Economic Contribution of the Oil and Gas Industry in the Piceance Basin

Colorado Mesa University

Executive Summary Part 1: The Relationship Between Rigs, Natural Gas Price, and Employment

- Part 1 of this report studies the relationship between rigs, natural gas price, and employment in the Piceance Basin using both a panel and aggregated autoregressive distributed lag (ADL) regression model.
- Each change in rig count changes employment by 208 people within the five county area of Mesa, Garfield, Rio Blanco, Delta, and Moffat Counties.
- At the county level, Mesa County experiences a change in employment of 122 per rig, while Garfield County experiences a change of 70 per rig. Rio Blanco (16), Delta (15), and Moffat (18) have much smaller effects per rig.
- From 1999-2009, the effect of rigs on employment is much more pronounced, changing employment by 373 per rig. From 2010-2017 the effect on employment is 91 per rig, reflecting changing technology in drilling.
- For every change in $1.00 of natural gas price as measured by the Rocky Mountain Opal Hub, employment changes by 1,183. For the three county area (Mesa, Garfield, and Rio Blanco), a $1.00 change in the price of natural gas changes employment by 1,415. Conducting the same analysis with Henry Hub gas prices for the five county area shows a change of employment of 1,289.
- At the individual county level, changes in the price of natural gas effect Garfield County the most, changing employment by 828, while the effect in Mesa County is 646.
- Every dollar change in the price of natural gas changes rig count by 8.8.

Executive Summary Part 2: The Economic Contribution of the Oil and Gas Industry in the Piceance Basin

- This section studies the economic contribution of the oil and gas industry in a six county area that represents the Piceance Basin (Mesa, Garfield, Rio Blanco, Delta, Gunnison, and Moffat Counties).
- The economic contribution analysis takes into account employment and wages, severance and Federal Mineral Lease royalties, ad valorem taxes, sales taxes, and royalties that are spent or distributed in this region.
- This economic contribution report uses multipliers to estimate the supply-chain and household spending effects associated with an industry, while adjusting for leakages to imports, commuting, taxes, profits, and savings, to determine the total economic contribution of the oil and gas industry in the Piceance.
- The regional GDP contribution of the oil and gas industry in the Piceance Basin is $1,083,361,743. For scale purposes, the total GDP of the study region is $11,819,208,415, equating to 9.2% of total regional GDP.
- The total contribution in terms of labor income (which is a part of the overall total) as a result of the oil and gas industry is $737,240,560.
- The total number of jobs supported by direct employment in the industry, supply chain effects, and induced (multiplier) effects is 10,959. For scale purposes, there are 164,956 total jobs estimated by IMPLAN equating to 6.6% of total jobs.

Background

This study idea was developed in early 2018 and was funded shortly after by the Unconventional Energy Center at Colorado Mesa University. The goal of this report is to provide an in-depth analysis of employment as a result of activity in the oil and gas industry in the Piceance basin. This is accomplished using two approaches: The first approach uses a statistical model to predict the changes in employment based on changes in rig counts and changes in the price of natural gas. This allows governments, businesses, and the oil and gas industry to use this information to predict local and regional employment changes based on fluctuations in the industry. This analysis is covered in section 1 of the report. The second approach is a comprehensive economic contribution analysis of the oil and gas industry in the Piceance basin. This analysis looks at contributions from supply-chain expenditures, employment and wages, severance taxes, Federal Mineral Lease, ad valorem, sales taxes and royalties to determine the total contribution that the oil and gas industry makes to regional GDP. This model takes into account direct effects, leakages, induced (multiplier) effects, and supply chain effects. This part of the study is found in section 2.[1]

Acknowledgements

I would like to thank the Unconventional Energy Center, Western Slope Colorado Oil and Gas Association, Gunnison Energy, Caerus Oil and Gas, Shear Inc., and the Garfield County Oil and Gas Liason for their support and help with information gathering, surveys, and discussions on the industry. I would also like to thank various state and county government agencies, including the Department of Local Affairs, the Department of Natural Resources, county assessors, and anyone who took the time to answer my phone calls and e-mails to help provide data and insight for this report, as well as the people at IMPLAN, who provided guidance, feedback, and criticism of the economic contribution model.

[1] This report is authored by Nathan Perry, Ph.D. Dr. Perry is an Associate Professor of Economics at Colorado Mesa University. Please direct all correspondence to naperry@coloradomesa.edu. The goal is that this report is as accurate as possible. Any mistakes that are found in this report will be updated and the report reposted to ensure the most accurate information is being used.

Part 1: The Relationship Between Rigs, Natural Gas Price, and Employment

Oil and Gas Employment in the Piceance

The oil and gas industry is a major employer in Western Colorado, contributing both a large number of jobs and a high volume of wages. The average weekly wage for this industry in Mesa County is $1,606, and in Garfield County it is $1,768. This high average weekly wage leads to a high percentage of total wages in high oil and gas production areas. Figures 1 and 2 illustrate the percentage of total wages that oil and gas represent for Garfield and Mesa counties.[2] In 2017, without any supply chain effects or multiplier effects, oil and gas contributed 14% of total wages to Rio Blanco.[3]

The Western Slope can experience strong swings in employment and economic growth due to the changes in natural gas prices. Although oil and gas prices peaked in 2008, total wages for oil and gas remained consistent from approximately 2006-2014. In the post energy bubble period (2009-present), natural gas prices peaked at $6.00/MMBtu in February of 2014, and from this point to March of 2016 natural gas prices fell to $1.73/MMBtu. This fall in natural gas prices caused a huge contraction in the oil and gas industry in the Piceance, which is visible in both the GDP numbers (figure 3) as well as oil and gas wage figures (figures 1 and 2). Since the oil and gas boom of 2008, technology in the industry has greatly enhanced the ability to extract oil and natural gas. This includes hydraulic fracturing and horizontal drilling, as well as more efficient rigs. This coupled with large natural gas discoveries in the last several years have dealt a blow to the price of natural gas compared to previous decades.

Figure 1:

Oil/Gas Wages as a Percentage of Total Wages: Garfield Country

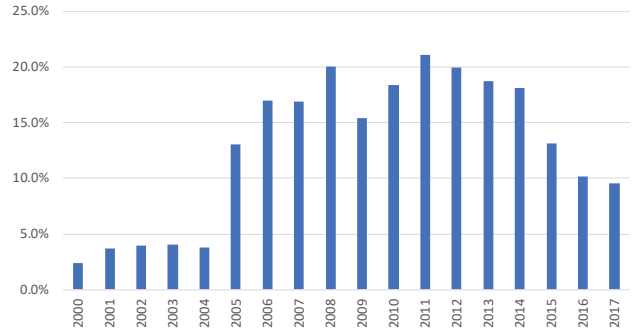


Figure 2:

Oil/Gas Wages as a Percentage of Total Wages: Mesa Country

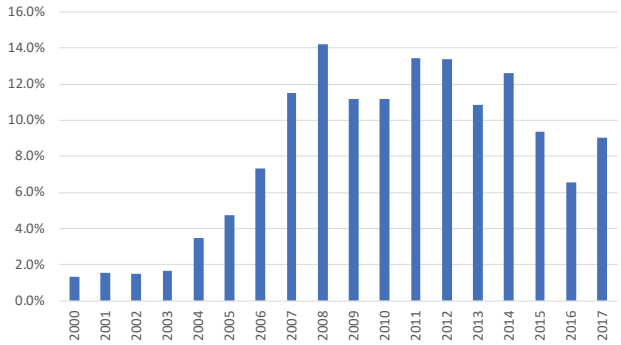


Figure 3:

Business Cycle for Mesa County (% Change in Gross Regional Product)

[2] Data is from the Quarterly Census of Employment and Wages (QCEW) and represents mining, oil and gas. Mining is a small percentage of total wages in Garfield and Mesa counties, hence figures 1 and 2 are an accurate representation of oil and gas wages. Mining is a larger portion of total wages for the other counties. Due to the Bureau of Labor Statistics' confidentiality of data collection, breaking down the QCEW data to show oil/gas vs. mining sectors is not possible in counties of this size.

[3] Calculation for Rio Blanco County performed using IMPLAN data.

The industry moderately recovered in the Piceance from the lows of 2016, helping to cause an economic upswing in several counties in the Western Slope in 2017 and 2018. This is illustrated in table 1, which shows the largest wage contributors to the economic upswing Mesa County experienced from 2016 to 2018. The largest wage contributor was the oil and gas industry, contributing 28% of new wages from Q2 of 2016 to Q2 of 2018. The ability of the oil and gas industry to swing employment numbers in such vast and volatile ways is an important characteristic of the Western Slope economy. As natural gas prices and rig counts move up and down responding to market supply and demand, Western Slope economies move and respond, begging the question as to what is the response of employment numbers to these changes in natural gas and rig counts?

Figure 4:

Henry Hub Natural Gas Price

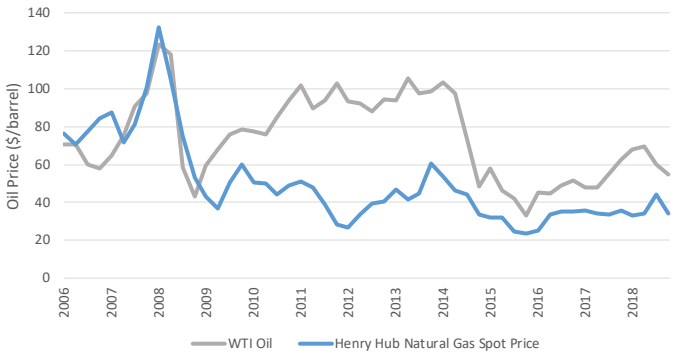


Table 1:

Contribution of Wages to Mesa County from Q2 2016 to Q2 2018

	Average Employment 2nd Quarter 2018	Total Quarterly Wages (Q2 2018)	Average Weekly Wage (Q2 2018)	Total Wage Change (Q2 2016 to Q2 2018)	Total Employment Change (Q2 2016 to Q2 2018)
Mining, Oil, and Gas Extraction	2,353	$50,789,054	$1,660	$19,832,899	753
Construction	4,590	$58,548,178	$981	$10,190,272	476
Retail Trade	8,205	$61,957,761	$581	$5,553,115	-47
Accommodation and Food Services	6,950	$34,060,484	$377	$4,865,622	121
Manufacturing	3,114	$32,811,576	$811	$4,511,341	309
Finance and Insurance	1,980	$33,346,449	$1,296	$4,031,922	-21
Health Care and Social Assistance	10,736	$122,797,342	$880	$3,867,143	878
Total Government	9,624	$114,581,244	$916	$3,625,730	118
Professional and Technical Services	2,168	$28,874,550	$1,025	$3,499,163	146
Wholesale Trade	2,420	$32,459,408	$1,032	$2,599,645	126
Transportation and Warehousing	2,173	$26,935,321	$953	$2,537,600	116
Other Services, Ex. Public Admin	1,799	$14,305,636	$612	$1,697,298	113

Previous Literature on the Response of Employment to Changes in Rig Counts and Natural Gas Prices

There is relatively little literature on the impact of rig counts and gas prices on local employment in oil and gas heavy areas. Brown (2015) studied the relationship between rig count and employment in the top 12 oil and gas producing states. The study uses employment as a function of rig counts and previous employment and finds the six month cumulative job numbers caused per rig to be 94. The long run number of jobs created per rig are 171. This implies a multiplier of 1.8. Brown suggests that 0.8 jobs are added outside the oil and gas sector for every job in the sector. Table 2 illustrates the cumulative and long run job numbers per rig.

Agerton et. Al. (2015) conducted a similar study using instead a structural vector autoregression to estimate the number of jobs created per rig. Agerton et. Al. finds that there are 37 jobs created initially per rig, and over the long run 224 jobs are created. Hartley et. Al. (2013) studies the employment impact of gas wells vs. wind power and finds that 77 short term jobs, or 6.4 full time equivalent (FTE) jobs are created per well.

Table 2:
Brown (2015) Cumulative Effect of Rig County on Employment

0 month:	28
1st month:	41
2rd month:	49
3rd month:	65
4th month:	76
5th month:	80
6th month: (cumulative)	94
Long Run:	171 jobs
Multiplier:	1.8

Data/Analysis of County

This study looks at both the effect of rigs and gas prices on employment in the Piceance basin region in the Western Slope of Colorado. Rig data covers January of 1999 through December of 2017 and was assembled from three different sources. The first source is from archived drilling activity reports that were purchased by the Colorado Assessor's Association. This data source was used for 1999 to 2004. The second source of data was from Garfield County reports provided by the Oil and Gas Liason for Garfield County. This data source was used for 2005 to 2011. The third piece of data is from Baker Hughes rig counts from 2011-2018. Because rig data needed to be pieced together, only the five counties of Mesa, Rio Blanco, Garfield, Delta, and Moffat counties in the Western Slope had the full 1999-2017 data. These counties represent the vast majority of oil and gas activity in the Western Slope. Employment data comes from the Colorado Department of Labor and Employment and covers the same time period.

Methodology

The econometric approach to this paper generally follows the work of Brown (2015). The statistical method employed is an autoregressive distributed lag model (ADL), which is a common time series model that is used to capture effects over lagged periods of time. Two models are used to study the effect of rig counts on employment. The first model is a panel approach similar to that used in Brown (2015). This paper's panel model is similar to Brown, except that Brown (2015) uses state level data while this paper uses county level data.[4] In the panel model, county level effects are controlled for using fixed effects. The second model aggregates the counties into one data series, treating the Western Slope as one entity. Seasonal factors are controlled for in each model using seasonal dummy variables. This approach eliminates seasonal factors from the final result, since county level employment data is not available de-seasonalized.[5] In addition to seasonal factors, both models control for population.

[4] In addition to this, Brown scales the dependent variable by population where this study controls for population using a population control variable.
[5] Note that employment has clear seasonal effects but rigs counts do not seem to exhibit seasonal effects.

The primary commodity extracted in the Piceance is natural gas. To study the impact of the price of natural gas on employment, an aggregated county model is employed which again combines the employment numbers from Mesa, Garfield, Rio Blanco, Delta, and Moffat counties into one time series and controls for population and seasonal factors. The generic econometric equation is listed below:

$$\Delta EMP_{it} = \sum_{m=1}^{p} \alpha_m \Delta EMP_{it-m} + \sum_{k=0}^{q} \beta_k \Delta RIGS_{it-k} + \gamma_t + \varepsilon_{it}$$

Where ΔEMP is the change in employment, ΔRIGS is the change in rig counts, γ represents seasonal factors and population, and ε is a random error term. The second analysis replaces rig count with natural gas prices. The inclusion of an autoregressive term (the lagged employment changes) has an important econometric purpose in that it helps to eliminate the problem of multicollinearity and serial correlation. The model estimates short run and long run impacts of changes in rig counts and gas prices on employment. The long run impact of an increase in one rig or a change in natural gas price is calculated using the following equation:

$$\text{LRM} = \frac{\sum_{k=0}^{q} \beta_k}{1 - \sum_{m=1}^{p} \alpha_m}$$

Where ∑β is the summation of lagged rig coefficients, and ∑α is the summation of employment coefficients. The econometric model takes the change in employment as a function of previous changes in employment and contemporaneous and previous changes in rigs. This allows for a calculation of the effect of rigs and natural gas price on employment over the course of the lag structure. The model uses data from the five counties that had rig data available in the Piceance (Mesa, Rio Blanco, Garfield, Delta, Moffat). A second set of results are listed using a narrower geographical region of just Mesa, Rio Blanco, and Garfield. The reasoning behind the five and three county comparison is to control for interconnectedness. Moffat county is a long distance from Mesa, and very few people commute from Mesa county (the highest population area in the Piceance) to Moffat. However, many people do commute the shorter distance to Rio Blanco county and Garfield county from Mesa county, and vice versa. Another benefit of excluding Moffat and Delta is to separate the potential effects of mining (specifically coal mining).[6] Statistical tests were performed to help choose the optimal lag structure.[7]

Results for Rig Count and Employment

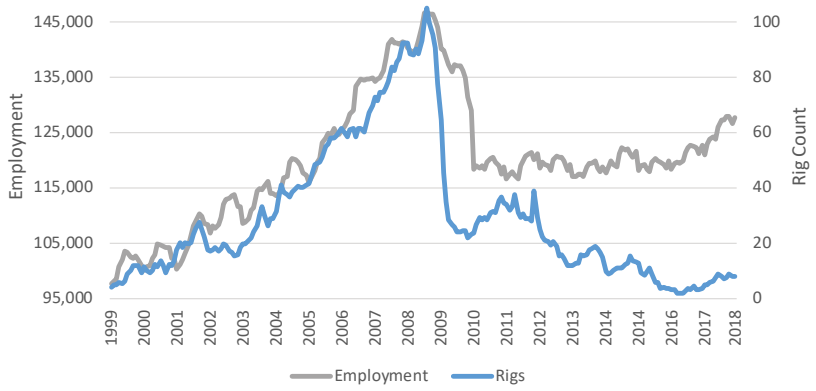
Figure 5 illustrates the relationship between Piceance rig counts and Piceance employment. From 1999 to 2009 there is a very strong correlation between the rise in rig counts and the rise in employment. This relationship remains through the energy bust of 2009 and the subsequent employment decline. Only by 2012 does the relationship between rigs and employment seem to stop moving in perfect unison.

[6] Further controls were implemented for coal, including regressions that included coal production and coal prices in a similar fashion to how the rig variable is implemented in the model. The inclusion of the coal variable did not create significant differences in results and was thus omitted from the analysis.

[7] Lag structures can be chosen by a variety of methods including statistical criterion (AIC, HQIC), or economic theory and reasoning. The lag structures in this paper were decided on using the AIC. The AIC shows that the optimal lag length is 24 for employment 12 for rigs, and 9 for both prices of natural gas.

Figure 5:

Piceance Rig Count and Employment



Panel models are powerful models econometrically, and the five county model has the most data and information, hence the five county panel model is considered the most important result. Table 3 illustrates the cumulative monthly change in employment (listed as 0 through 6th month), with zero representing the contemporaneous value of the rig (the current time). The first month represents the month after the rig goes into production, up through the 6th month after production. The numbers are cumulative and provide an estimate for the short run employment impact. The long run employment impact is listed in the bottom row and is the total impact on employment over the course of the lag structure (2 years).

The results for the long run impact show that for every additional rig employment increases by 208. When the three county area is used (Mesa, Garfield, Rio Blanco), the numbers are almost identical at 203. Table 3 illustrates the cumulative employment effects over a six month period, culminating with 79 jobs over six months. Over the long run, these jobs create more spending causing multiplier effects and job creation, ending with 208 jobs created in total. When the data is aggregated into one time series, the five county model shows a change of employment of 213 per rig. The three county aggregated model shows a change in employment of 203 per rig.

Table 3:

Rig Count Change in Employment

Approach	Panel	Panel	Aggregated	Aggregated
Counties	5 counties	3 counties	5 counties	3 counties
0 month	21.41	22.73	13.88	17.86
1st month	37.54	39.52	28.40	38.07
2nd month	63.24	65.29	49.83	58.96
3rd month	69.06	71.27	80.52	81.80
4th month	82.80	85.83	111.35	104.04
5th month	89.93	91.98	142.00	126.18
6th month (cumulative)	79.53	78.94	161.37	140.50
Long Run Impact on Employment	208.00	203.17	213.33	202.58

It is important to note that the three county and five county model provide similar results, which shows that including or omitting coal heavy counties, which experienced a similar boom to the oil/gas boom, does not have an effect. The estimates for the panel model fall within the range of previous literature.

What does this employment estimate consist of? This estimate is not just the people working on the rig, it includes the following:

- Direct employment working on the rig
- Direct employment from servicing the new gas well
- Contractors (water support, welders, pipeline support, infrastructure)
- Multiplier Effects (car dealerships, real estate, restaurants/bars, car rentals, etc.)

Estimates from this study show the initial employment from rig placement to be 21. The same model above was run using individual county employment numbers, while using the five county rig count data point in order to get an idea of the impact per county per rig. Although the five county model is better because of the interconnectedness of the industry between counties, the county level model provides useful information at the county level. Table 4 illustrates the long run impact per rig at the county level. Mesa County has an employment impact of 122 per rig, while Garfield County has an employment impact of 70.

Table 4:

County Level Long Run Employment Estimates

County	Long Run Employment Per Rig
Mesa County	121.74
Garfield County	70.48
Rio Blanco County	15.55
Delta County	15.34
Moffat County	17.64

Table 5:

1999-2009 vs. 2010-2017 Estimates

Time Period	Long Run Employment Per Rig
1999-2009	373.05
2010-2018	90.78

Table 5 illustrates the breakdown of two time periods where there was an apparent structural change in the behavior of natural gas prices and employment. The data was divided into two time periods, 1999-2009 and 2010-2017. The results indicate that from 1999-2009, employment per rig was significantly higher than the 2010-2017 time period. It is important to note that when the data is split into two groups, degrees of freedom are lost, and to account for this, the lag structure was shorted from 24/12 to 12/6 to preserve data points. Because of this, these results should be seen as slightly less confident than the rest of the results. This provides evidence that the employment impact per rig has fallen since the peak of oil and gas price, which is likely due to technological improvements in drilling and rig technology.

Employment Forecast: Rigs

Employment was added for Mesa, Garfield, Rio Blanco, Delta, and Moffat counties to create a total employment number. Rigs went from 105 in August of 2008 to 2 in May of 2016, for a difference of 103 rigs. In the same time period, employment went from 146,870 to 119,773, for a difference of 27,097 employed. Multiplying 103 rigs by 208 jobs per rig gives a predicted employment loss attributed to the reduction in rigs of 21,424, which equates to approximately 80% of job losses from peak to trough.

Employment and Natural Gas Prices

Since the majority of extraction in the Piceance Basin is natural gas, a second analysis was conducted to understand the impacts of changes in natural gas prices on employment. For this model, a panel approach was not used because the price of natural gas is the same per county, unlike the rig count which changes per county over time. The procedure aggregated the data and treated Mesa, Rio Blanco, Garfield, Delta, and Moffat counties as one data point. Figure 6 illustrates the relationship between employment in the five counties and the Henry Hub natural gas price.

Two gas prices were used: Henry Hub and Rocky Mountain Opal. Henry Hub is the standard for measuring the price of natural gas on a national level, however, there are local fluctuations in the price of natural gas. There were two hubs considered that were more local: Rocky Mountain Opal and the White River hub. White River hub prices only date back to August of 2009, while Rocky Mountain Opal goes back to the early 1990's. Because of this, Rocky Mountain Opal was used even though White River Hub is closer to the Piceance. It is important to note that their prices are almost identical, with the Opal Hub having a $0.05 average difference in price, with low volatility from August 2009 to the end of 2017. This makes the Opal Hub price data a good proxy for local prices. Figure 7 illustrates both natural gas prices graphically.

Figure 6:

Piceance Employment with Natural Gas Prices

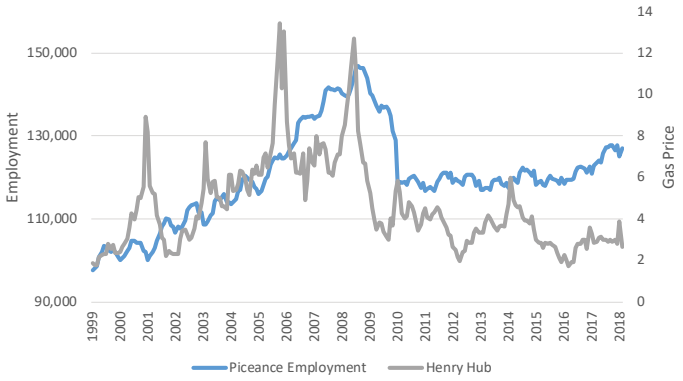
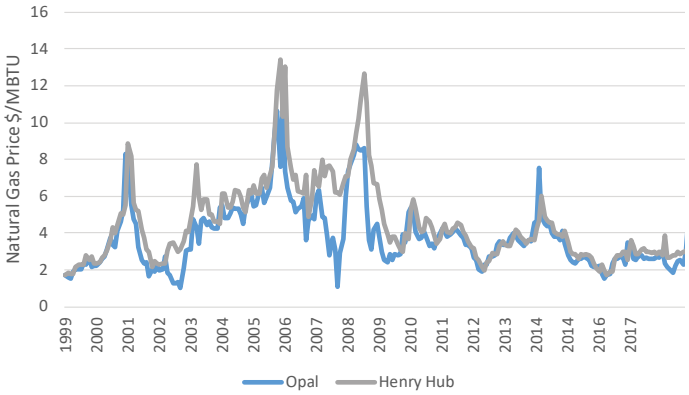


Figure 7:

Rocky Mountain Opal Hub vs. Henry Hub Prices



[8] There is a $0.19 cent difference in average price between Rocky Mountain Opal and Henry Hub, with the Opal Hub being cheaper. There is however high volatility in the difference between these prices.

Table 6 illustrates the results for the impact per increase in the price of natural gas for both Opal and Henry Hub. There is very little difference between the Henry Hub results and the Opal results, likely because the prices move very similarly (figure 7). The table illustrates that for every increase in $1.00 of Opal Hub price of natural gas, in the long run employment changes by 1,183. This is very similar to the three county area, as a $1.00 change in the price of natural gas changes employment by 1,416. The results are similar for Henry Hub, with a $1.00 change in the price of natural gas leading to a 1,289 change in employment.

In addition to the regional estimate, the same estimate was performed at the county level. Since the industry is regional and so interconnected, the regional model is considered the better model. The results show that every change of $1.00 of Rocky Mountain Opal natural gas price results in a change of 645 jobs in Mesa County, while Garfield County sees a change of 828 jobs. Rio Blanco, Delta, and Moffat counties were statistically insignificant and empirically nonsensical and hence are not reported.

Table 6:

Impact of Gas Price on Employment

Hub	OPAL	OPAL	Henry Hub	Henry Hub
Counties	5	3	5	3
0	-21.08	-19.99	-20.86	-30.44
1st month	79.35	79.74	153.88	119.64
2nd month	4.65	42.46	186.68	163.10
3rd month	-26.55	66.61	204.57	213.29
4th month	152.46	212.04	337.87	328.92
5th month	284.47	339.62	436.90	437.14
6th month	390.27	427.91	581.97	547.34
Long Run Impact on Employment (per $1 change in natural gas price)	1183.05	1415.74	1289.37	1394.44

Table 7::

Long Run Employment Change Due to Gas Price: By County

County	Long Run Employment $1 Change in Natural Gas Price
Mesa County	645.55
Garfield County	828.21
Rio Blanco County	N/A
Delta County	N/A
Moffat County	N/A

Figure 7 shows that after 2009 the trends in the relationship between natural gas prices and employment seem to have a structural break and change. The same time period test was performed for the 1999-2009 and 2010-2017 time period as was performed with rigs. However, the result for the natural gas variable were statistically incoherent, likely because there were not enough data points to be statistically significant.[9]

Employment Forecast: Natural Gas Price

Most previous literature agrees that rigs model employment better than gas/oil prices. Using the same analysis as before, this model can be used to determine how many of the Piceance job losses from 2008 to 2016 were a result of changes in the price of natural gas. Using a similar time period as before, gas prices peaked in June of 2008 at 12.69, and bottomed in March 2016 at 1.73. Multiplying this difference in price by the long run job change of 1,183 shows a difference of 12,965 jobs. As stated above in the same time period, employment went from 146,870 to 119,773, or a difference of 27,097 in employment. The predicted change in employment is 12,966, out of a total of 27,097. This model accounts for 48% of employment losses due to the change in the price of oil and gas. This is lower than the rig estimate of 21,424.

[9] Note that in order to preserve data point it was necessary to lower the lag structure from 24 and 12 to 12 and 6. This was still not enough to provide statistical coherence.

Rig Counts and Gas Prices

Figures 8 and 9 illustrate the graphical relationship between rig counts and the price of natural gas (Henry Hub). Rig counts should respond to changes in gas prices, and not vice versa, however it is possible that producers will change their rig counts in anticipation of price changes. A simple linear regression illustrates that for every $1.00 increase in gas prices there is an increase in rig counts by 8.8 rigs. At a natural gas price of about $8.00, the relationship weakens a bit, with only several data points reaching beyond that point. Figure 9 illustrates a non-linear relationship between rig counts and gas prices. With a peak in gas prices of 12.69 in June of 2008, and bottom in gas prices of 1.73 in March of 2016, that equates to a difference of approximately $10.00. Ten dollars multiplied by the regression coefficient of 8.8 predicts a loss of 88 rigs from 2008 to 2016. The actual loss in rigs during the same time period was 103 rigs, illustrating that the predicted rig count from this model is quite accurate in explaining history, and hence may help predict the future well.

Figure 8:

Rig Counts and Gas Prices

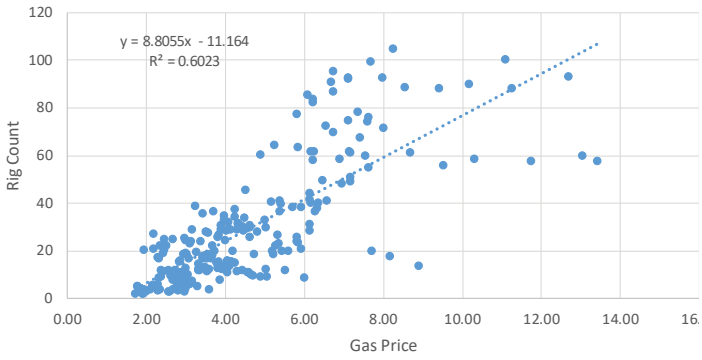
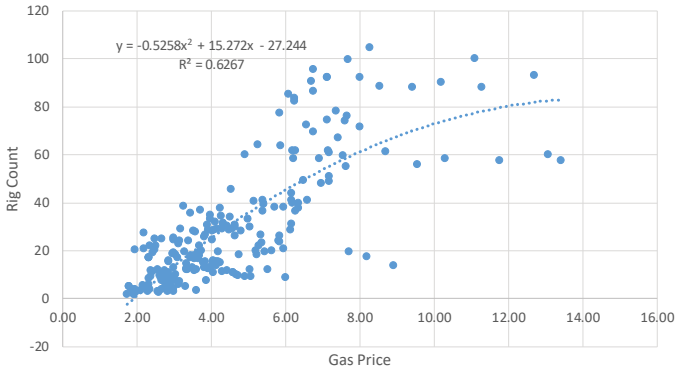


Figure 9:

Rig Counts and Gas Prices: Non-Linear Regression

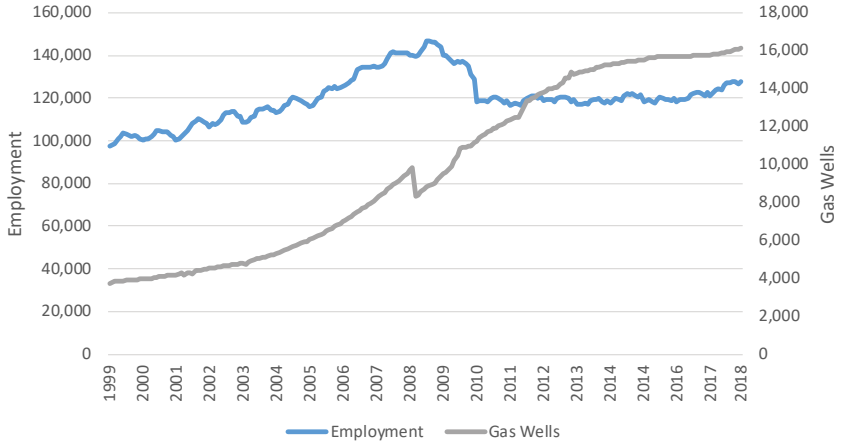


Employment and Gas Wells

The same analysis that was conducted for rigs and gas prices was conducted for gas wells. The results were statistically insignificant and nonsensical, thus they were omitted from this report because of the lack of use value. Figure 10 illustrates the relationship between employment and well count. A potential reason the gas well model was not significant is that the employment scaling takes place with drilling. Once a gas well is in place it requires some maintenance, but that maintenance stays constant and relatively low compared to the capital and labor employed when gas prices rise and more drilling occurs. Hence the model used for rigs and gas prices may not be appropriate for gas wells.

Figure 10:

Employment and Gas Wells



Conclusion

The oil and gas industry is a large contributor of wages on the Western Slope. Changes in the price of natural gas can cause swings in the business cycle locally due to the large employment changes that result from gas and rig changes. Changes in rigs cause a change in employment of 208 employees, while a $1.00 change in the price of natural gas changes employment by 1,183. Every change in $1.00 of natural gas price is related with an 8.8 change in rig count. The impact of rig count on employees has fallen since the 2000's due to changes in technology that create more efficiency with drilling. At the county level, Mesa and Garfield are attributed to most of the employment changes, with Mesa and Garfield County employment changing by 122 and 70, respectively. These two counties capture most of the employment changes resulting from changes in the price of natural gas, changing by 828 (Garfield) and 646 (Mesa) per $1.00 change in the price of natural gas.

Part 2: The Economic Contribution of the Oil and Gas Industry in the Piceance Basin

Goal and Scope of Part 2

The purpose of this report is to determine the economic contribution of the oil and gas industry for a six county region that defines the Piceance Basin. This report is unique in the sense that it covers the Piceance basin represented by six counties (Mesa, Garfield, Rio Blanco, Moffat, Gunnison, and Delta counties), as opposed to a state or national study.[10] The study focuses on the extraction industry, also known as upstream (drilling and extraction). The report covers some midstream (transportation and pipelines) activities that are a natural result of extraction, and does not cover downstream activities (refining, gas stations, etc.).

Economic Impact vs Contribution

Economic contribution and economic impact are two different concepts. Economic impact only counts new money that an event or an industry brings to the study area. This type of study is suitable for festivals or events or new businesses, for example. Economic contribution looks at the total economic activity of an existing event or industry, and its contribution to regional Gross Domestic Product (GDP).[11] This report is an economic contribution report and measures the total contribution to regional GDP that the oil and gas industry contributes in the Western Slope.

In deciding what should be included as part of the contribution analysis, a simple hypothetical question was asked: "If oil and gas extraction did not exist in the the state of Colorado, what income and taxes would be eliminated in the Piceance Basin?"[12] A contribution analysis including employment and wages, severance and Federal Mineral Lease taxes, ad valorem taxes, sales taxes, and royalties was created in an economic impact software called IMPLAN to measure the economic contribution of the industry. The area of measure is the Piceance Basin, with six counties included in the analysis as a single study region. Those counties include Mesa, Garfield, Rio Blanco, Delta, Gunnison, and Moffat. Mesa, Garfield, and Rio Blanco have the most economic activity from oil and gas, but Delta, Gunnison, and Moffat all have less oil and gas employment, with much of this employment existing as a result of the high levels of activity in Mesa, Garfield, and Rio Blanco. Since many people live in Delta County and commute to Mesa County, or live in Mesa County and commute to Garfield County to work in the oil and gas industry, conducting this on a per county basis did not seem the most accurate way to conduct the study. Instead a regional model of these six counties was developed to more accurately measure the economic contribution of the oil and gas industry in the Piceance. Conducting a regional analysis eliminates the problem of living in one county and working in another, and vice versa. The six counties analyzed cover the majority of employment and tax impact of Piceance oil and gas extraction.

It is important to note that the emphasis of this report is on the economic contribution of oil and gas extraction, or upstream activities. Once the gas is sold wholesale to a refinery or other entity it moves out of the scope of this report.

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[10] Note that in part one of this report a five county area was used because rig counts for Gunnison county were not available for the full time series. In the second part of the report Gunnison County is included.

[11] For a detailed discussion of the difference between economic impact and economic contribution, please refer to the following reference: Watson, P., Wilson, J., Thilmany, D., and Winter, S. (2007). Determining economic contributions and impacts: What is the difference and why do we care? Pedogogy in Regional Studies, JRAP 37(2): 140-146.

[12] The assumption that oil and gas extraction would not exist in the state of Colorado vs. the Piceance is important because if oil and gas were still extracted in other parts of the state, Western Slope counties would still receive a small amount of severance and FML distribution from the Department of Local Affairs. Also, IMPLAN code 266 may still exist due to the proximity to Front Range oil and gas extraction. Changing the assumption to the elimination of oil and gas in the Piceance changes the final total results very little, as without oil and gas extraction the Western Slope would receive significantly less severance and FML distributions from the Department of Local Affairs.

This reflects the actual activity of the oil/gas industry in the Piceance, which is primarily focused on upstream drilling and extraction of natural gas. There are other studies conducted that look at upstream, midstream, and downstream (including gas stations, petroleum products, etc.), and those studies would not be comparable to this one.

Input-Output Modeling

This report uses a data and software program called IMPLAN to conduct the economic contribution analysis. IMPLAN is an Input-Output model that accounts for all flows of economic activity between different sectors in an economy, including government and households. The model uses a Social Accounting Matrix (SAM), which along with accounting for the relationships between different sectors, also accounts for the relationships between industries, households, and government, as well as other elements like saving, commuting, and trade.

The direct effect from wages, taxes, and royalties is only the beginning of the economic contribution story. After the direct industry contribution is added, these raw tax and royalty numbers need to be adjusted for leakages from the economy, adjusted for supply chain effects, and adjusted for multiplier effects, all of which IMPLAN estimates.

Leakages are important because not every dollar that is spent in the six county region stays in the region. Leakages include taxes, commuting (which is a leakage of employee compensation), and imports from other areas, as imported goods do not drive further local effects. In addition to this, there is a difference between proprietor owned businesses and corporate businesses, as corporate owned businesses sends profits to a corporate office and are not spent locally. Leakages are calculated by IMPLAN for each economic activity.

IMPLAN also calculates supply chain effects for each spending category and industry. Supply chain effects are the effects of local spending on suppliers down the chain. For instance, purchasing pipe for a gas line has an economic effect on the local pipe supplier company. The local pipe supplier in turn spends money on other local suppliers of the inputs needed to manufacture the pipe. However, there may be instances where there is not a local pipe supplier, and pipe supplies are purchased outside of the region. Both the gas well servicer and the pipe supply company are affected by the direct spending, and IMPLAN estimates how much of this supply chain effect is local.

Induced effects are also calculated by IMPLAN and are vital to any economic impact report. Every dollar spent by oil and gas workers in the Piceance becomes income to someone else, such as a local business, a hotel employee, gas station attendee, or waiter/waitress. Each of these businesses or employees spends this new income, creating income for someone else. The cumulative impact of these rounds of spending are known as the multiplier effect. The multiplier effect is the total economic effect divided by the direct effect.

Direct Industry Contribution

IMPLAN sectors that represent the oil and gas extraction industry were used to measure the direct contribution of the industry. Table 8 illustrates the IMPLAN codes that were used for this study. All codes that were related with oil and gas extraction and distribution were included. This section includes the value of the industry's production as well as the employment and labor income associated with the industry.

Table 8:
Implan Codes

Implan Code	Description
20	Extraction of natural gas and crude petroleum
21	Extraction of natural gas liquids
37	Drilling Oil and Gas
38	Support Activities for oil and gas operation
266	Oil and Gas Field Machinery and Equipment

As the report progresses, the economic contribution of each section (employment and wages, severance and FML, ad valorem property taxes, sales taxes, and royalties) will be calculated individually, with the final result showing the total economic contribution. It is the total economic contribution that matters most (see table 19 on page 22), but seeing the individual contribution of each category is important to tell the story of the oil and gas industry's economic contribution to the Piceance.

Table 9 illustrates the employment, labor income, Gross Regional Product, and total output estimates for the oil and gas industry. The direct effect is the initial value that the industry contributes to the study region. Indirect effects are supply chain effects, and induced effects are the spending and respending that results from the direct and indirect contribution. The three combined are the total economic contribution for employment. The direct employment for this industry is 5,656, and after indirect and induced effects the total contribution to regional employment is 9,392. The direct industry contribution portion of the oil and gas industry contributes $977,527,338 to Gross Regional Product.

Table 9:
Economic Contribution of Employment

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	5,656	$504,085,385	$708,858,022	$1,099,930,354
Indirect Effect	718	$48,189,757	$60,705,217	$117,851,905
Induced Effect	3,018	$109,201,084	$207,964,099	$377,903,998
Total Effect	9,392	$661,476,226	$977,527,338	$1,595,686,257

The contribution to Gross Regional Product represents final goods and services and is the portion of total output that is paid to business and other entities in the form of employee compensation, proprietor income, taxes on production, and profits. Output includes value-added (GRP) plus the cost of intermediate goods.[13]

The total output value of $1,595,686,257 represents the gross total value of all sales and production due to the oil and gas industry. This is a broader measure than the standard Gross Domestic Product (GDP). Total output counts the Regional GDP and the intermediate goods that are associated with it. Total output represents how a business sees or feels its activity, or the gross sales and production that funnel through businesses. This total output measure is the gross measure of local economic activity, and is more in line with how a business would account for the sales transaction from one firm to another. GDP is considered a more accurate representation of economic contribution and is the emphasis of this report.

[13] A good example between Total Output and regional GDP is car production: Regional GDP only counts the final value of the car, but Total Output adds the intermediate goods of steel, rubber, and other parts, plus the total value of the car. This is known as double counting in GDP calculations.

Severance and Federal Mineral Lease (FML)

Severance taxes and Federal Mineral Lease royalties paid by the oil and gas industry are collected by the state and make their way back to Western Slope counties through several state programs listed in table 11. In cases such as direct distribution, Energy Impact Assistant Fund, and several others, county level distributions were available to be coded in IMPLAN. In the case of state level programs that get money contributed to their general budget, an estimation of the percentage of the statewide budget that goes to the six Western Slope counties focused in this study was calculated.[14]

Direct Distribution

Direct distribution is money from both severance and FML that is distributed to the county, municipalities, and school districts based on three sets of formulas (see appendix A). These revenues come from the State severance tax receipts and the FML non-bonus payments.

Table 10:

Direct Distribution to the Western Slope

	Total Numbers			Adjusted Numbers		
	SDD $	FML Muni/ County $	FML School District $	SDD $	FML Muni/ County $	FML School District $
Mesa	$585,727	$1,288,412	$109,515	$553,285	$1,288,412	$109,515
Delta	$141,403	$172,396	$14,654	$133,571	$68,204	$5,797
Garfield	$1,010,954	$3,222,927	$273,949	$954,960	$3,222,604	$273,921
Rio Blanco	$530,594	$3,500,908	$297,577	$501,205	$2,541,659	$216,041
Moffat	$472,683	$1,319,849	$112,187	$446,502	$414,683	$35,248
Gunnison	$399,480	$762,385	$64,803	$377,354	$47,680	$4,053
Totals	$3,140,841	$10,266,877	$872,685	$2,966,876	$7,583,244	$644,576
Grand Total			$14,280,403			$11,194,696

There are three types of direct distribution. The first is direct distribution that goes directly to local government budgets and is from severance taxes. The second goes to counties and municipalities from Federal Mineral Lease. The third comes from Federal Mineral Lease and is distributed to school districts. Table 10 illustrates these three separately, although they are all part of the direct distribution program. This direct distribution can be seen in figure 11 in appendix A and figure 12 in appendix B. The formulas used to determine the distribution can also be found in appendix A and B.

It is important to note that severance and FML are taxes and royalties collected from not just oil/gas extraction but also mining. Only the impact of oil/gas is important to this study. To adjust for this, the proportion of oil/gas to mining for both severance and FML was calculated and the numbers adjusted for each input into the model. For severance this proportion is taken from the Department of Revenue's annual report (2018) as an average proportion from the years 2010-2018. The proportion that is attributed to oil and gas is 94.46%. For FML the data is more granular at the county level, and a weighted share based on each county's proportion was calculated. Data for this proportion came from the Office of Natural Resource Revenue. This proportion used for FML funds is 74.92%.

Table 10 illustrates the total numbers for the three types of direct distribution as well as their adjusted numbers to reflect the proportion of oil/gas to mining. Data for direct distribution comes from DOLA, while the adjusted numbers are the authors calculations. Please note that all numbers in table 11 are adjusted for this proportion.

[14] Note that many of these calculations were performed with the help of several government administrators who took the time to carefully estimate how much of their organizations budget was spent on the Western Slope. Special thanks to everyone at DOLA, and to all the administrators of each program in table 11 who took the time to explain their program and help find data to complete this report.

Energy Impact Assistant Fund

The Energy Impact Assistant Fund is a program that results from both severance taxes and Federal Mineral Lease royalties and can be seen on both the FML flow chart and severance tax flow chart (see appendix A and B). DOLA describes the program as follows:

"The purpose of the EIAF Program is to assist political subdivisions that are socially and/or economically impacted by the development, processing, or energy conversion of minerals and mineral fuels. Funds come from the state severance tax on energy and mineral production and from a portion of the state's share of royalties paid to the federal government for mining and drilling of minerals and mineral fuels on federally-owned land."[15]

The Energy Impact Assistance Fund is rewarded to municipalities, counties, school districts, and other political subdivisions in the form of grants or loans. The exact awards for each of the six counties is listed in appendix C. Each award was coded into IMPLAN to reflect the type of expenditure. In the event that the grant awarded money for a purchase or for equipment that was likely to be purchased from outside of the county, the award was omitted from the IMPLAN model.

Table 11:

Programs Resulting From Severance/FML

Program	Amount to Western Slope	Description	Details
Direct Distribution	$2,966,876.06	Severance	
Direct Distribution: Municipality/ County	$7,583,244.00	FML	
Direct Distribution: School Districts	$644,575.90	Severance and FML	
Energy Impact Assistance Fund	$8,577,377		
	Severance and FML		
State Public School Fund	$2,603,668.27		
	FML	See below	
Small Communities Water and Waste-water Grants	No Funding for 2017	Severance	Reduced severance due to previous overpayment and reduction in oil and gas prices means that severance taxes did not reach sufficient levels to fund this program for 2017. 2016 contribution to the Western Slope was $534,078.
Federal Mineral Lease Revenue Fund	No Funding for 2017	FML Overflow (Bonus Funds)	
Tier 1 Programs			
COGCC	$1,700,000	Severance	Estimated amount of COGCC's $11,389,629 expenditures in Western Slope. (DNR Estimate)
Colorado Water Conservation Board	$79,301	Severance and FML	Federal Mineral Lease money goes to this organization to help their operational costs. They have a large fund and provide highly subsidized loans for water improvement efforts.
Division of Reclamation, Mining, and Safety	$358,732	Severance	Estimated amount of $2,522,594 budget that was spent in Western Slope. (DNR estimate)

[15] Source: https://www.colorado.gov/pacific/dola/energymineral-impact-assistance-fund-eiaf

Table 11 Continued:

Programs Resulting From Severance/FML

Program	Amount to Western Slope	Description	Details
Avalanche Information Center	$48,450	Severance	Estimated amount of $549,487 that was spent in the Western Slope.
Colorado Parks and Wildlife	$960,642	Severance	Estimated amount of $2,341,732 that was spent in the Western Slope. (DNR Estimate)
Colorado Geological Survey	N/A		Did not respond to phone/e-mail requests for data.
Tier 2 Programs			
Water Supply Reserve Fund	$902,500	Severance	(DNR estimate) For details go to: https://www.colorado.gov/pacific/cowaterplan/water-supply-reserve-fund
Species Conservation Trust Fund	$825,640	Severance	(DNR estimate)
Aquatic Nuisance Species	$528,276	Severance	(DNR estimate)
Soil and Water Conservation Grants	Funded	Severance	2016/2017: 0 2017/2018: $65,510
Water Efficiency Grant Program	No Funding	Severance	
Low Income Energy Assistance (LEAP)	No Funding	Severance	
Agriculture Value Added Cash Fund	No funding	Severance	
Interbasin Compacts	No funding	Severance	
Forestry Grants	No funding	Severance	2016/2017: 0 2017/2018: $363,944
Invasive Phreatophyte Management	No funding	Severance	Program not in existence anymore.
Wildfire Risk Reduction Grants	No funding	Severance	Zero both years
Forfeited Mine Site Reclamation	No funding	Severance	Zero both years.

State Public School Fund

The FML money that goes into the State Public School Fund is intermingled and not distinguishable from other budget sources. However, the total state school budget is $4,121,000,000, and $64,813,020 of that budget comes from FML. Dividing the FML amount by the total amount provides a proportion of 1.573%. A reasonable estimate for the FML contribution back to the counties in the form of school funds is thus the total money distributed by the state to the school districts multiplied by the proportion of funds that are FML funds, or 1.573%. The total amount of school spending as a result of FML funds is listed in table 12. The total amount for the Piceance is $3,475,265, and adjusted for the proportion of oil/gas to mining for FML the IMPLAN contribution is $2,603,668.27.

Table 12:

State Public School Fund FML Local Proportion

	Total School Funding	Proportion from FML	Proportion from Oil/gas
Mesa	$116,943,609	$1,839,230	$1,377,951
Delta	$25,955,493	$408,215	$305,835
Gunnison	$5,987,358	$94,166	$70,549
Rio Blanco	$3,395,585	$53,404	$40,010
Garfield	$62,293,423	$979,720	$734,006
Moffat	$6,391,993	$100,530	$75,317
Total	$220,967,460	$3,475,265	$2,603,668

Small Communities Water and Wastewater Grants and Federal Mineral Lease Revenue Fund

The Small Communities Water and Wastewater Grants can be seen on the flow chart in appendix A. This program was not funded in 2017 due to reduced severance taxes due to a previous overpayment and oil and gas production levels not being high enough to generate sufficient levels to fund the program. The 2016 contribution to the Western Slope was $534,078, but is not counted in this 2017 based report.

The Federal Mineral Lease Revenue Fund is a program that was funding institutional capital construction. The money for this project is tied to bonus FML funds (see figure 12 in appendix B). For the last several years, bonus funds for FML have been relatively non-existent, so this program does not get FML funds like it did in the past.

Tier 1 Programs

Tier 1 programs get their funds in part from severance taxes that flow through the Department of Natural Resources. Since this severance tax money goes into the general budget, the amount of that budget that is from severance taxes had to be calculated, and then the amount of that budget spent in the six counties in question was estimated.[16] Table 11 lists tier 1 programs and their estimated contribution to the six county area that results from oil/gas severance/FML.

Tier 2 programs

Tier 2 programs are smaller programs that received money from primarily severance taxes. Some of the programs were funded, but several were not funded due to lack of overflow severance funds. Programs that were not funded would have the potential to be funded if severance tax collections were to increase substantially. Table 11 illustrates tier 2 programs.

Economic Contribution of Severance and FML

Table 13 illustrates the economic contribution of programs related to severance and FML distributions back to the county. Severance and FML programs create 328 jobs, contribute $16,138,382 in labor income, and contribute $21,889,504 to Gross Regional Product.

Table 13:

Economic Contribution of Severance and FML

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	230	$12,488,705	$15,185,781	$21,166,778
Indirect Effect	24	$974,970	$1,615,384	$3,421,270
Induced Effect	74	$2,674,708	$5,088,338	$9,252,971
Total Effect	328	$16,138,383	$21,889,504	$33,841,019

Ad Valorem Taxes

Western Slope Counties collect ad valorem property taxes from the extraction, production, and transportation of oil and gas. Each county was asked to calculate how much ad valorem property tax was due to the oil/gas industry. Table 14 illustrates the ad valorem tax received. The taxes reflect 2017 production, which would be the 2018 payroll, collected in

[16] Special thanks to the Department of Natural Resources for taking the time to look over the DNR budget and estimate how much of the budget was spent in the six county region.

2019. Since this report is trying to capture the economic impact of 2017, it made the most sense to use 2017 production numbers even though the counties actually receive the funds at a later date.

In keeping with the hypothetical question regarding the banning of oil and gas extraction in Colorado, all assessed property related to oil and gas that are a result of Western Colorado extraction were included. This includes wells, property, intrastate and intercounty pipeline transportation of Piceance specific gas (note that interstate oil or gas pipelines that are not the result of Piceance extraction are excluded).

Table14:

Ad Valorem Taxes

County	Ad Valorem Tax Received
Mesa	$2,644,361
Delta	$104,343
Rio Blanco	$9,655,318
Garfield	$70,869,554
Moffat	$2,624,738
Gunnison	$591,218
Total	$86,489,534

Sales Taxes

Sales taxes are collected and in some cases are tracked by industry. In the event that the county or municipality tracked their sales taxes by industry, the data was included in the model. This sales tax collection would cease to exist if the oil and gas industry in the Piceance were to disappear. Each county and municipality was contacted to ask for data on sales tax by industry. Delta, Rio Blanco, and Moffat counties and their municipalities do not track their sales tax collection by industry.[17] Because data is not available for all counties and municipalities, this sales tax estimate likely undercounts the true sales tax contribution made by the oil and gas industry.

Table15:

Sales Taxes

County	Sales Tax
Mesa	$1,336,194
Garfield	$1,144,138
Gunnison	$2,852.71
Total	$2,483,185

Economic Contribution of Ad Valorem and Sales Taxes

Table 16 lists the economic contribution of ad valorem and sales taxes. These taxes and government administration and spending of this money supports 1,087 jobs with $53,929,918 in labor income. The total contribution to Gross Regional Product is $73,365,577.

Table 16:

Economic Contribution of Ad Valorem and Sales Taxes

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	766	$41,963,884	$51,436,720	$70,192,766
Indirect Effect	75	$3,026,733	$4,923,426	$10,332,037
Induced Effect	247	$8,939,301	$17,005,431	$30,924,547
Total Effect	1,087	$53,929,918	$73,365,577	$111,449,350

[17]Mesa county includes the county, Grand Junction, and Fruita. Garfield includes the county and Rifle. Gunnison only includes the County. All other municipalities do not track sales tax by industry.

Royalties

State Royalties

State Land Trust royalties are collected by the State Land Trust board and distributed to the Department of Education, who funds their Best Fund program, a program which assists schools with building and renovation projects. In addition to this, money goes to an endowment fund which funds the Department of Education. Best Fund grant funds can be tracked when they are distributed back to the Western Slope. Table 17 illustrates the Best Fund Grants to the Piceance. Since not all royalties collected by the State Land Trust Board are from oil and gas, a proportion of oil/gas royalties to total royalties was calculated. Because not all funds from the Best Fund are from royalties, a similar proportion calculation was performed to get the final proportion to adjust the Best Fund Grant awards to most accurately reflect the contribution from oil/gas State royalties.[18] A total amount of $1,347,012.85 was input into the economic contribution model. Note that royalties are also paid to the Federal government, but there is no specific program or amount of money that can be traced back to the Western Slope, hence the Federal royalties were omitted.

Table 17:
Best Fund Grant Awards

Type	Project Description	Amount	Adjusted Amount
Garfield	ES Security Vestibule	$148,274	$66,710
Garfield	HS Sitework, HVAC, ADA and Security Project	$2,125,286	$956,190
Garfield	ES Partial Roof Replacement	$226,253	$101,794
Mesa	PK-12 RTU Replacement	$494,139	$222,319
Total		$2,993,951.63	$1,347,012.85

Private Landowner Royalties

The top natural gas producing companies in the Piceance were contacted and asked to provide a list of royalty payments to landowners. Because many royalty recipients may live outside of the Piceance, the companies were asked to provide the zip code where the royalty payment was sent. This zip code is used as a proxy for where they live, because only royalties that are spent in the Piceance can be counted as economic contribution. Because not all companies responded to the survey, an extrapolation had to be performed in order to estimate the total royalties collected. The extrapolation was performed using total oil and gas production numbers retrieved from the COGCC. Approximately 40% of total production was represented from the survey data, and that was extrapolated to the total production numbers to perform an estimate for local royalty collection. Different income ranges have different spending patterns. Individuals with high income buy different things and save at a different rate than individuals with low income. IMPLAN models these income level spending patterns. Since there is no data on the income level of the royalty recipient, the royalty amount of $22,857,142.26 was spread through IMPLAN's various income spending patterns in order to capture different spending patterns of different income ranges. Note that IMPLAN household income categories account for taxes. Because the private landowner royalties is an estimation (while much of the rest of the report relies on exact data), appendix D lists total economic contribution without private landowner royalties as an alternative total economic contribution.

[18] The proportion is calculated from two sources. First, the proportion of oil/gas royalties of total royalties is calculated using the "Income and Inventory Report" from the Colorado State board of land commissioners (retrieved from here: https://drive.google.com/file/d/0BxZl_4fdYJ5kT2loeGhOVUhTMzlCT2w3cmZoenFkejRjRXdN/view). Next this proportion is applied to the revenue source proportion for BEST program funding (retrieved from here: http://cde.state.co.us/communications/capitalconstruction-factsheet). The final proportion is approximately 45%.

Economic Contribution of Royalties

Table 18 illustrates the economic contribution of royalty spending. Spending on royalties locally supports 140 jobs with $5,088,345 in labor income. The contribution of royalty spending to Gross Regional Product is $10,579,323.

Table 18:
Economic Contribution of Royalties

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	9	$497,427	$655,593	$1,383,935
Indirect Effect	3	$110,261	$192,732	$394,188
Induced Effect	140	$5,088,345	$9,730,997	$17,634,469
Total Effect	152	$5,696,034	$10,579,323	$19,412,594

Total Economic Contribution

This section combines all the previous sections (employment, severance and FML, ad valorem, sales taxes, and royalties) to determine the total economic contribution of the oil and gas industry in the Piceance Basin six county region. It is important to remember that these results take into account leakages from the economy, supply chain effects, and induced effects. The total economic contribution resulting from the oil and gas industry in the Piceance six county region is $1,083,361,742 (table 19). As a comparison point, total Gross Regional Product for the six county area is $11,819,208,514, equating to 9.2% of total GRP. Note that if the study area were changed to Mesa, Garfield, and Rio Blanco, the percentage of GRP would likely be higher because the percentage of total economic activity resulting from the oil and gas industry is higher than in Delta, Gunnison, and Moffat, where the proportion of activity is lower. The goal of the report is to accurately model the total economic contribution of the oil and gas industry in the Piceance, and thus these counties are included in order to capture their peripheral employment resulting from these industries.[19] Total employment resulting from the oil and gas industry totals 10,959. For scale purposes, there are 164,956 total jobs estimated by IMPLAN in the region equating to 6.6% of total jobs. The contribution of labor income is $737,240,560. Total output resulting from the industry is $1,760,389,220.

Table 19:
Total Economic Contribution

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	6,660	$559,035,402	$776,136,117	$1,192,673,833
Indirect Effect	820	$52,301,721	$67,436,760	$131,999,401
Induced Effect	3,479	$125,903,438	$239,788,866	$435,715,986
Total Effect	10,959	$737,240,560	$1,083,361,743	$1,760,389,220

[19] Note that it is not possible to run this model at the individual county level and have the result add to the final results listed in table 19 as doing so would no longer account for interregional trade among the counties. The regional six county model is a more accurate representation of the economic contribution of this industry.

Table 20 illustrates the top industries that experience employment as a result of the oil and gas industry. The first four industries are the oil and gas industry IMPLAN codes input into the model. Besides those four, local government (557), real estate (334), and limited service restaurants (242) have the most employment resulting from the oil and gas industry.

Table 20

Employment by Industry Resulting from the Oil and Gas Industry

Description	Total
Total	10,959.0
Support activities for oil and gas operations	2,180.1
Extraction of natural gas and crude petroleum	1,435.2
Drilling oil and gas wells	1,069.0
Extraction of natural gas liquids	954.4
Employment and payroll of local govt, non-education	556.9
Real estate	334.8
Limited-service restaurants	241.5
Full-service restaurants	228.9
Maintenance and repair construction of nonresidential structures	164.2
Hospitals	156.5
Wholesale trade	133.2
Retail - Food and beverage stores	110.6
Retail - General merchandise stores	110.4
Individual and family services	97.4
Offices of physicians	96.4
Services to buildings	96.1
All other food and drinking places	93.7
Retail - Nonstore retailers	91.9
Other financial investment activities	83.5

Description	Total
Automotive repair and maintenance, except car washes	79.7
Architectural, engineering, and related services	79.1
Legal services	75.9
Personal care services	73.6
Accounting, tax preparation, bookkeeping, and payroll services	72.5
Monetary authorities and depository credit intermediation	71.1
Other personal services	67.8
Nursing and community care facilities	65.8
Employment and payroll of state govt, non-education	61.1
Retail - Miscellaneous store retailers	60.5
Other educational services	56.6
Offices of other health practitioners	54.1
Retail - Motor vehicle and parts dealers	53.6
Employment services	52.8
Retail - Building material and garden equipment and supplies stores	50.2
Construction of new highways and streets	48.6
Construction of other new nonresidential structures	47.0
Transit and ground passenger transportation	45.6
Landscape and horticultural services	44.5
Management of companies and enterprises	43.0

Conclusion

The oil and gas industry contributes $1,083,361,743 to the regional GDP. The high wages this industry pays resonate with multiplier effects that support 3,478.9 jobs by spending alone. Counting supply chain effects and the direct employment numbers, the industry contributes or causes 10,959 jobs in the Western Slope. Along with healthcare, retail trade, and construction, the oil and gas industry is one of the top contributors to the local economy, measuring at 9.2% of Gross Regional Product.

This study can be used in several ways to help policy makers, businesses, and others make informed data driven decisions regarding the regional and local economy. The first section of this report can be used to help predict the employment impacts of changes in rig counts and natural gas prices. The second part of this report provides an understanding of the scope and impact of the oil and gas industry and allows for predictions of change in local employment and GRP as a result of changes to the industry.

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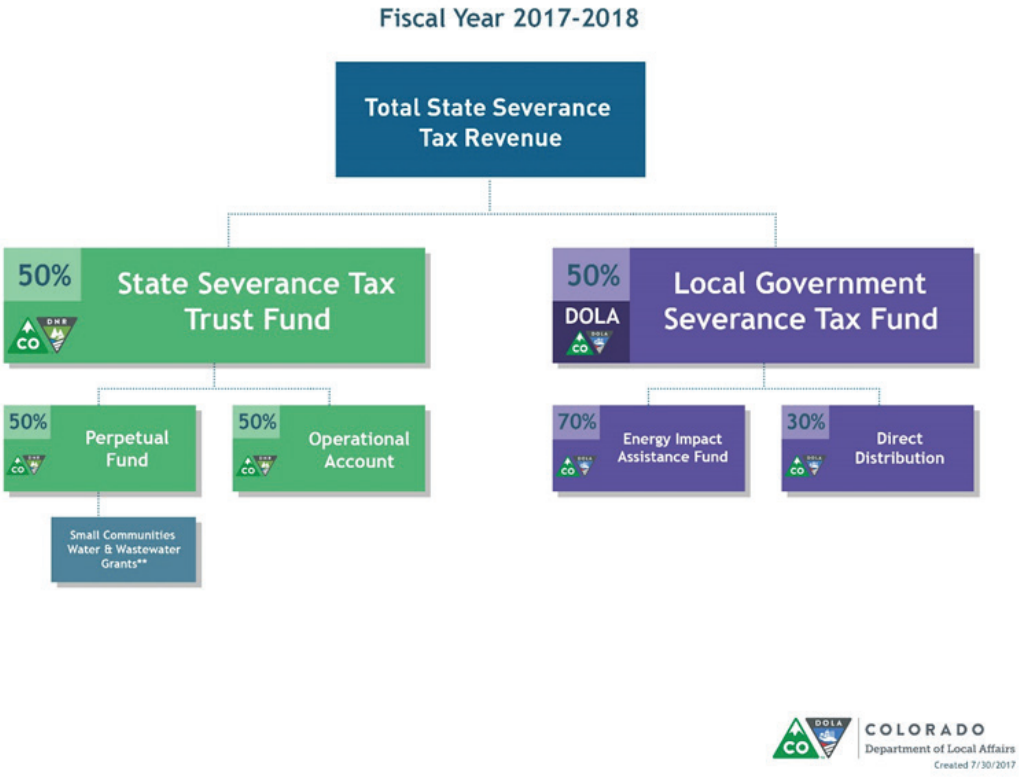
Appendix A: Severance Taxes

A severance tax is a tax on the removal of a non-renewable energy source. Figure 11 illustrates the flow chart of state severance tax revenue. For information on the formula that DOLA uses to distribute income via direct distribution from severance and FML, visit https://www.colorado.gov/pacific/dola/direct-distribution-severance-tax-federal-mineral-lease.

Figure 11:

Department of Local Affairs Severance Tax Flow Chart

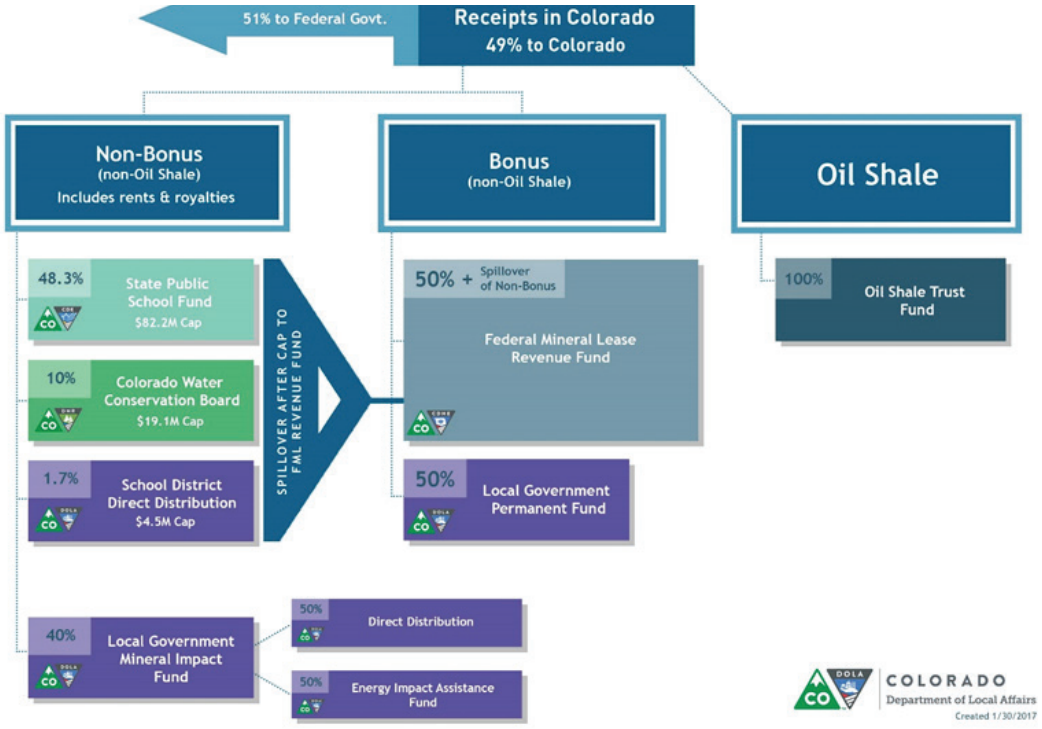


Appendix B: Federal Mineral Lease

Federal Mineral Lease money is collected from the lease of federal land to companies that extract natural resources. Figure 12 illustrates how FML is distributed.

Figure 12:

Department of Local Affairs Severance Tax Flow Chart



Appendix C: Energy Impact Assistance Fund Award Recipients

The Energy Impact Assistance Fund distributes both severance and FML money. To learn more about the disbursement process, visit https://www.colorado.gov/pacific/dola/energymineral-impact-assistance-fund-eiaf. Table 21 lists all of the Energy Impact Assistance Fund grant awards for 2017. Energy Impact Assistance Fund data is from DOLA.

Table 21

Energy Impact Assistance Fund Award Receipients

County	Project Name	Applicant	Total Amount Awarded	Severance Amount	FML Amount
Garfield	Parachute Building Design Standards Development	Parachute, Town of	$20,000	$20,000	
Garfield	Carbondale Best & Brightest Intern 2017-2019	Carbondale, Town of	$42,000	$42,000	
Garfield	Rifle Water Transmission Lines Design	Rifle, City of	$75,000	$75,000	
Garfield	Glenwood Springs Best and Brightest Intern 2017-2018	Glenwood Springs, City of	$42,000	$42,000	
Garfield	Glenwood Springs 7th Street Plaza Construction Phase I	Glenwood Springs, City of	$400,000	$400,000	
Garfield	Rifle North/South Integration Project- Water Line	Rifle, City of	$800,000	$800,000	
Garfield	Rifle Main Street Scholarship FY 16-17	Rifle, City of	$3,000	$3,000	
Garfield	Rifle Enterprise Court Road Reconstruction	Rifle, City of	$250,000	250000	
Gunnison	Gunnison County Family Services Facility Remodel	Gunnison County	$478,307	$478,307	
Gunnison	Crested Butte Wastewater Treatment Plant Upgrades Phase 2	Crested Butte, Town of	$200,000		$200,000
Gunnison	City of Gunnison Central Bus. District Plan	Gunnison, City of	$25,000	$25,000	
Gunnison	Crested Butte Wastewater Plant Upgrades	Crested Butte, Town of	$400,000	$400,000	
Gunnison	Western State Colorado University ICEhouse Innovation Center	Western State College	$115,623	$115,623	
Mesa	Mesa County V.8 Road Big Salt Wash Crossing	Mesa County	$450,000	$450,000	
Mesa	Mesa County/Grand Valley CNG Transit Buses	Mesa County	$137,904	$137,904	
Mesa	Clifton SD Maintenance and Parts Storage Building Expansion	Clifton Sanitation District	$48,000	$48,000	
Mesa	Grand Junction Grand Mesa Radio Site	Grand Junction, City of	$150,000		$150,000
Mesa	Mesa WSD Submersible Well Pump Improvement	Mesa Water & Sanitation District	$12,900		$12,900
Mesa	Mesa Palisade Plunge Trail Project Permitting and Design	Mesa County	$200,000	$200,000	

County	Project Name	Applicant	Total Amount Awarded	Severance Amount	FML Amount
Mesa	Palisade Comprehensive Master Plan & Zoning Code Update	Palisade, Town of	$25,000	$25,000	
Mesa	De Beque Fiscal Health Asset Inventory CIP/GIS	De Beque, Town of	$43,985	$43,985	
Mesa	Grand Mesa Metro. Dist. WW Treatment Plant Improvements	Grand Mesa Metropolitan District	$100,000	$100,000	
Mesa	Fruita Kokopelli Riverfront Trail Construction	Fruita, City of	$1,000,000	$1,000,000	
Mesa	Mesa County West Divide Road Improvements	Mesa County	$750,000	$750,000	
Rio Blanco	Meeker Water Supply Improvement(s)	Meeker, Town of	$318,479		$318,479
Rio Blanco	Rio Blanco FPD Building Renovation and Expansion	Rio Blanco Fire Protection District	$1,000,000		$1,000,000
Rio Blanco	Rio Blanco Dept. of Health and Human Services Renovations	Rio Blanco County	$157,570	$157,570	
Rio Blanco	AGNC Mini Grants	Adams County Aging Network - The Senior Hub	$77,000	$77,000	
Rio Blanco	Rangely Wastewater Treatment Plant Improvements	Rangely, Town of	$200,000	$200,000	
Rio Blanco	Meeker Main Street Scholarship FY 16-17	Meeker, Town of	$3,000	$3,000	
Rio Blanco	Rio Blanco County Columbine Park Building Design	Rio Blanco County	$152,500	$152,500	
Moffat	Moffat County Fiscal Health Initiative	Moffat County	$28,000	$19,500	
Moffat	Moffat County Browns Park Swinging Bridge Rehab	Moffat County	$760,000	$760,000	
Delta	City of Delta Asset Management Program	Delta, City of	$25,000	$25,000	
Delta	Delta Innovation Center Architecture/Design	Delta County School District 50(J)	$55,000	$55,000	
Delta	Delta City Hall Renovation Plans	Delta, City of	$25,000	$25,000	
Delta	Delta County Master Plan/Land Use Code Update Phases 3 & 4	Delta County	$71,375	$71,375	
Delta	Cederedge WW Rate Study	Cedaredge, Town of	$20,000	$20,000	
Delta	Delta County Master Plan Update - RESET	Delta County	$25,000	$25,000	
Delta	Delta Urban Renewal Authority Assessment	Delta, City of	$25,000	$25,000	
Delta	Delta County Radio Console Update	Delta County	$300,000	$300,000	

Appendix D: Total Economic Contribution Omitting Private Royalty Estimates

Table 22 lists results omitting private landowner royalty estimates.

Table 22:
Total Economic Contribution Omitting Private Royalty Estimates

Impact Type	Employment	Labor Income	Regional GDP	Total Output
Direct Effect	6,660	559,035,402	776,136,117	1,192,673,833
Indirect Effect	820	52,301,721	67,436,760	131,999,40
Induced Effect	3,342	120,935,130	230,286,522	418,496,953
Total Effect	10,822	732,272,253	1,073,859,399	1,743,170,187