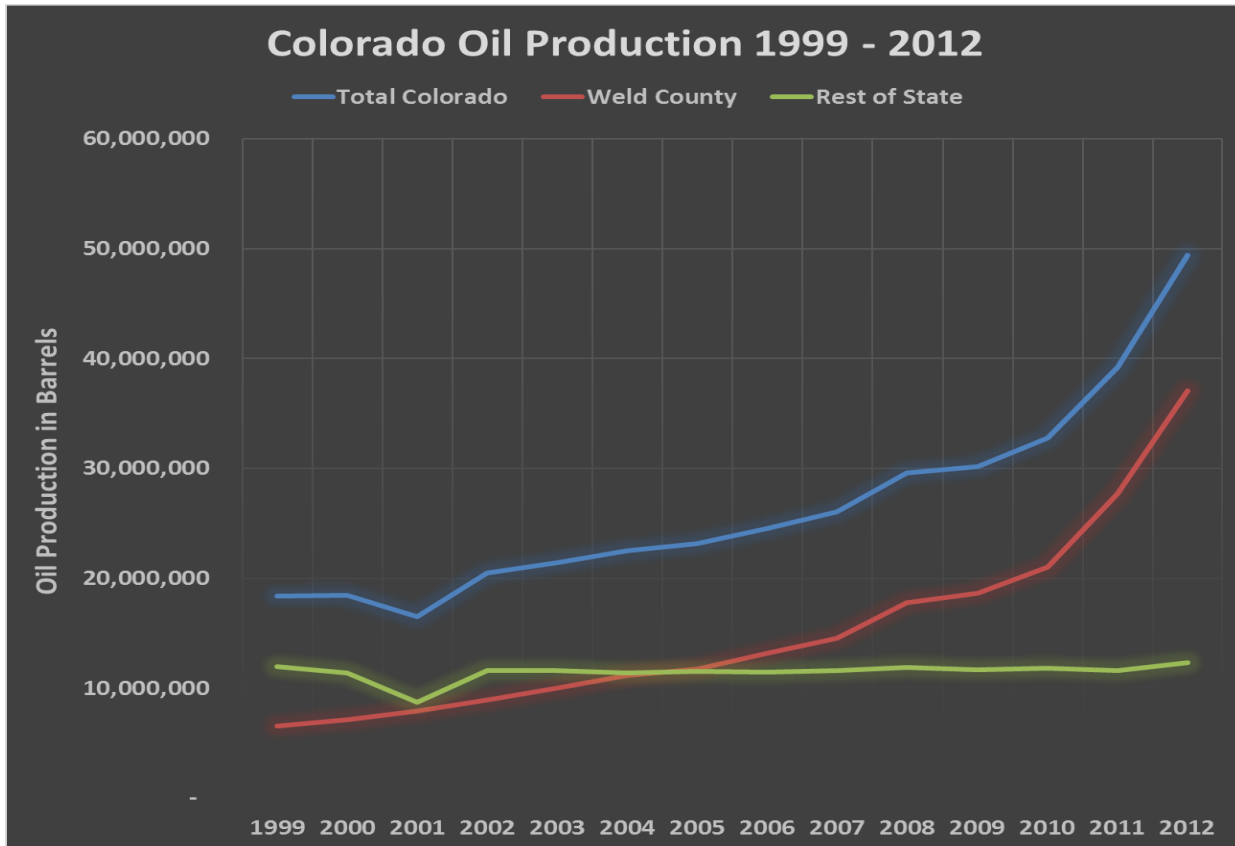
Home to two of the largest oil fields in the United States, located in the Denver-Julesberg basin in Northeastern Colorado and the Piceance Basin on the Western Slope, Colorado is a significant oil producer nationally. In 2012, the state produced just shy of 50 million barrels of oil, or just over 1 out of every 50 barrels of oil produced in the U.S. Only eight other states – in descending order Texas, Alaska, North Dakota, California, Oklahoma, New Mexico, Louisiana, and Wyoming – produced more petroleum than Colorado.

Colorado oil production has increased significantly over the past decade, in tandem with the onset of the “shale revolution” in the United States. Colorado has capitalized on the technological advances in oil and natural gas extraction, including hydraulic fracturing, horizontal drilling, and other enhanced recovery techniques. Substantial new production has come online with discovery, development, and extraction of hydrocarbons from the Niobrara shale formation in the Denver-Julesberg Basin in northeastern Colorado. Industry estimates of retrievable oil in the Niobrara exceed 2 billion barrels.

The addition of Niobrara production has allowed Colorado to accelerate its oil production over the past 11 years. In 2001, Colorado produced just 16.5 million barrels of oil; by 2012, that figure had nearly tripled to just under 50 million barrels. This growth has been led by Weld County, which produces three-quarters of the state’s oil. Although it will be several months until final oil production figures are compiled for 2013, Colorado Oil & Gas Conservation Commission (COGCC) data through the first 10 months of the year is 60.5 million barrels. Given these preliminary estimates and two months of data left to be compiled, Colorado has easily set a new oil production record in 2013.

Figure 2 plots total Colorado oil production from 1999 to 2012 along with Weld County alone and the rest of the state. One can see that whereas in 1999 Weld County alone accounted for just over a third of oil output and the rest of the state two-thirds, the proportions have more than completely reversed with Weld County’s output exceeding three-quarters of the state’s oil output. In addition, as of 2012 Weld County is the 8th largest producer by county nation-wide.

Figure 2



Source: Colorado Oil & Gas Conservation Commission

The rapid growth in Colorado production is among the fastest nationally. Over the same period, 2001-2012, total U.S. petroleum production grew by 257 million barrels or 12.1%. Colorado production grew by nearly 33 million barrels, or 199%, and contributed one out of every eight new barrels in national production. Again this was principally led by production activity in the Niobrara shale formation, kicked off in 2009 when the “Jake” well hit in Weld County. Only Texas and North Dakota, home of the massive Eagle Ford and Bakken shale formations, respectively, contributed more to the increased domestic production than Colorado. Only North Dakota exceeded Colorado’s percentage increase over that period, growing by a whopping 665%.

The Natural Resources and Mining Estimates Committee, which prepares forecasts of industry activity for the annual Colorado Business Economic Outlook (CBEO) produced by the Business Research Division of the Leeds School of Business at the University of Colorado-Boulder², forecasts Colorado oil production in 2014 to increase by another 15% to 68.5 million barrels of oil.

² http://leeds.colorado.edu/asset/brd/2014_colo_bus_econ_outlook.pdf

Natural Gas

Colorado remains one of the largest producers of natural gas nationally. The state boasts all, or a portion of, nine of the largest natural gas fields in the U.S. Major Colorado production regions are found in the San Juan Basin, (shared with New Mexico), the Piceance Basin on the Western Slope and the oil-rich Denver-Julesberg Basin. Along with New Mexico and Wyoming, Colorado is the leading producer of coal-bed methane natural gas - gas extracted from coal seams - principally in the San Juan and Raton basins. According to the EIA³, Colorado has more than two-fifths of U.S. proved reserves, more than any other state.

As with petroleum, natural gas production in Colorado has grown rapidly over the last decade. In 2000, Colorado produced 798,065,774 Million Cubic Feet (MCF) of natural gas. In 2012, that number grew by a factor of 2.1, topping 1,707,086,149 MCF. By contrast, U.S. natural gas production over the same period grew only 25% compared to Colorado's 127% gain. Furthermore, the 2012 figure constitutes 6.8% of the 25,307,949,000 MCF of natural gas produced in the U.S. This is a remarkable figure given that the U.S. is also the world's foremost producer and consumer of natural gas⁴. Among counties, Garfield County's 2012 output is the nation's fourth largest among counties at 700,163,329 MCF and La Plata County is ranked tenth at almost 393,118,446 MCF. Combined, the two counties comprise two-thirds of Colorado's natural gas output.

Colorado's 2012 production level places it as the sixth-largest producer among the states. Only Texas, Louisiana, Pennsylvania, Oklahoma, and Wyoming produce more natural gas than Colorado. Traditionally Colorado has been the fifth largest producer nationally, but it was surpassed by Pennsylvania in 2012, which jumped from seventh to third nationally due to development of the Marcellus shale formation. Pennsylvania production has grown from 182,277 MCF in 2007 to 2,256,696,000 MCF (a 1,138.1% increase) in 2012 and is anticipated to overtake Louisiana as the second largest producer nationally. By contrast, Colorado's natural gas production has grown only 37.6% over the same period from 1,366,721,783 MCF to 1,709,376,000 MCF.

Preliminary COGCC natural gas production data through October 2013 totaled approximately 1,564,182,137 MCF, which puts Colorado on pace to exceed 1,750,000,000 MCF for the year. The final total could be higher, as natural gas prices have modestly grown since 2012, likely accelerating 2013 production.

Coal

While petroleum output has increased significantly in the past decade and accelerated in the last few years and natural gas grew quickly over the decade but has slowed over the last five years, coal production has not fared as well either in the last decade or within the last five years. Figure 3 plots the

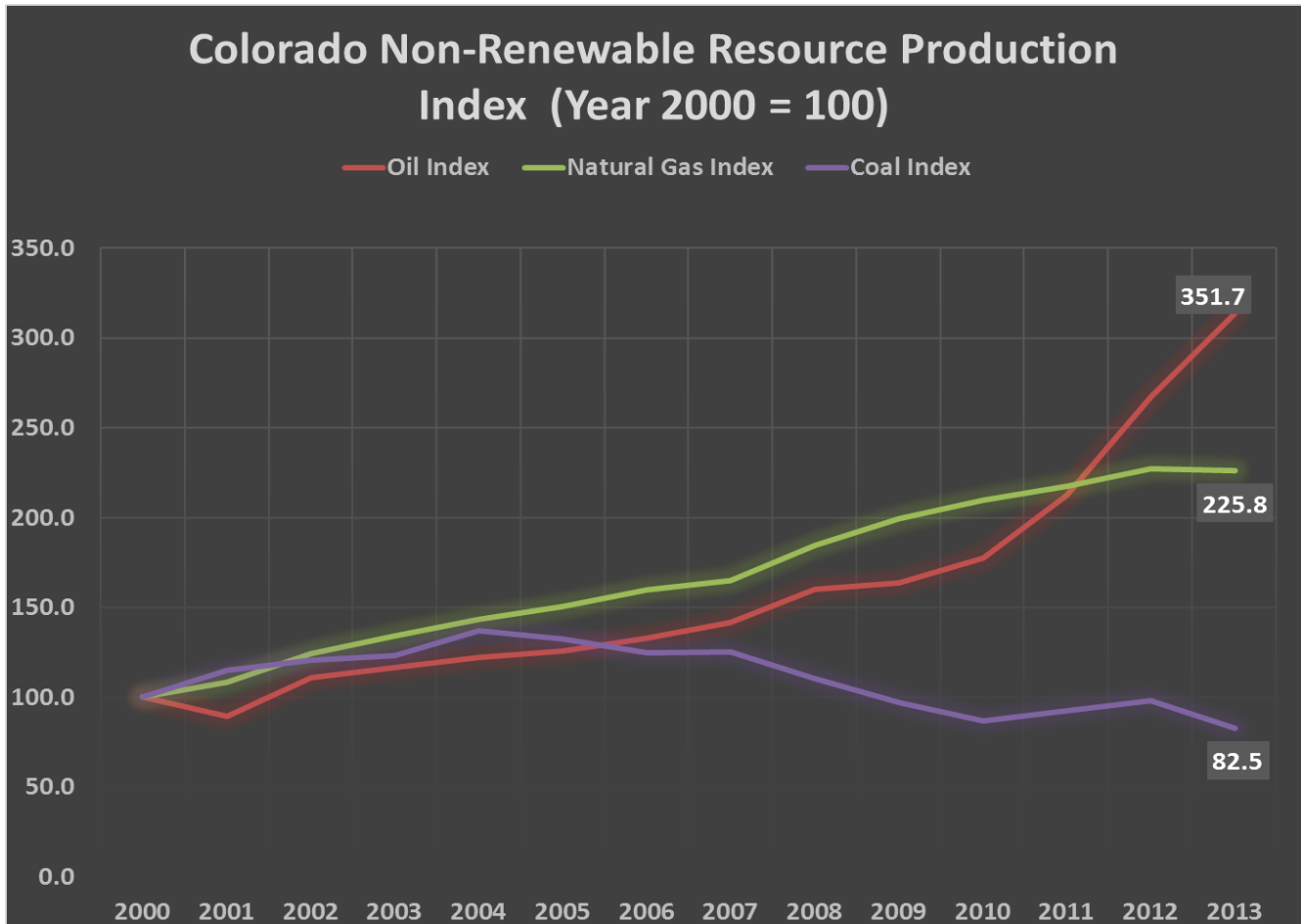
³ Ibid.

⁴ British Petroleum (2013). Statistical Review of World Energy 2013

http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf

changes in Colorado oil, natural gas, and coal production via index values from 2000 to 2013 illustrating the divergences between production levels.

Figure 3



Source: Colorado Oil & Gas Conservation Commission; U.S. Energy Information Administration; 2013 is estimated data.

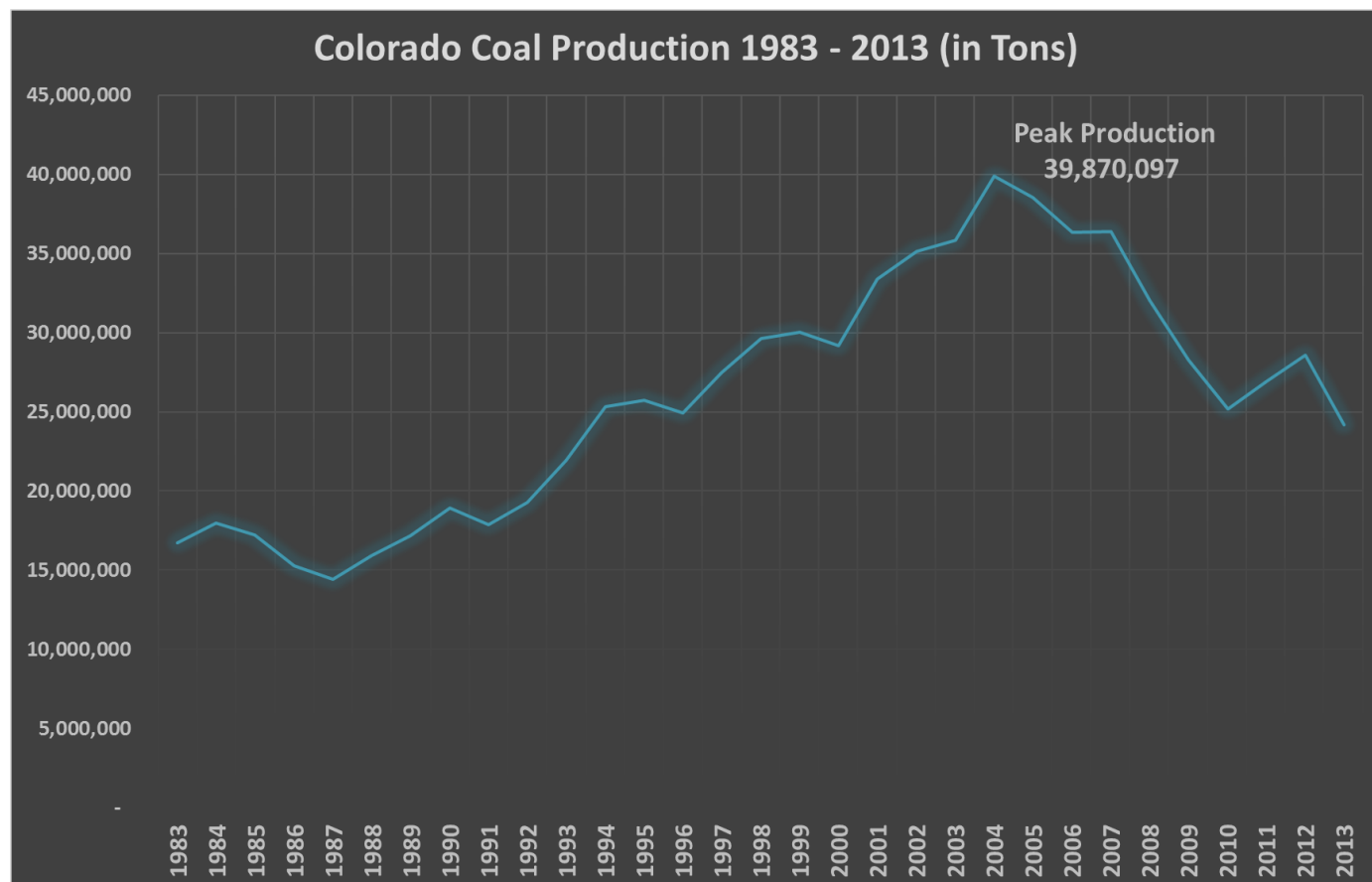
Colorado coal is produced from underground and surface mines principally located in the Green River, San Juan, and Uinta basins. Production occurs in 9 counties: Delta, Garfield, Gunnison Las Animas, La Plata, Moffat, Montrose, Rio Blanco, and Routt, with Routt County being the largest producer. In 2012 Routt County produced 8 million tons, or nearly 30% of the state’s output, from the Peabody Energy Foidel Creek Mine. Almost half of Colorado’s coal production is consumed in the state for electrical power generation, with the remaining coal exported to other states and outside the country.

As shown by [Figure 4](#), there has been a consistent upward trend in Colorado coal production spanning the early 1980s all the way through the early 2000s. In 2004, production peaked at 39.9 million tons, or almost 2.5 times larger than the 1983 level of production. Despite an increase of real coal prices from \$20.59/ton in 2004 to \$37.54/ton in 2012, Colorado coal production has fallen by 11.3 million tons, or by 28% over that period.

In 2013, Colorado’s coal output is expected to significantly decline again. Using the Colorado Department of Natural Resources [Division of Reclamation, Mining and Safety coal production data](#)

2013 production was approximately 24.2 million tons, a decrease of over 4.3 million tons or nearly 15%, from 2012 and 15.7 million tons below the peak 2004 figure. This year-over-year decline is significantly more than the anticipated 2.7% decrease in U.S. coal production from 2012 to 2013.

Figure 4



Source: U.S. Energy Information Administration

While the lower coal production can in part be explained by one-off occurrences such as the coal-seam fire in January 2013 at the Elk Creek Mine in Gunnison County, which resulted in an idled mine and layoffs of more than 250 employees that predominantly live in nearby Delta County, the competitive pressures on Colorado and U.S. coal production are more deep-seated. These concerns relate to emergence of low-priced and relatively cleaner natural gas as an alternative to coal in generating electricity and uncertainty posed by impending U.S. Environmental Protection Agency regulations. According to the EIA, U.S. coal consumption has fallen by almost 25% since 2007 as utilities switched to natural gas, and from 1990 to 2011 natural gas-fired plants accounted for 77% of additions to the nation’s generating capacity. The EIA also reports that in 2012 utilities nationwide retired 57 aged, coal-fired power plants, with another 61 coal-fired units are slated to close in 2015.

In the longer term, the EIA⁵ expects the competition between coal and natural gas as the premier fuel source of electricity production to continue, with the edge going to natural gas for the following reasons:

⁵ EIA. Annual Energy Outlook 2013. http://www.eia.gov/forecasts/aeo/IF_all.cfm#coal_gas

- 1) New Natural Gas-fired plants are generally 1.5 times more efficient than coal plants
- 2) Natural combined-cycle (gas) turbines are more flexible than steam turbines. Natural gas output can be calibrated upwards and downward more readily, resulting in reduced start-up and shutdown procedures in terms of cost and time.
- 3) Coal plants are poised to struggle with the cost of impending regulations. The EIA anticipates coal-fired plants will be required to have scrubbers systems installed by 2016 to comply with mercury and air toxics standards. These systems, combined with higher coal prices, and lower wholesale electricity prices will make it difficult for coal plants to compete.

This competition between coal and natural gas use in the electricity sector will be closely watched over the next several years.

Non-fuel Minerals

As explained above, Colorado is endowed with a diverse array of non-renewable resources. In addition to the hydrocarbon products described above, the state also boasts significant non-fuel mineral deposits, including molybdenum and gold.

Among non-fuel minerals, molybdenum comprises the largest component of mineral production in Colorado. Given its ability to withstand extremely high temperatures, molybdenum is used in a number of industrial applications, including production of steel, cast iron, machine tools, and aerospace manufacturing.

In operation since 1976, the Henderson Mine in Clear Creek County is the largest and highest quality producer of primary molybdenum in the world. Virtually all Henderson mine output is exported to chemical markets in Europe, where buyers are highly sensitive to the quality of the molybdenum and the environmental footprint of the source mine, for both of which Henderson mine is renowned. After being shuttered for a number of years, the Climax Molybdenum Mine in Lake County resumed operations in 2011 under the same ownership group as Henderson.

In 2012, the Henderson Mine produced more than 34 million pounds of molybdenum for export. Climax Mine added another 7 million pounds of production. The price of molybdenum averaged approximately \$13/pound in 2012, and fell to \$11/pound in 2013. With molybdenum prices having dropped significantly since 2008 with the onset of the global economic downturn, production at both of Colorado's molybdenum mines are unlikely to significantly vary from the 2012 production levels.

Historically an important source of Colorado mining production, gold retains an important position today. According to the United States Geological Survey⁶, in 2011 Colorado ranked as the fourth largest gold-producing state in the country. Only Alaska, Nevada, and Utah, in descending order, produce more gold. Cresson Mine in Teller County is the nation's eighth largest producing gold mine overall. The

⁶ USGS. 2011 Minerals Yearbook – Gold. <http://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2011-gold.pdf>

mine produced 292,800 ounces of gold in 2011, a 15% increase from the prior year on account of mine capacity upgrades completed by the mine's owner - AngloGold Ashanti Ltd. As gold prices began to depart from historical highs during 2012, production fell to 247,000 ounces, a 16% decrease, which is also below the 2010 output of 254,600 ounces. As gold prices have retreated significantly throughout 2013, from as much as \$1,700/ounce in January 2013 to just below \$1,200/ounce by year end, 2013 production will likely be lower than in recent years.

Summary

Colorado remains a significant producer of non-renewable resources. The volume of production and diversity of outputs, including oil, natural gas, coal and non-fuel minerals such as gold and molybdenum are rivaled by few other states and constitute major sources of employment in many of Colorado's regions and counties. As this report has highlighted, the volatile nature of the prices of non-renewable resources has a significant impact on output quantities and total value produced. After prices for mineral and energy commodities peaked in 2008, prices plummeted in 2009 amid a major global economic recession. As the world economy has recovered mineral and energy commodity prices have too, which has prompted increases in Colorado output and dollar value of production. As price increases have abated from 2012 onward, the outlook for significant increases in Colorado production look doubtful. With the exception of petroleum and natural gas, the state should expect flat or slow growth in non-renewable resource output in the next few years.

For more information about this report or other economic indicators, visit the SDO website at www.colorado.gov/demography or contact Grant Nülle, Economist, at grant.nulle@state.co.us