Colorado Extractive Industries Production Update

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Executive Summary

This report utilizes data from the Colorado Oil & Gas Conservation Commission (COGCC), the Energy Information Administration (EIA) and the Colorado Department of Natural Resources (DNR) to examine recent hydrocarbon resource production trends in Colorado. Production of molybdenum and gold are also examined using data reported by the U.S. Geological Survey and the two companies that mine these minerals in Colorado. The principal focus is to identify production changes relative to other states and changes in non-renewable resource production within Colorado’s counties endowed with natural resources.

In 2017, crude oil production in Colorado set a record at 131.1 million barrels, natural gas production edged up to 1.71 trillion cubic feet, and coal production rose about 2.5 million tons to 15.2 million. Molybdenum production increased more than 20% in 2017 and gold production also edged up. Employment in mining rose by 2,100 to 29,200, but remains 8,400 below the 2014 peak employment level.

Total Production and Value of Natural Resources Extracted:

The total value of production of natural resources extracted in Colorado can be estimated by multiplying the quantity of production of the resource by the price of the commodity received at first sale (Total Value of Production = Quantity Produced x Sale Price of Commodity). The value of production provides insights into shifts in resource production (and price) over time and can be used to inform severance tax liabilities and other royalties as these are based on the gross income received or accrued from the resource production. Figure 1 estimates the total value of crude oil, natural gas and coal production in Colorado from 2006 through 2017.
The total value of production in 2017 was $11.4 billion - $6 billion from oil, $5 billion from natural gas and the balance from coal. From 2006 to 2016, the total value of production averaged $11.1 billion with considerable volatility over this period. Both 2008 - with total production valued at nearly $15 billion - and 2014 - with about $16 billion of total production value, stand out as years with exceptional total production values. Natural gas (shown in red in Figure 1) accounted for a majority the increase in the total value of production in Colorado in 2008; gas production increased by 14% (195,000,000 Mcf) and its price rose 25% from 2007 (Henry Hub natural gas prices averaged nearly $9/Mcf in 2008). The 2014 peak was the result of a large increase in oil production combined with oil and natural gas prices reaching their highest value since 2008. Record oil production in 2017 coincided with rising prices, leading to an increase in in the total value of oil produced of more than $1 billion from 2016. However, the total value of oil produced in 2017 was just over $6 billion - about $2 billion less than record value of oil produced in 2014.

Trends in oil, natural gas, coal, molybdenum, and gold production are examined in detail below.

**Crude Oil**

The EIA’s preliminary production totals from 2017 which are used in the comparative statistics in the following paragraphs (final 2017 annual figures will be released at the end of September; the final estimates should be closer to the COGCC total of 131.1 million barrels). With an increase of 12.5 million barrels (10.6%) from 2016, Colorado was one of the top 3 states in the U.S. in terms of oil production growth from 2016 to 2017 - trailing only Texas (+106.7 million barrels) and New Mexico (+26.8 million barrels). Colorado accounted for 3.8% of oil production in the United States in 2017 and was the 7th largest oil producing state in 2017 as shown below in Table 1.

<table>
<thead>
<tr>
<th>Area</th>
<th>Crude Oil Produced</th>
<th>Share of US Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Total</td>
<td>3,414,528</td>
<td>100%</td>
</tr>
<tr>
<td>Texas Onshore</td>
<td>1,281,692</td>
<td>37.6%</td>
</tr>
<tr>
<td>Federal Offshore-Gulf of Mexico</td>
<td>613,017</td>
<td>18.0%</td>
</tr>
<tr>
<td>North Dakota</td>
<td>388,305</td>
<td>11.4%</td>
</tr>
<tr>
<td>Alaska (Includes North Slope)</td>
<td>180,467</td>
<td>5.3%</td>
</tr>
<tr>
<td>California</td>
<td>173,240</td>
<td>5.1%</td>
</tr>
<tr>
<td>New Mexico</td>
<td>172,817</td>
<td>5.1%</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>165,920</td>
<td>4.9%</td>
</tr>
<tr>
<td><strong>Colorado</strong></td>
<td><strong>128,387</strong></td>
<td><strong>3.8%</strong></td>
</tr>
<tr>
<td>Wyoming</td>
<td>75,513</td>
<td>2.2%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>50,036</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Source: https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm

In 2007, Colorado produced 26.2 million barrels of oil, was the 11th largest producing state accounting for 1.4% of the nation’s production. Since 2007, Colorado has ridden the wave of increased oil production from tight rock formations (aka shale) that has led to an 83% increase in U.S. crude oil production over the past decade. Colorado’s petroleum production rose 400% between 2007 and 2017, second only to North Dakota’s 767% increase. These large gains were driven by a combination of high oil prices (from 2010 to 2014 West Texas Intermediate (WTI), the benchmark for U.S. oil, averaged $92/barrel) and technological advances such as horizontal drilling and fracking. Almost all of the increased oil production in Colorado since 2007 is due to nearly exponential growth in production from Weld County, as can be observed in Figure 2.
Although crude oil production reached then-record levels in 2015, the price per barrel fell by nearly 50% from 2014. Falling prices led to a decline in production starting in August 2015 and lasting through February 2017. As oil prices rose throughout most of 2017, so too did oil production - in the 2nd half of 2017 Colorado production averaged 12 million barrels per month, marking a substantial increase from the 9.5 million barrels per month average over the first half of the year. During the 4th quarter of 2017, oil production was approximately 12.5 million barrels per month as producers increased output in response to oil prices that were above $55/bbl.

**Oil Production – Short term forecast**

In June 2018, the U.S. Energy Information Administration (EIA) again boosted its projection for U.S. crude oil production in its [Short-Term Energy Outlook](http://cogcc.state.co.us/COGCCReports/production.aspx?id=MonthlyOilProdByCounty). According to the report, “EIA projects that U.S. Crude oil production will average 10.8 million barrels per day (b/d) in 2018, up from 9.4 million b/d in 2017, and will average 11.8 million b/d in 2019.”

If the 2018 projection is achieved, this would be the highest U.S. annual oil production on record, surpassing the previous record of 9.6 million b/d set in 1970. Figure 3 below shows the daily production of crude oil in the U.S. from 1950 to 2019.
Most of the increased production in 2018 is expected to come from the Permian Basin in Texas and New Mexico along with a significant contribution from the Federal Gulf of Mexico expected at the end of 2019. Considering New Mexico and Texas saw the greatest growth in oil production in 2017 up 17.0% and 7.5%, respectively from 2016, this expectation continues the trend observed last year. Colorado was among the top states in the U.S. in terms of percentage increase in oil production in 2017, but wasn’t specifically mentioned in the EIA forecast.

From August 2017 to March 2018, Colorado has accounted for more than 4% of all U.S. Oil production. Assuming Colorado maintains a 4.1% share of U.S. oil production over the next 2 years, statewide production of oil would rise to 153 million barrels in 2018 and increase by another 5 million barrels in 2019 to 158 million barrels.

To reach production of 150 million barrels of oil in 2018, Colorado needs to produce an average of 12.5 million barrels per month or roughly 416,000 barrels per day. In December 2017, statewide production exceeded 13 million barrels for the first time on record. January and March 2018 also saw monthly production in excess of 13 million barrels.

**Natural Gas**

With 1.69 trillion cubic feet of natural gas production in 2017 preliminarily estimated by the EIA, Colorado ranked 8th in the U.S. for total natural gas produced. Natural gas production in Colorado set a record at 1.723 trillion cubic feet in 2012, but production has been slightly lower in the six years since. Although natural gas production has been relatively stable, the production by county within the state has changed. With large amounts of associated gas coming from oil drilling operations, Weld County has been the top producer of natural gas in Colorado for the past 2 years. After displacing Garfield County as the largest producer of natural gas in Colorado in 2016, Weld produced 41% more gas than Garfield in 2017. Weld accounted for 40% of all natural gas produced in the state in 2017, a three-fold increase from 2010 when it comprised 13% of state production. Natural gas production in Garfield County has declined by 31% over five years, falling from 700 million Mcf in 2012 to about 480 million Mcf in 2017. As a result of this declining production, Garfield County’s share of Colorado’s total gas production has fallen from 41% to 28%. The three largest natural gas producing counties after Weld and Garfield - La Plata, Las Animas, and Rio Blanco - have also seen their gas production fall substantially from 2012 to 2017 as shown in Figure 4 below.
Colorado accounted for just over 5% of U.S. Natural Gas production in 2017, a share that is essentially unchanged from 2007. Many of the largest natural gas producing states in the U.S. such as Texas, New Mexico and Louisiana have seen their share of the nation’s production fall over this same period. Nearly exponential growth in production from the Marcellus and Utica shale formations has turned West Virginia, Ohio and Pennsylvania into major natural gas producers over the past decade. In 2007, these 3 states combined to account for 2% of the natural gas produced in the U.S., but they accounted for 27% of all natural gas produced nationally in 2017.

Natural Gas – Short term forecast

The EIA short term forecast is also projecting record natural gas production this year. Natural gas production is expected to grow by 10.3% in 2018 to 81.2 billion cubic feet per day (Bcf/d). EIA expects natural gas production will rise to 83.8 Bcf/d in 2019, growth of 3.2%. The increased production nationally is expected to keep a lid on natural gas prices which averaged $2.99/MMBtu in 2017; the EIA is projecting an average Henry Hub spot price of $2.99/MMBtu in 2018 and $3.08/MMBtu in 2019.

Through the first quarter of 2018, natural gas production in Colorado is up 5.9% from the same period in 2017. Assuming sustained production growth continues through the last three quarters of 2018, Colorado is on pace produce a record 1.75 trillion Mcf in 2018.
Coal

Increased production of natural gas has driven down its cost and has made it more economical to produce electricity with gas instead of coal. The lower costs and emissions have caused many utilities to favor natural gas over coal for electricity generation. This shift has lowered demand for coal and resulted in a substantial decline in coal production in Colorado from 2012 to 2016 as shown in Figure 5. In 2012, Colorado had 11 coal mines operating in nine counties that produced 28.6 million tons of coal. By 2016, there were only seven coal mines that operated for the full year and statewide production of coal was 12.8 million tons - down 55% from the 2012 level. In 2017, Colorado produced 15.2 million tons of coal, an increase of 18% from one year ago. Nationally, coal production also fell from 2012 to 2016, but edged up by 6% to 773 tons in 2017. Colorado accounted about 2% of all U.S. coal production last year. EIA forecasts coal production in the U.S. to decline by 2% to 756 million tons in 2018. Despite only having six operating mines in 2018, Colorado is likely to see a slight increase in coal production in 2018. Colorado, Alabama, Montana and West Virginia are the only coal producing states that have experienced a year-to-date increase in production through early June of 2018 compared to the same period one year ago.

Figure 5

Source: Department of Natural Resources, Division of Reclamation Mining & Safety
**Molybdenum and Gold**

In addition to the hydrocarbon resource production detailed above, Colorado also boasts significant non-fuel mineral deposits of molybdenum and gold.

Molybdenum is the largest non-fuel mineral mined in Colorado. It is used in a number of industrial applications including production of steel, cast iron, machine tools and aerospace. Molybdenum is primarily used as an alloying agent in steel, but it is also used as a catalyst in petroleum refineries and as a lubricant for engines used in manufacturing, mining and transportation.

Molybdenum is produced in 9 mines across the U.S. It is the primary product produced at the Henderson mine in Clear Creek County (it gets milled in neighboring Grand County) and the Climax mines in Lake County; it is also produced as a byproduct at 7 copper mines throughout the western U.S. (4 in Arizona and one each in Montana, Utah and Nevada). Molybdenum production nationally increased by 25% to 44,600 tons in 2017, according to the U.S. Geological Survey. According to the Freeport McMoran 2017 annual report, molybdenum production at the Climax Mine rose 25% to 20 million pounds (10,000 tons) and the Henderson Mine was up 20% to 12 million pounds (6,000 tons). The company also reported that the average price per pound it realized in 2017 increased by 12% to $9.33/lb. Colorado’s value of molybdenum production in 2017 was about $300 million.

U.S. gold production in 2017 rose by 10% to 245 tons. Gold is produced in more than 40 mines throughout the United States, with most production occurring in Nevada and Alaska. Colorado has one major gold mine, the Cresson Mine in Teller County. Newmont Mining purchased this mine in 2015 from the Cripple Creek & Victor Gold Mining Company and reported 451,000 ounces (just over 14 tons) produced in 2017 - or about 6% of the U.S. total. At an average price of $1,258 per ounce in 2017, the total value of gold produced in Colorado was approximately $550 million.

**Mining Employment**

According to the Total Estimated Employment figures computed by the State Demography Office, mining employment in Colorado rose 1,700 or 6.1% in 2017. The number of people working in mining across the state fell 10,400 from 2014 to 2016, but the industry employment reversed course in 2017 as rising oil prices help to spur more drilling activity in Colorado. Nearly all of the employment gain in 2017 occurred in Support Activities for Mining – a category that includes drilling of oil & gas wells. Coal mining employment continued to decline in 2017 – falling to 1,100 according to the Colorado Department of Natural Resources’ Coal Production report. In 2012, nearly 2,300 miners were reported working in Colorado’s coal mines.

A time series of mining employment from 2000 to 2017 is shown in Figure 2.

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Final Thoughts

Colorado continues to be among the top producing states of non-renewable resources. The extraction of these commodities provides a significant source of property taxes and employment in many Colorado counties. As this report has highlighted, the volatile nature of the non-renewable resources combined with shifts in demand has a significant impact on output quantities and total value produced. The expectation for production growth looks the brightest for crude oil and natural gas in the near-term, while other non-renewable resources should see flat to slow growth throughout the remainder of 2018 and into 2019.

Oil production will likely decline again in the wake of the next recession and coal production will likely remain at depressed levels as more electricity is generated from natural gas and renewables. Continued gains in renewable energy production combined with increased usage of battery powered technology for transportation will likely dampen demand for fossil fuels after 2030.

Recent gains in the price of molybdenum have caused Freeport McMoran to delay the closure of the Henderson mine, but this delay merely presents a unique opportunity for Clear Creek and Grand counties to plan for a future in which mining will not be an economic driver. Areas of the state that are dependent upon extractive industries for employment and taxes should continue efforts to diversify their economies so that they are better prepared to weather future declines in natural resource production.