
COLORADO OIL AND GAS INDUSTRY

Updated Economic Assessment of Colorado Oil and Gas Prices

Conducted by:

BUSINESS RESEARCH DIVISION

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Embargoed until 6:00 a.m. on Friday, August 21, 2015

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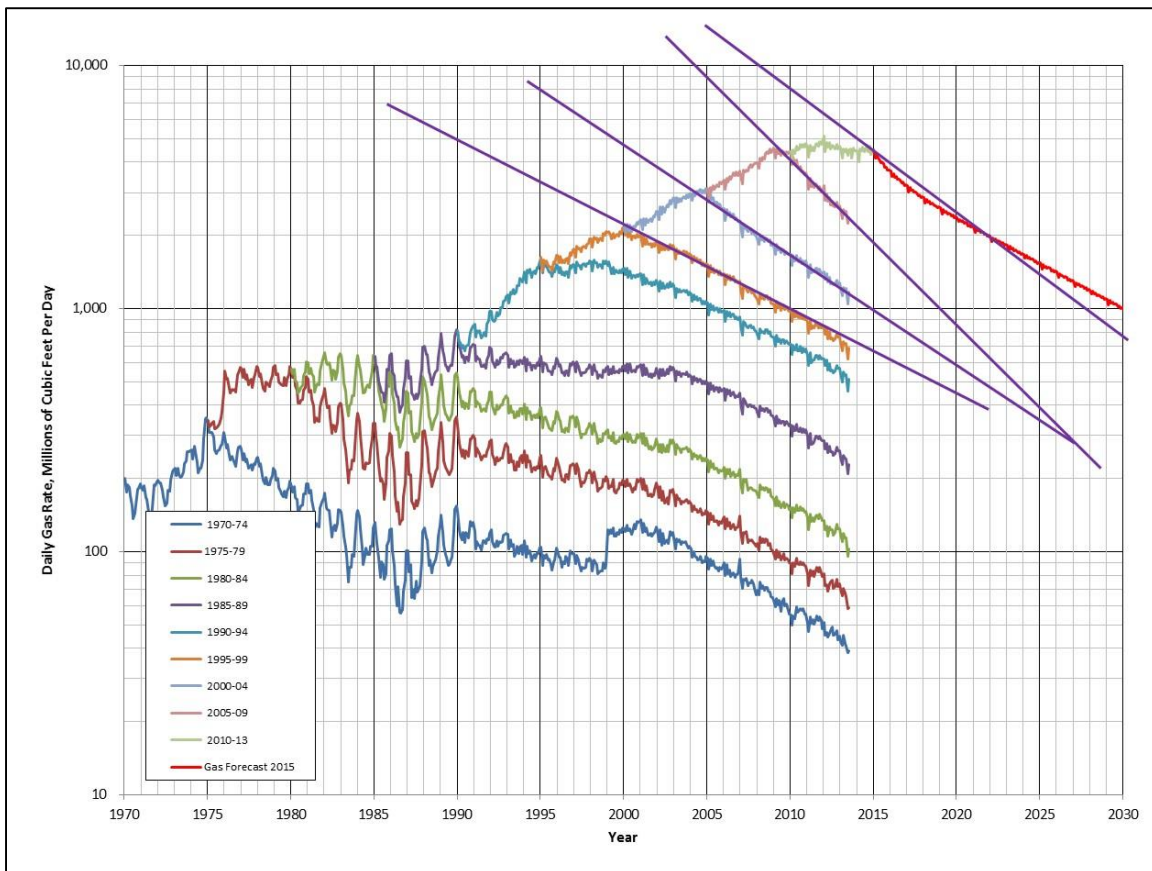
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SUMMARY

The spot price for West Texas Intermediate (WTI) peaked June 20, 2014, at \$107.95 per barrel, and the average weekly Henry Hub natural gas spot price peaked at \$6.55, in February 2014. As of July 2015, oil spot prices were down 49% year-over-year, and natural gas prices were down over 30%. The sharp decline in prices has had a measurable but delayed impact on rig counts, industry employment, and taxes, but production has thus far remained stable. Based on the relationship between price, rig counts, and production, 2015 will record a decrease in oil and gas production.

Wells typically record the greatest volume of production in year 1 and decrease at a slower rate with each successive year. Examining Colorado production data from 1970–2014, each successive five-year band records steeper depletion curves, and the 2010–2015 depletion curve is unprecedented in the 44-year period. Colorado oil production spiked over the past five years, breaking the single-year production record established in the 1950s in the state. With each successive year beginning in 2012, Colorado produced more oil in a single-year period than at any point in the state’s history.

FIGURE 1: SLOPE OF NATURAL GAS DEPLETION CURVES



Sources: IHS, EE3 LLC, BRD.

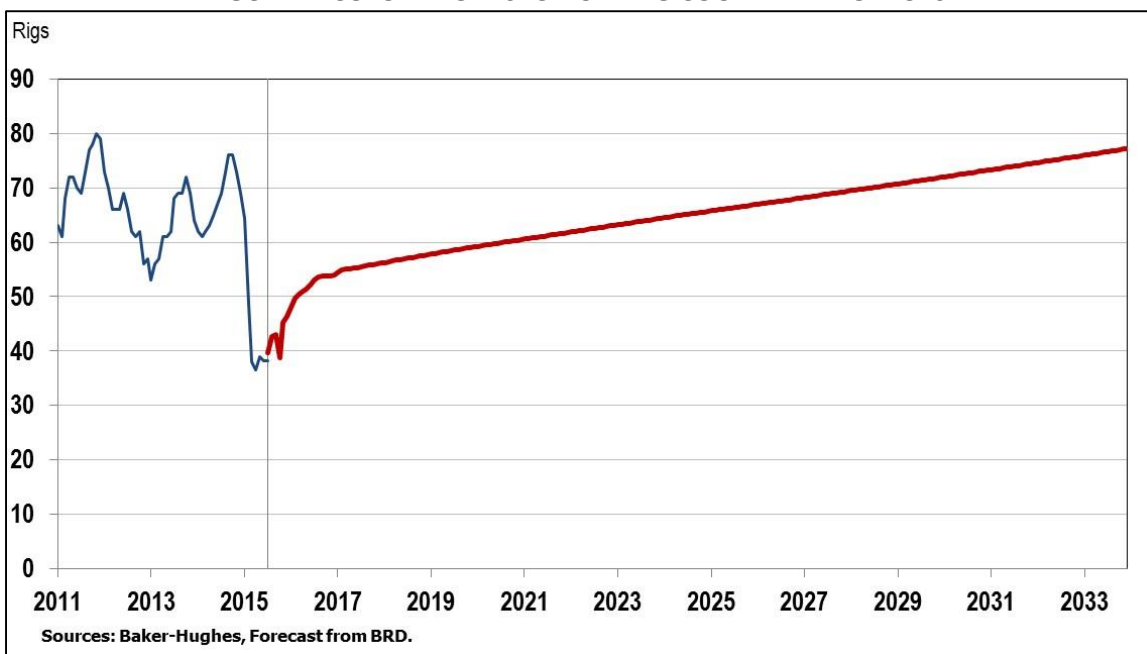
The Colorado rig count reported by Baker-Hughes reached 80 in November 2011 and averaged 72 in 2011, 65 in 2012, 63 in 2013, and 68 in 2014. The decrease in the rig count lagged the price decline, with the decrease showing in the data in 2015—the average was 43 for the first 6½ months of the year. There is a positive correlation between price and the rig count with a three-month lag. As oil prices are forecasted to recover later this decade, the rig count will rebound then flatten with a relatively flat price increase.

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From 2010–2014, Colorado averaged about 240 new wells per month; 2014 alone averaged 157. Given production depletion, a steady supply of wells is necessary to backfill lost production. Based on historical production and rig counts, Colorado would need to bring on about 170 wells per month in perpetuity to keep production constant. Assuming drilling rigs can produce 2.8 wells per month (approximately one well per 11 days), Colorado’s oil well rig count would need to total 57. Colorado’s rig count averaged 57 in 2014 but has averaged 37 rigs through mid-June 2015 (and fewer than 30 since April).

Oil production will depend on the wells drilled, which, in turn, will depend on active rigs in Colorado. This paper examines three rig count scenarios. Under the first scenario, where the current rig count is extended through the forecast horizon, production has already peaked in the state. The depletion curve will flatten assuming that the rig count remains stable at the current price. Under the second scenario, where the number of wells (and thus rigs) are increased to keep Colorado production flat (estimated at 57 rigs, or about 20 more than are currently active in Colorado), production remains flat but the value of production increases as prices increase. Under the third scenario, where drilling and production increase as prices increase as forecasted by Moody’s Analytics, both production and value of production rebound. This scenario projects a short-term drop in production in Colorado, followed by a long-term production increase with a rebounding rig/well count.

FIGURE 2: COLORADO HISTORICAL RIG COUNT AND FORECAST



Based on the three production scenarios and the price forecast from Moody’s, the total value of production will decrease in 2015 before rebounding with a price rebound. Using the production estimates in this paper multiplied by the Moody’s forecast for WTI, the value of production will decrease by one-third from 2014 to 2015 before increasing in 2016, due mostly to an increase in pricing.

PRICE IMPACT

The Business Research Division (BRD) has studied the contributions of the oil and gas industry in Colorado since 2010. In 2014, the BRD began analyzing policy and price impacts on the oil and gas industry and the implications on the state economy using the REMI model with support from the Metro Denver Economic Development Corporation, the Denver South Economic Development Partnership, and the Common Sense Policy Roundtable. Three papers describe policy and price impacts:

- *Hydraulic Fracturing Ban: The Economic Impact of a Statewide Fracking Ban in Colorado* (March 2014)
- *Colorado Oil and Gas Industry: Updated Economic Assessment of Colorado Oil and Gas Ballot Initiatives in 2014* (September 2014)
- *Oil and Gas Prices – the Upside and the Downside* (January 2015)

This paper refines the work completed in 2014 and early 2015, isolating the price impact on production in Colorado.

Data on drilling rigs, production, and prices lend insight into the production forecast for Colorado. Notably, data on the history of wells in Colorado not only show that the depletion curve is steep for oil and gas production, but that the curve became steeper over the past decade, indicating that more drilling would be warranted to backfill lost production. While the depletion curve is steeper, the same shale wells are producing more in the first year than wells brought online a decade ago.

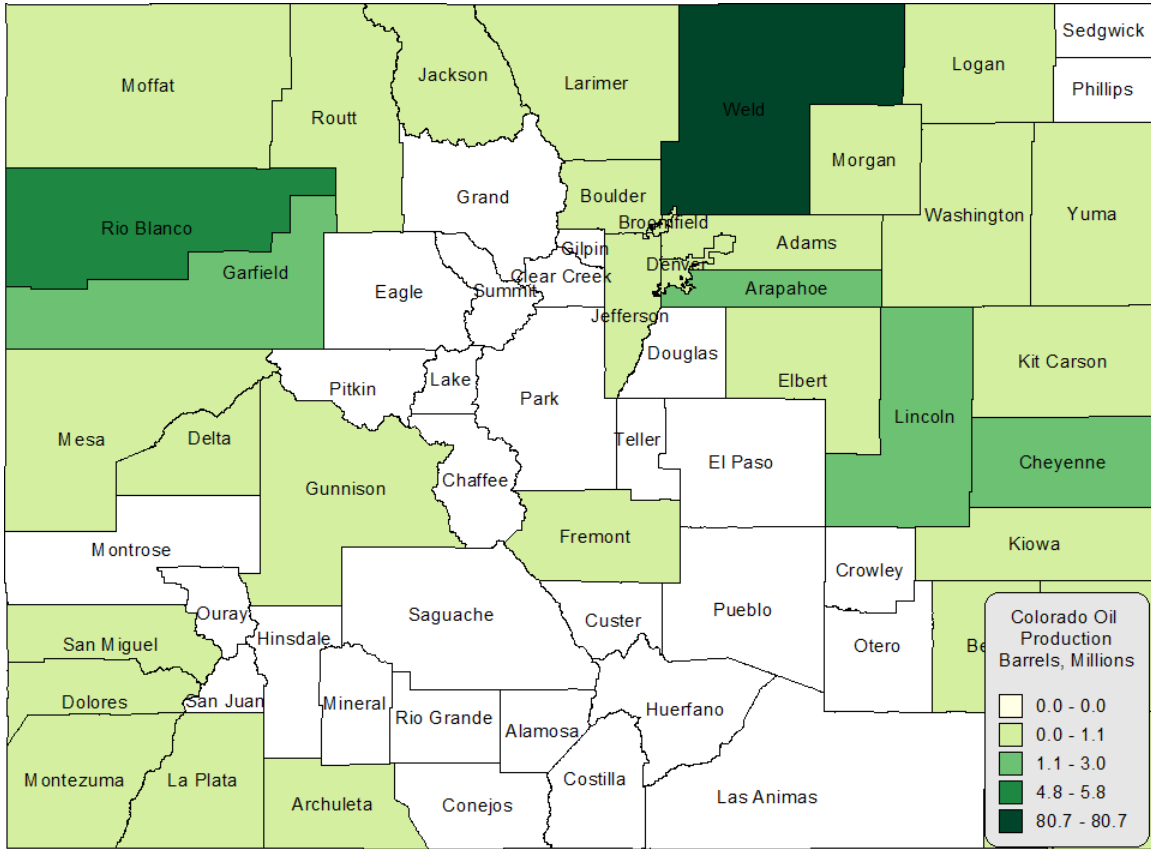
During the current price event in which prices fell 50% or greater year-over-year, the impact resonates in drilling, tax, and permit data, while production has increased and remained stable. However, the relationship between drilling rigs and production suggests that Colorado production will soon (if not already) be decreasing, and that Colorado would need about 57 active rigs to keep production flat (without decreasing).

COLORADO OIL PRODUCTION

Resource extraction is concentrated in a few areas in Colorado, with nearly 96% of oil production and 86% of natural gas production occurring in five counties according to production data from the Colorado Oil and Gas Conservation Commission (COGCC).

The top five counties for oil production in 2014 were Weld, Rio Blanco, Garfield, Lincoln, and Cheyenne, with Weld accounting for more than 85% of the state total. Weld has effectively increased market share each year since 1999 (earliest data available), increasing from 33% in 1999 to 86% in 2014.

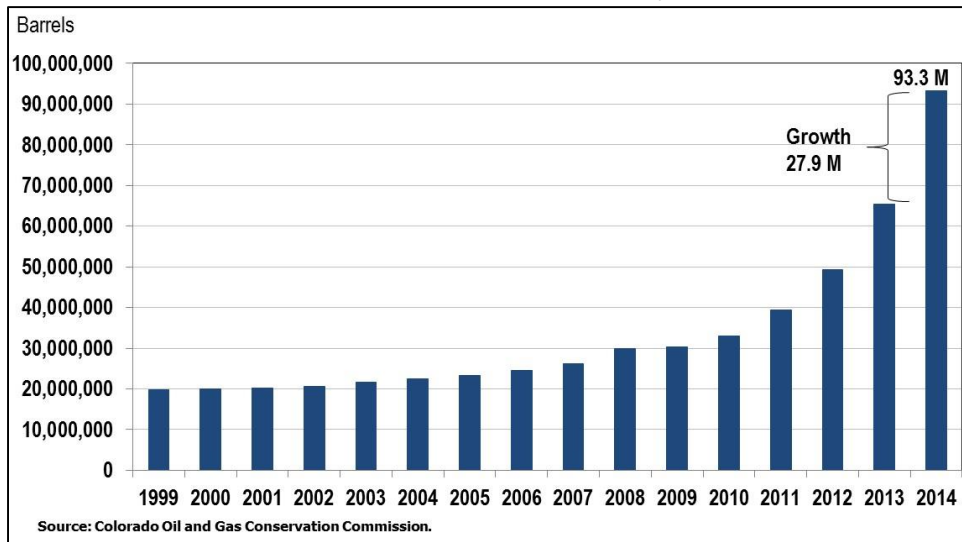
FIGURE 3: COLORADO OIL PRODUCTION, 2014



Source: COGCC.

Oil production in Colorado began a steep ascent in 2010, increasing by 60 million barrels in four years and spiking by 27.9 million barrels in 2014 alone. Differential production from 2013 to 2014 eclipsed *total* production in Colorado in 2007.

FIGURE 4: COLORADO OIL PRODUCTION, 1999–2014



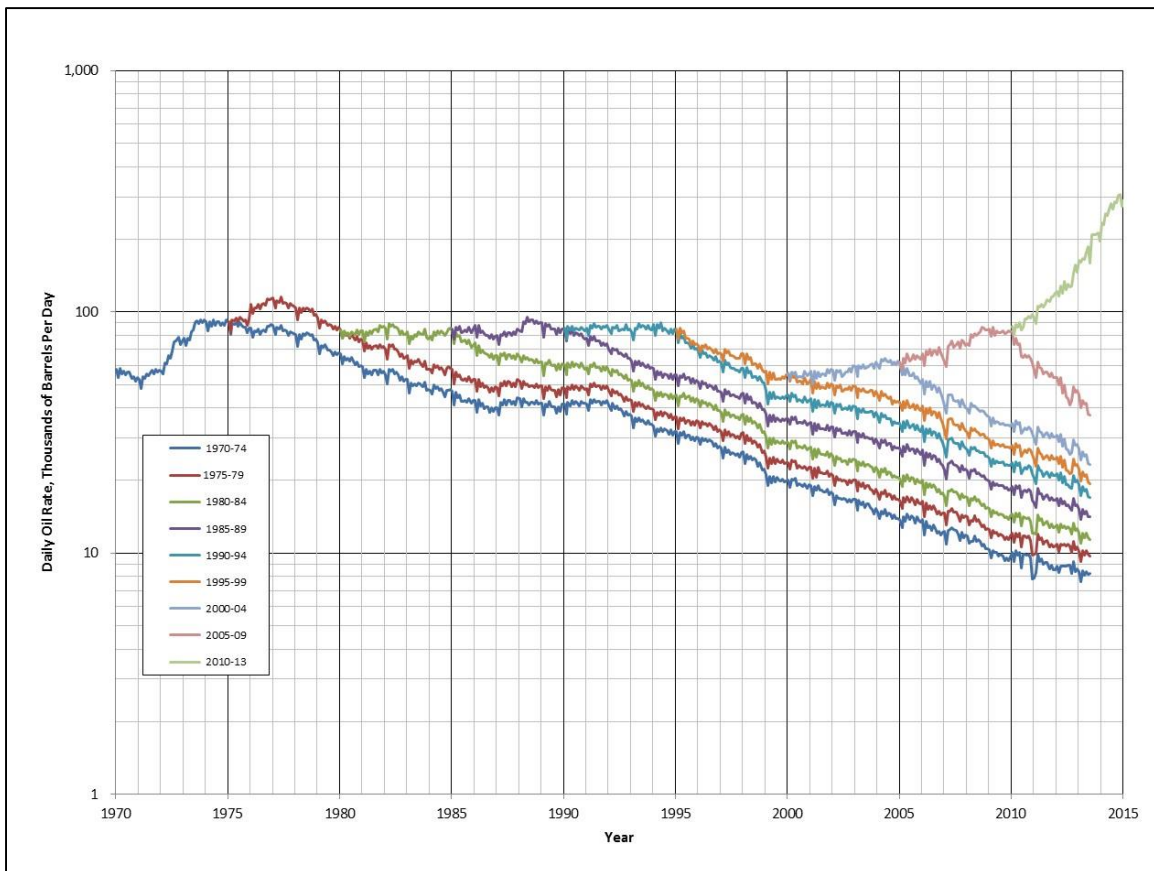
Source: Colorado Oil and Gas Conservation Commission.

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Oil wells perform differently basin to basin and well to well. Examining the population of wells imbedded in total Colorado production from 1970 forward illustrates well production in aggregate and allows for analysis on the pace of production depletion.

FIGURE 5 displays oil production data from 1970–2015 in Colorado in five-year increments on a semi-logarithmic chart. Each successive period adds to Colorado’s production total—production added in the five years from 1975–1979 is presented as a marginal increase over the production that existed prior to 1975. Some periods recorded substantial production, adding to the Colorado base (e.g., 1975–1979, 2005–2009, and 2010–2015), while other periods resulted in a net decrease in aggregate production (e.g., 1995–2000).

FIGURE 5: COLORADO OIL PRODUCTION



Sources: IHS, EE3 LLC, BRD.

DEPLETING OIL WELL PRODUCTION

Wells typically record the greatest volume of production in year 1 and decrease at a slower rate with each successive year. Presented on a semi-logarithmic chart, the production curves appear linear, with the exception of the 2010–2015 depletion curve. Two critical observations:

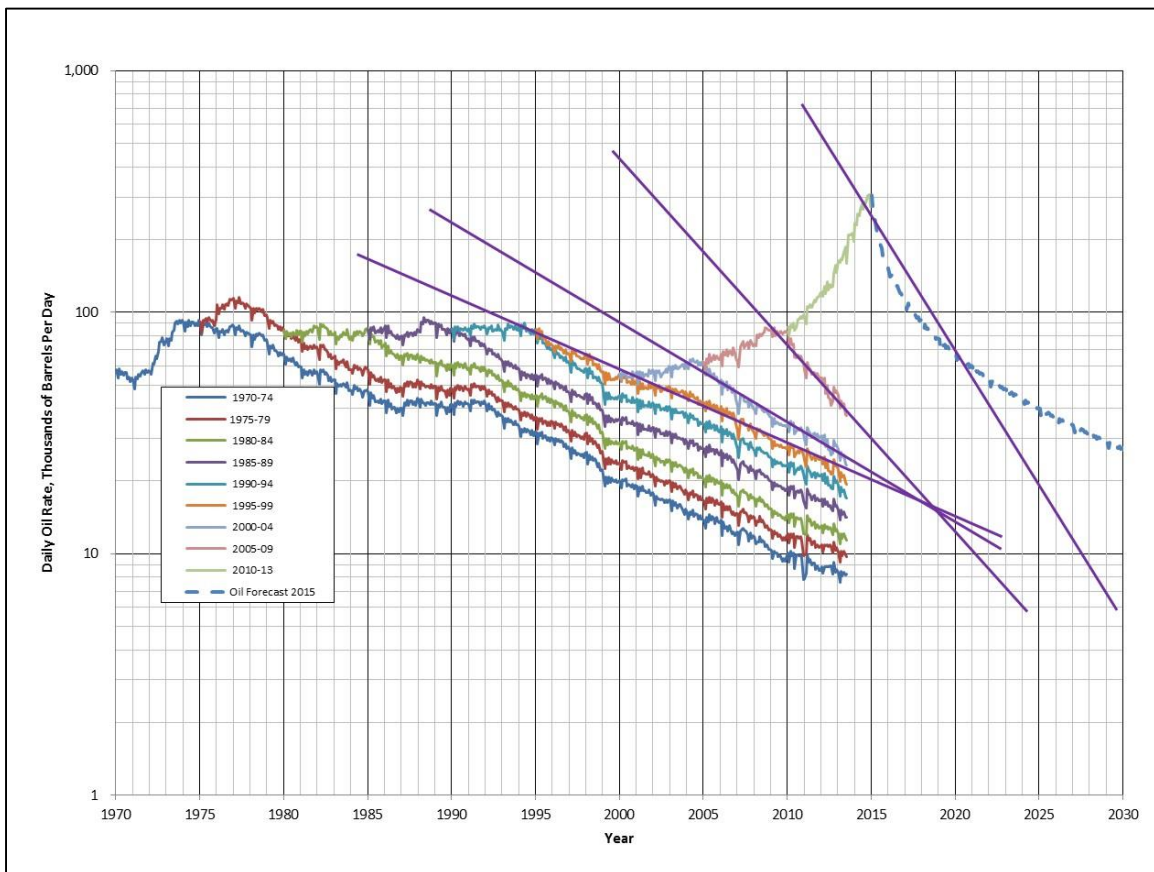
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- 1) Each successive period records steeper depletion curves.
- 2) The 2010–2015 depletion curve is unprecedented in the Colorado production history, 1970–2015.

Colorado oil production spiked over the past five years, breaking the single-year production record established in the 1950s in the state. With each successive year beginning in 2012, Colorado produced more oil in a single-year period than at any point in the state’s history. If new production ceased in 2015, total production would deplete at a rate of 50% in year 1, 26% in year 2, and 19% in year 3, settling at about 6.9% per year by 2015. Production from wells started in 2010 will deplete at 55% in year 1, 30% in year 2, and 23% in year 3 before settling at 6.9% by year 2015. However, production from wells drilled in 2014 indicate a steeper curve—decreasing 74% in year 1, 44% in year 2, and 32% in year 3. A steeper depletion curve means that Colorado will need more aggressive drilling in order to maintain current production levels. Without further technology breakthroughs or oil discovery similar to the Denver-Julesburg (D-J) Basin, 2014 and 2015 will likely be the new peak, with lower production on the horizon.

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FIGURE 6: SLOPE OF OIL DEPLETION CURVES



Sources: IHS, EE3 LLC, BRD.

TABLE 1: PERCENTAGE OIL DECLINE BY YEAR (DEPLETION RATE)

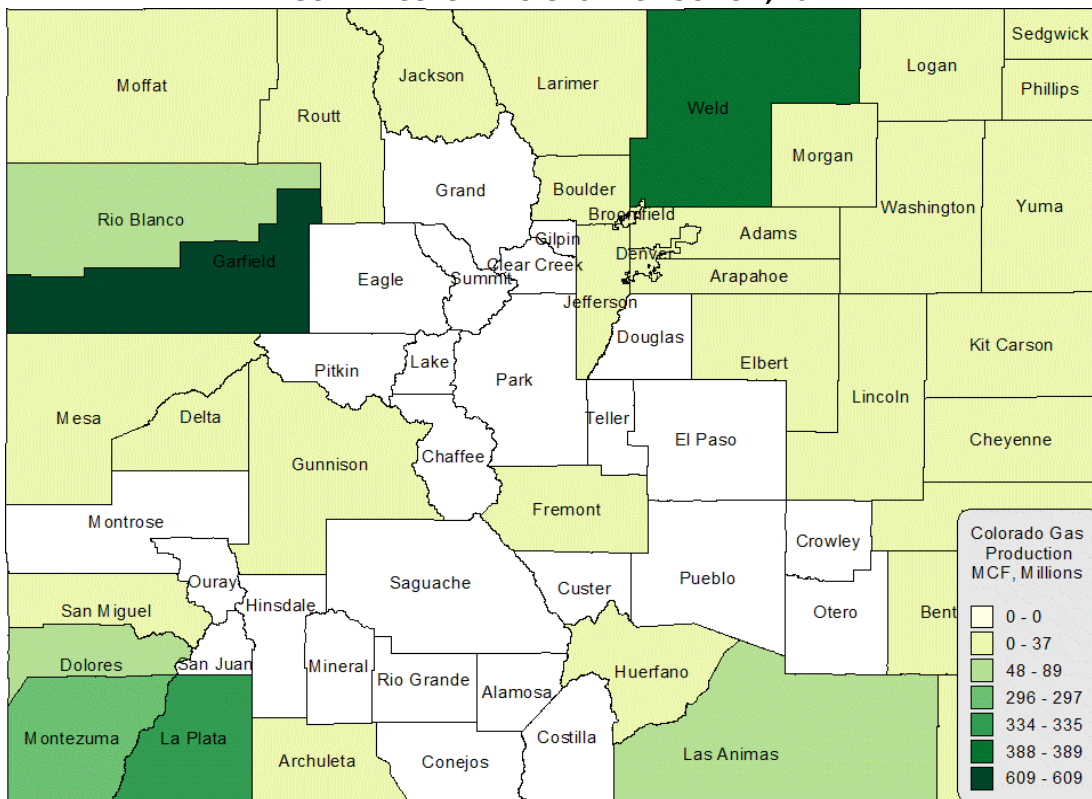
Year	All Colorado Wells	Wells 2010-2014	Wells 2014
2016	50.1%	54.7%	74.4%
2017	25.9%	30.1%	44.2%
2018	19.0%	22.5%	32.0%
2019	15.4%	18.4%	25.1%
2020	13.1%	15.7%	20.7%
2021	11.6%	13.7%	17.7%
2022	10.5%	12.2%	15.3%
2023	9.6%	11.0%	13.6%
2024	9.0%	10.0%	12.2%
2025	8.4%	9.3%	11.1%
2026	8.0%	8.5%	10.1%
2027	7.6%	8.0%	9.3%
2028	7.3%	7.5%	8.6%
2029	7.1%	7.2%	8.1%
2030	7.0%	7.0%	7.5%
2031	6.9%	6.9%	7.1%
2032	6.9%	6.9%	6.9%

Source: EE3 LLC, BRD.

NATURAL GAS PRODUCTION

The top five counties for natural gas production in 2014 were Garfield, Weld, La Plata, Montezuma, and Las Animas, with Garfield accounting for nearly 31% of the state total.

FIGURE 7: COLORADO GAS PRODUCTION, 2014

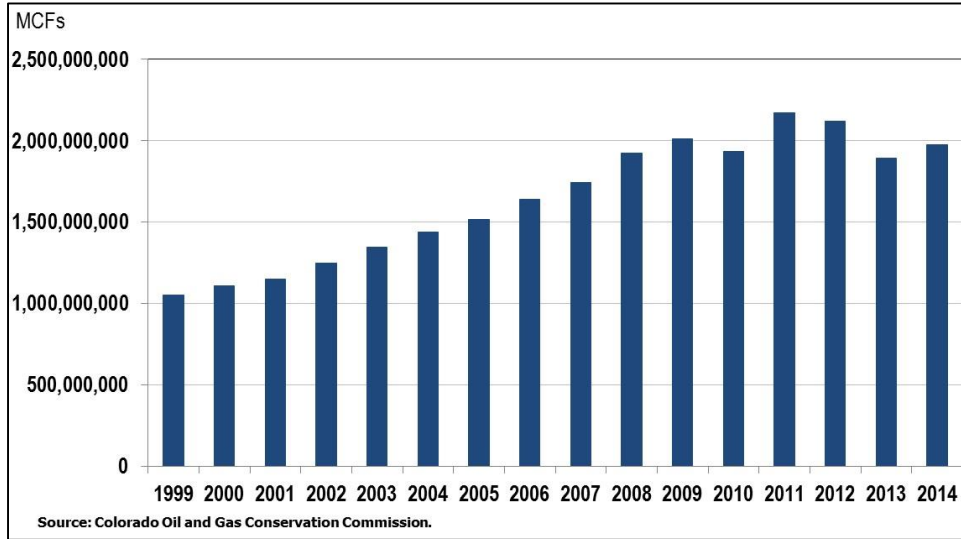


Source: COGCC.

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Natural gas production in Colorado recorded a steady ascent, to 2.2 million MCFs of production, between 1999 and 2011. After peaking in 2011, production has hovered around 2 million MCFs.

FIGURE 8: COLORADO NATURAL GAS PRODUCTION, 1999–2014

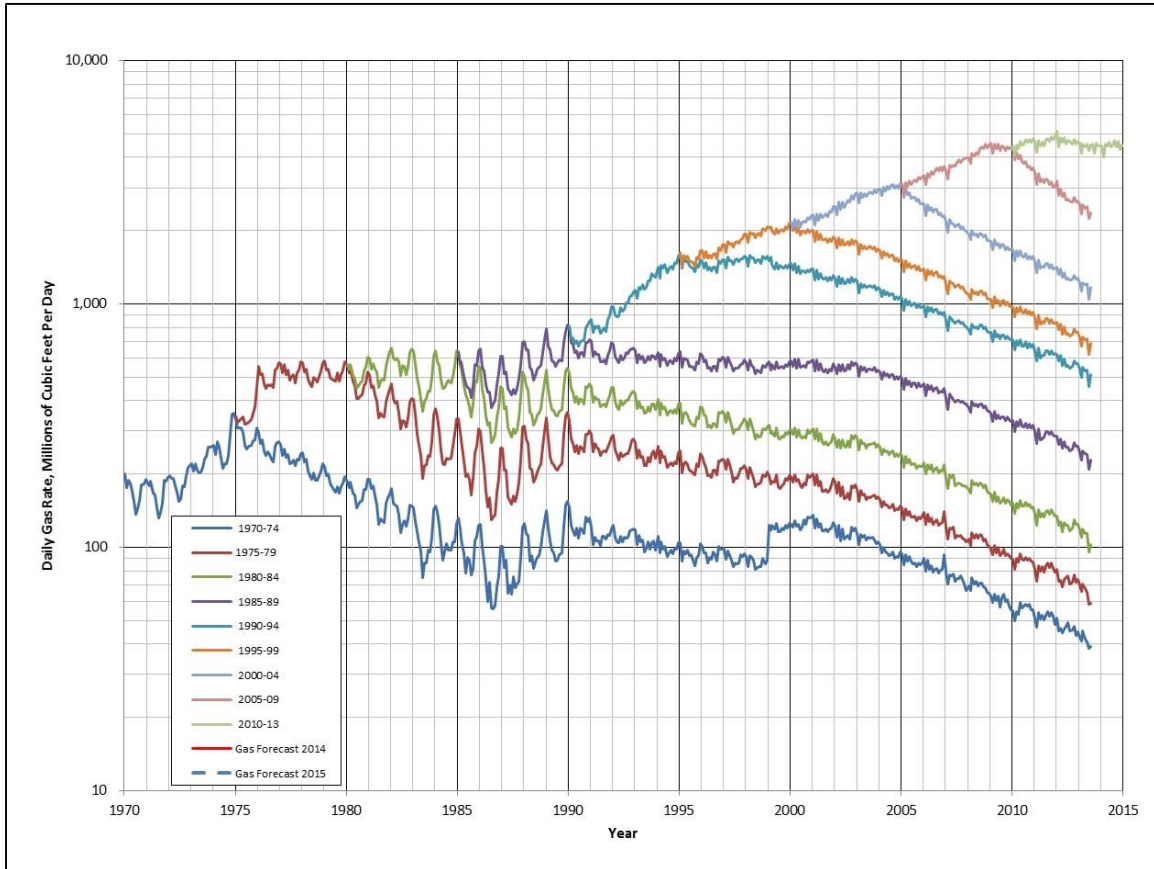


Like oil wells, natural gas wells perform differently basin to basin and well to well. Examining the population of wells imbedded in total Colorado production from 1970 forward illustrates well production in aggregate and allows for analysis on the pace of production depletion.

The following figure displays natural gas production data from 1970–2015 in Colorado in five-year increments on a semi-logarithmic chart. Each successive period adds to Colorado’s production total—production added in the five years from 1975–1979 is presented as a marginal increase over the production that existed prior to 1975. From 1990 forward, each successive five-year period has resulted in an increase to the natural gas production base in Colorado; however, the period 2010–2015 recorded a flattening in the pace of growth compared to the prior periods.

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FIGURE 9: COLORADO NATURAL GAS PRODUCTION



Sources: IHS, EE3 LLC, BRD.

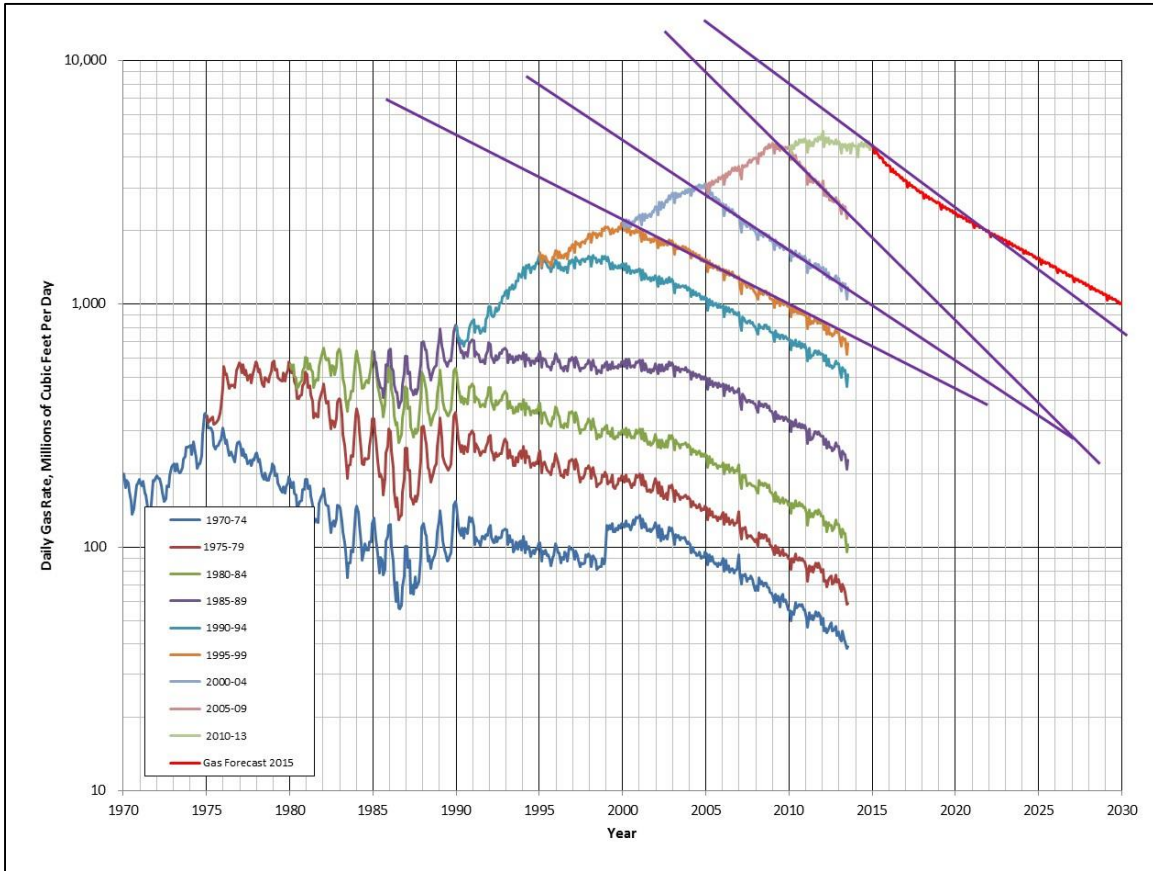
DEPLETING NATURAL GAS WELL PRODUCTION

Natural gas production proves more volatile than oil production. Like oil production, natural gas wells typically record the greatest volume of production in year 1 and decrease at a slower rate with each successive year. Presented on a semi-logarithmic chart, the production curves appear linear. Two critical observations:

- 1) The depletion curves are more stable for natural gas than for oil from decade to decade.
- 2) Natural gas is largely concentrated in western Colorado, so development in the D-J Basin has marginally affected overall natural gas production in the state.

Through 2011, Colorado gas production continued a fairly steady pace of growth that began in the early 1990s. Total production leveled after peaking in 2011. If new production ceased in 2015, total production would deplete at a rate of 19% in year 1, 13% in year 2, and 11% in year 3, settling at about 8.2% per year by year 2015. Production from wells started in 2010 will deplete at 26% in year 1, 17% in year 2, and 13% in year 3 before settling at 8.1% by year 2015. However, wells drilled in 2014 indicate an even steeper decline—46% in year 1, 27% in year 2, and 20% in year 3, still settling at 8.1% at the end of the horizon.

FIGURE 10: SLOPE OF NATURAL GAS DEPLETION CURVES



Sources: IHS, EE3 LLC, BRD.

TABLE 2: PERCENTAGE NATURAL GAS DECLINE BY YEAR (DEPLETION RATE)

Year	All Colorado Wells	Wells 2010-2014	Wells 2014
2016	18.5%	26.3%	45.9%
2017	12.7%	16.9%	27.2%
2018	10.6%	13.1%	19.5%
2019	9.5%	10.9%	15.3%
2020	8.8%	9.5%	12.6%
2021	8.5%	8.8%	10.7%
2022	8.3%	8.4%	9.3%
2023	8.2%	8.2%	8.4%
2024	8.2%	8.1%	8.2%
2025	8.2%	8.2%	8.2%
2026	8.2%	8.1%	8.1%
2027	8.2%	8.1%	8.1%
2028	8.2%	8.1%	8.1%
2029	8.2%	8.2%	8.2%
2030	8.2%	8.1%	8.1%
2031	8.2%	8.1%	8.1%
2032	8.2%	8.1%	8.1%

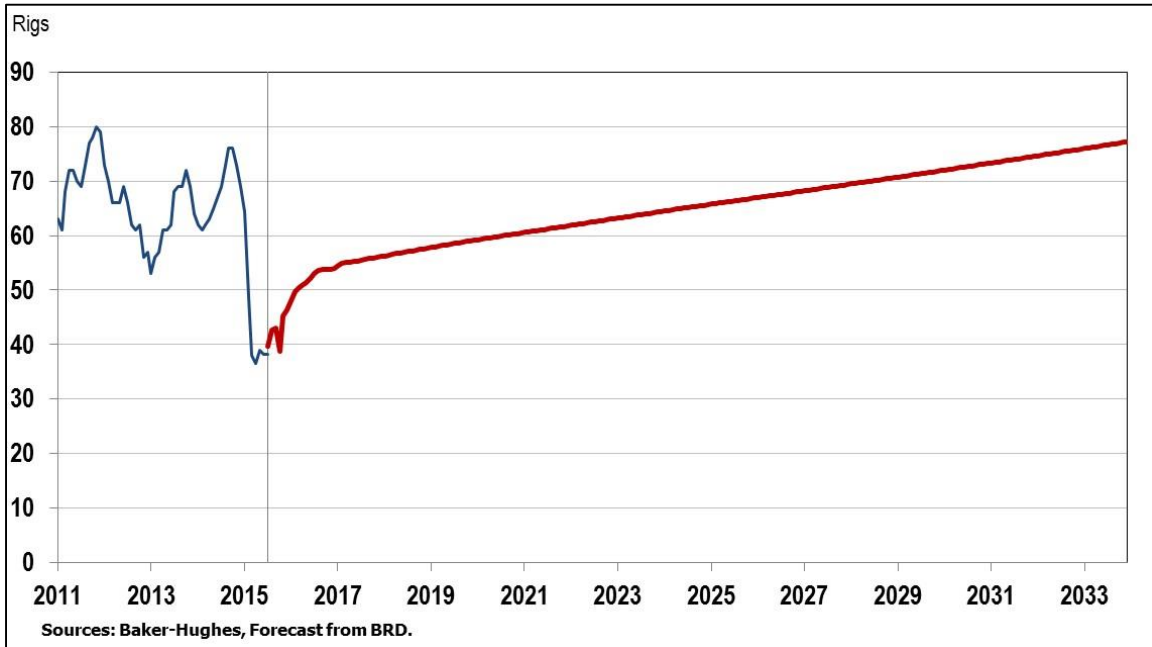
Source: EE3 LLC, BRD.

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RIG COUNT

The Colorado rig count reported by Baker-Hughes reached 80 in November 2011 and averaged 72 in 2011, 65 in 2012, 63 in 2013, and 68 in 2014. The decrease in the rig count lagged the price decline, with the decrease showing in the data in 2015—the average was 43 for the first 6½ months of the year. There is a positive correlation between price and the rig count with a three-month lag. As oil prices recover later this decade, the rig count will rebound then flatten with the relatively flat price increase.

FIGURE 11: COLORADO HISTORICAL RIG COUNT AND FORECAST



WELLS AND RIG COUNTS

From 2010 through 2014, Colorado averaged about 240 additional wells per month; 2014 alone averaged 157. Given production depletion, a steady supply of wells is necessary to backfill lost production. Based on historical production and rig counts, Colorado would need to bring on about 170 wells per month in perpetuity to keep production constant. Assuming drilling rigs can produce 2.8 wells per month (approximately one well per 11 days), Colorado's oil well rig count would need to total 57. The Colorado rig count averaged 57 in 2014 but has averaged 37 rigs through mid-June 2015 (and less than 30 since April). Most of the new oil production currently resides in the D-J Basin.

OIL PRODUCTION FORECAST

Oil production will depend on the wells drilled, which, in turn, will depend on active rigs in Colorado. The figure below illustrates three scenarios based on (1) the current rig count, (2) the rig count necessary to

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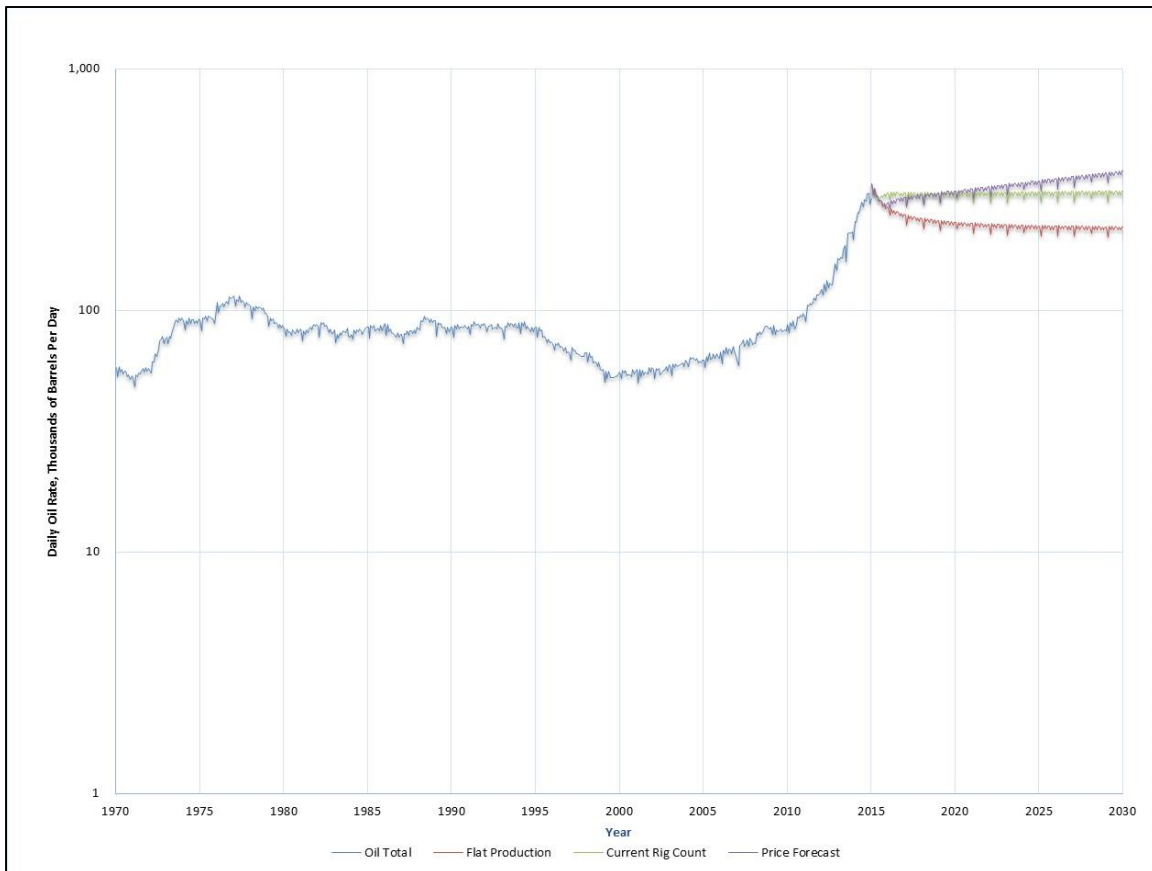
keep production flat, and (3) the rig count forecast based on the long-term price forecast from Moody's Analytics.

Under the current rig count scenario, production has almost certainly peaked in the state, and the decline will soon show in the production data published by the COGCC. The curve will flatten assuming that the rig count remains stable at the current price.

The second scenario projects the number of wells (and thus rigs) necessary to keep production flat—estimated at 57 rigs, or about 20 more than are currently active in Colorado.

The third scenario uses the Moody's price forecast for WTI. This scenario projects a short-term drop in production in Colorado, followed by a long-term production increase with a rebounding rig/well count

FIGURE 12: OIL PRODUCTION SCENARIOS

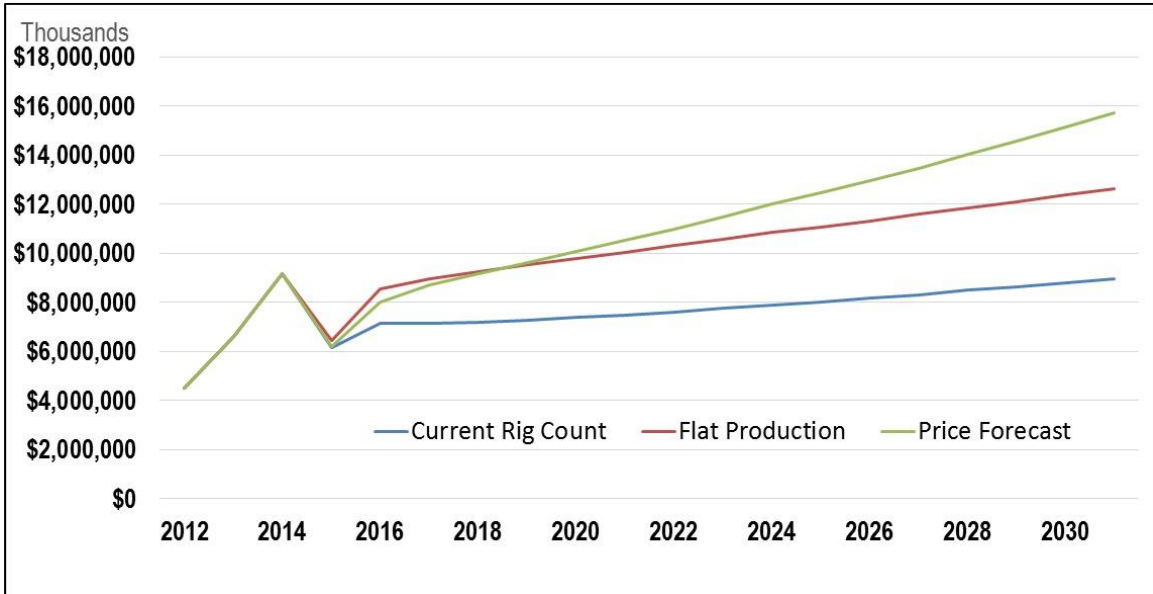


Source: Data from EE3 using IHS data. Scenarios by BRD.

Based on the three production scenarios and the price forecast from Moody's, the total value of production will decrease in 2015 before rebounding with a price rebound.

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FIGURE 13: COLORADO VALUE OF OIL PRODUCTION, FORECAST



Source: BRD.

COMMODITY PRICES

Oil and gas prices recorded a precipitous decline in 2014 that has extended into summer 2015. As of mid-July, the West Texas Intermediate (WTI) spot price was 54% below the June 20, 2014, cycle peak. Prices are 44% below the five-year average. Price volatility has stabilized. The WTI has now recorded 13 months of year-over-year declines. Drilling permits and starts are down for the six months of 2015 year-over-year in Colorado, and the rig count is down 43% year-over-year.

FIGURE 14: WTI SPOT PRICE



Source: Energy Information Association (EIA), Cushing, OK WTI Spot Price FOB (Dollars per Barrel)

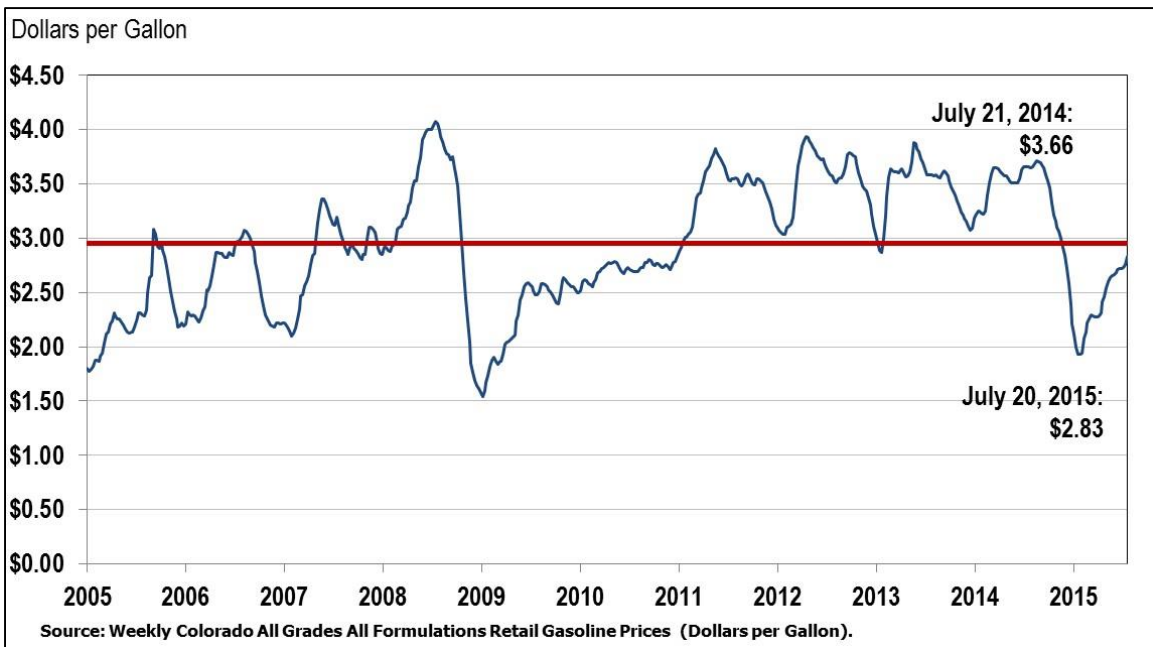
Natural gas prices are also off peak from 2014, down 53% in July. The average monthly price topped out at \$6.00 per million BTUs in February 2014 before falling, to \$2.82, in July (average as of July 20).

FIGURE 15: HENRY HUB NATURAL GAS SPOT PRICE



The impact of gasoline prices is readily observable to consumers. Prices topped \$3.71 per gallon on August 18, 2014, before falling 48%, to \$1.93, in Colorado on January 19, 2015, according to the EIA. Despite prices rebounding 46%, the average in Colorado of \$2.83 on July 20, 2015, remains 23% below the same period a year ago and 14% below the five-year average.

FIGURE 16: COLORADO GASOLINE PRICE



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TABLE 3: PRICE DECLINES

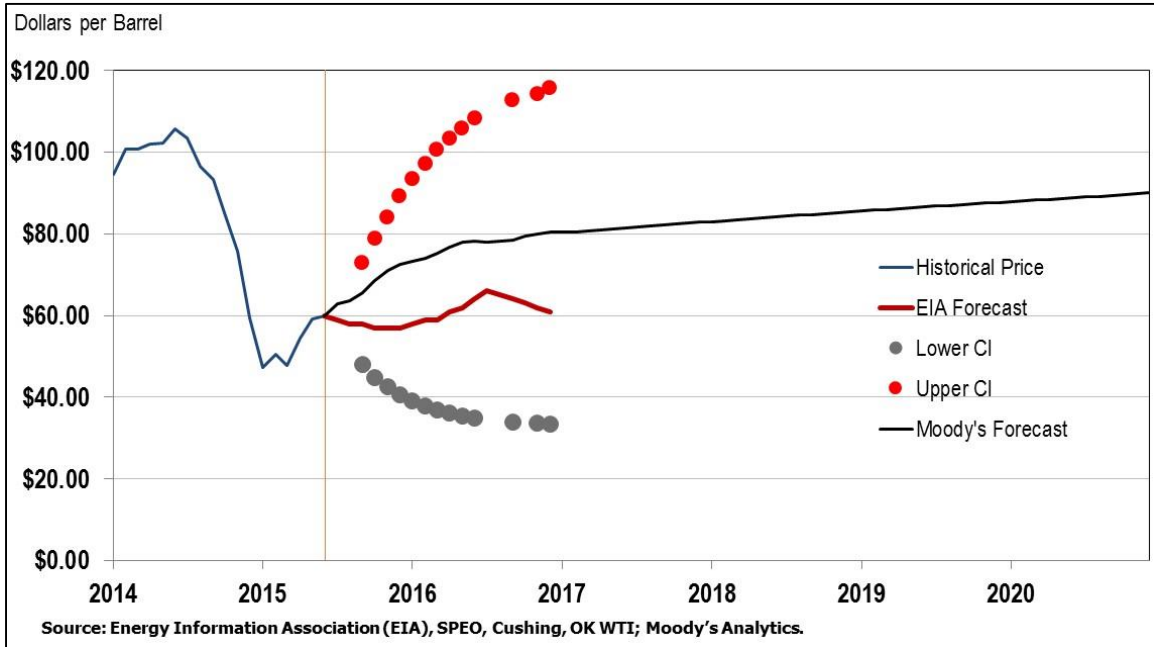
Month	Oil	Natural Gas	Gasoline	Baker-Hughes Rig Count
January 2014	-0.1%	41.6%	10.5%	17.0%
February 2014	5.8%	80.2%	-3.1%	8.9%
March 2014	8.5%	28.7%	0.7%	8.8%
April 2014	10.9%	11.8%	-0.5%	3.3%
May 2014	8.1%	13.4%	-6.5%	6.6%
June 2014	10.5%	19.9%	-5.1%	8.1%
July 2014	-1.0%	11.8%	1.8%	1.5%
August 2014	-9.4%	14.2%	3.4%	5.8%
September 2014	-12.3%	8.4%	1.2%	10.1%
October 2014	-16.1%	2.8%	-3.5%	5.6%
November 2014	-19.3%	13.3%	-6.5%	5.8%
December 2014	-39.3%	-17.9%	-18.4%	7.8%
January 2015	-50.1%	-36.5%	-38.4%	3.9%
February 2015	-49.8%	-52.1%	-37.5%	-20.1%
March 2015	-52.6%	-42.3%	-37.4%	-38.7%
April 2015	-46.9%	-44.0%	-34.1%	-42.1%
May 2015	-42.0%	-37.7%	-26.0%	-40.0%
June 2015	-43.5%	-39.3%	-24.4%	-42.9%
July 2015	-49.2%	-30.5%	-24.2%	-44.6%

Source: Energy Information Administration, Henry Hub Natural Gas Spot Price (Dollars per Million Btu; Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Weekly Colorado All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon). COGCC Staff Reports. Baker-Hughes Rig Count. Data as of July 26, 2015.

The July 2015 short-term forecast for WTI from the EIA projects the 2015 average at \$55.51 per barrel and the 2016 average at \$62.04 per barrel. Moody’s Analytics forecasts 2015 prices at \$60.36 per barrel, 2016 prices at \$77.50 per barrel, and 2020 prices at \$88.95.

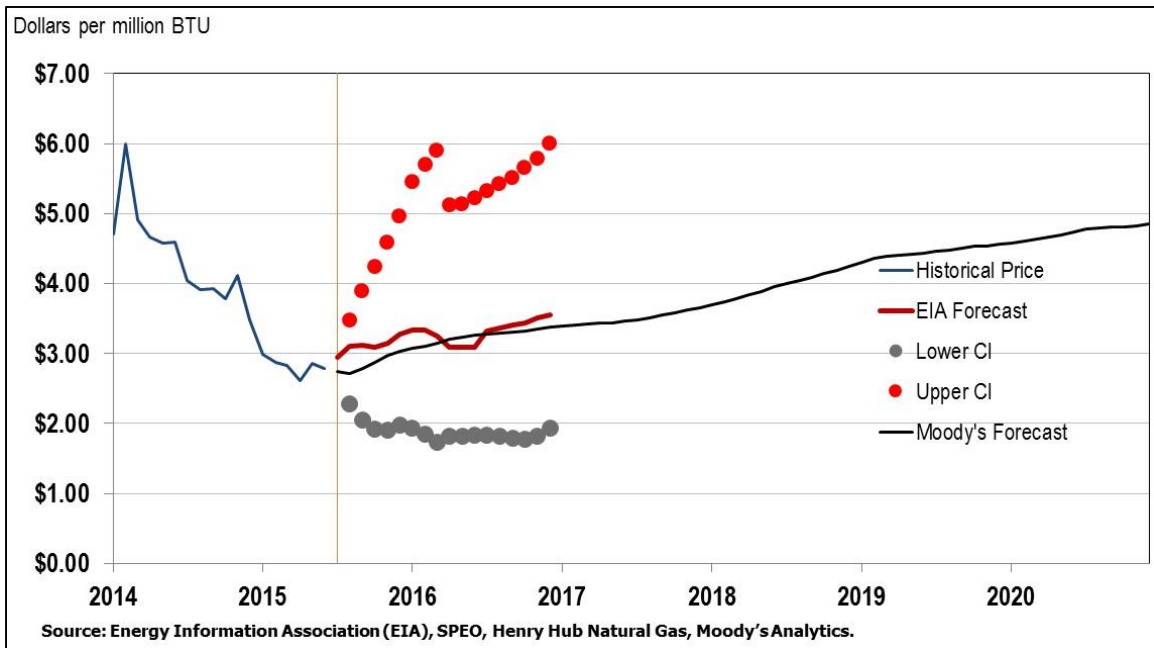
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FIGURE 17: WTI CRUDE OIL PRICE FORECAST



The July 2015 short-term price forecast for Henry Hub natural gas from the EIA projects the 2015 average at \$3.06 per million BTUs and the 2016 average at \$3.41 per million BTUs. Moody's Analytics forecasts (NYMEX Natural Gas Futures Prices: Contract 1, [\$ per MMBtu] for United States) 2015 prices at \$2.81 per million BTUs, 2016 prices at \$3.24 per million BTUs, and 2020 prices at \$4.73 per million BTUs.

FIGURE 18: HENRY HUB NATURAL GAS PRICE FORECAST



The July 2015 short-term forecast for gasoline from the EIA projects the 2015 average at \$2.48 per gallon and the 2016 average at \$2.55 per gallon. Moody's Analytics forecasts 2015 prices at \$2.79 per gallon, 2016 prices at \$3.30 per gallon, and 2020 prices at \$3.70 per gallon.

FIGURE 19: GASOLINE PRICE FORECAST

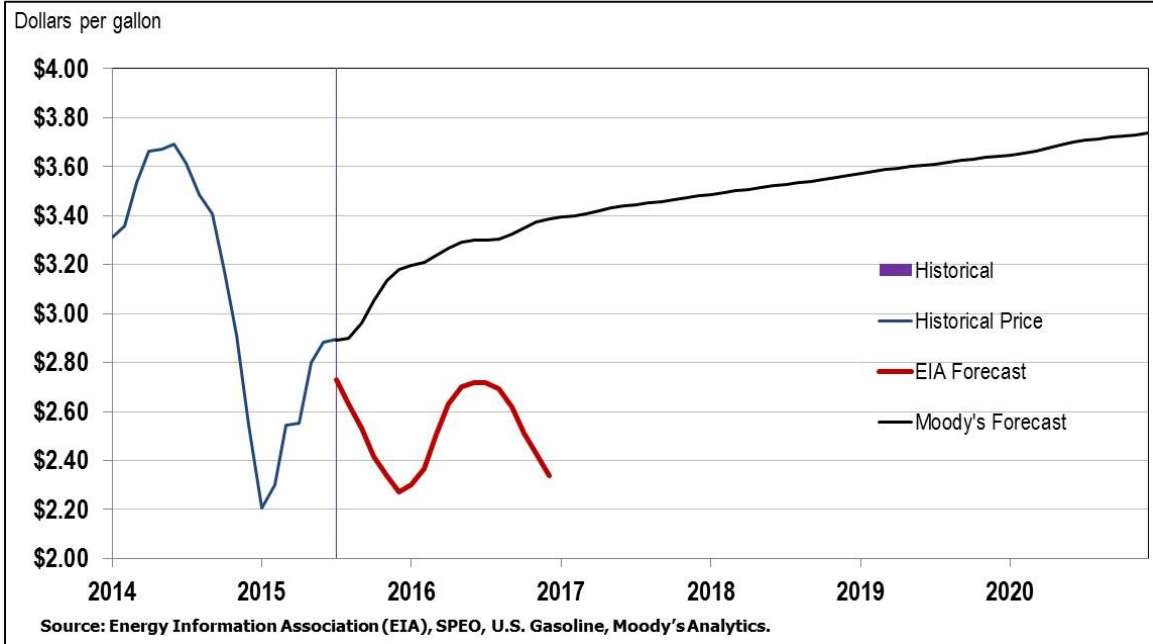
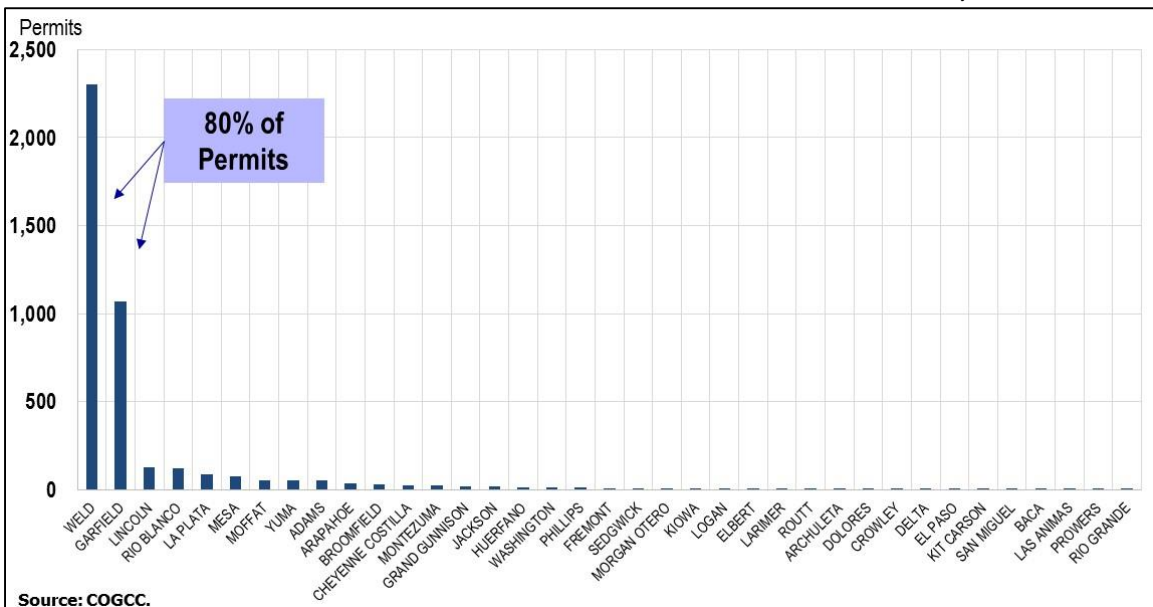


FIGURE 20: COLORADO OIL AND GAS DRILLING PERMITS BY COUNTY, 2014

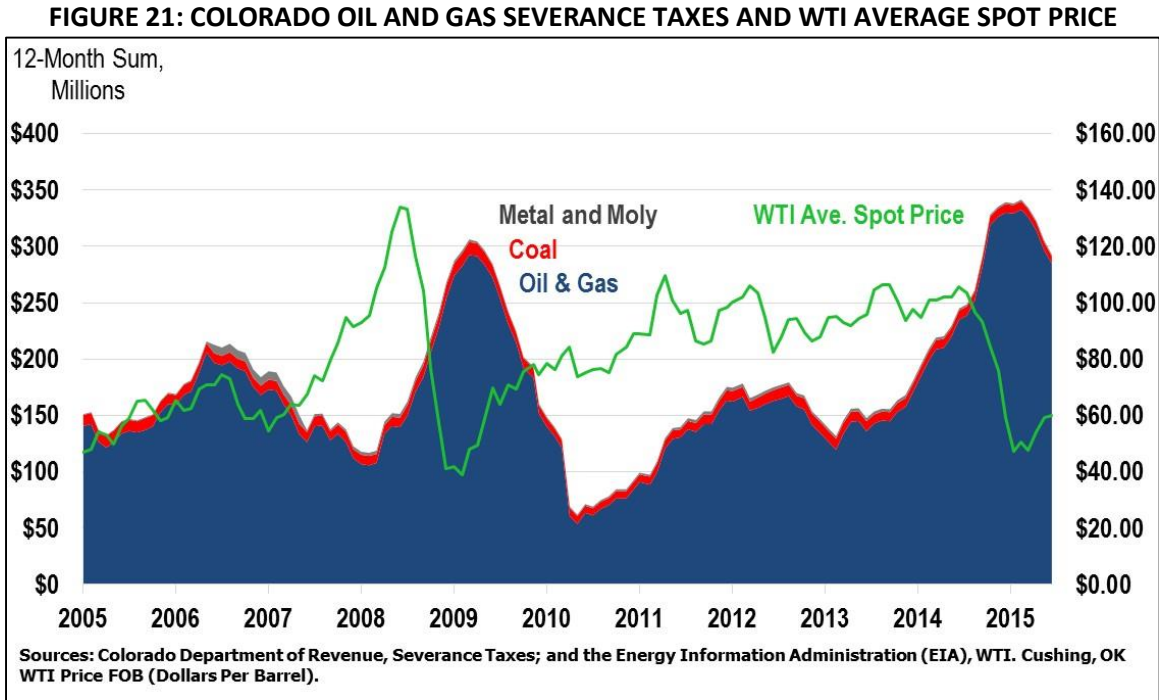


SEVERANCE TAXES

Severance taxes are those that the state charges for the removal of nonrenewable natural resources and are reported by the Colorado Department of Revenue for oil and gas, coal, and metals and molybdenum.

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Severance taxes related to oil and gas in 2012 and 2013 were reported at \$134.9 million and \$170.6 million, respectively (Figure 21). In 2014, severance taxes reached \$330 million. The 12-month trailing sum peaked in April 2015, at \$341.6 million, before dropping 14.3%, to \$292.7 million in June.



In June 2015, the Governor’s Office of State Planning and Budgeting (OSPB) estimated severance taxes increased 6.8% in fiscal year 2015 to \$287.1 million. OSPB’s forecast for fiscal year 2016 is \$110.8 million—a decrease of 61.4%. Fiscal year 2017 is projected to rebound to \$171.6 million. Colorado Legislative Council estimated fiscal year 2015 severance taxes at \$286.7 million, dropping 55.7% to \$127 million in fiscal year 2016, before rebounding 69.2% in fiscal year 2017 to \$214.9 million.

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