

The Regional Economic Impacts of Coal Mining: A Case Study of Signal Peak Energy

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Abstract

This paper quantifies the regional economic contributions of coal exports from the US using a case study of Signal Peak Energy in Montana. Two methods of estimating economic contributions are compared, contribution and impact analysis. The latter is adopted because the industry impact analysis is more accurate, especially since it is based upon accounting records from Signal Peak. Our estimates of regional economic and fiscal impacts do not vary significantly with the price of coal because we explicitly account for swings in royalty income. Our analysis finds that Signal Peak Energy supports 678 jobs, over \$55 million in tax revenues, more than \$90 million in royalties, \$111.7 million in value added, and \$62.3 million in labor income. Curtailing or halting Signal Peak's coal production for environmental reasons as some environmental groups have argued would eliminate these economic contributions.

Keywords

Coal, Regional, Economic, Exports, Fiscal

1. Introduction

Since the 1970s through 1990s, Considine (2009) [1] shows that the adoption of low-sulfur, sub-bituminous coal reduced environmental pollution and contributed to lower electricity prices. In contrast, Betz *et al.* (2015) [2] find that coal in the United States has been in steep decline since 1998, losing markets to natural gas and renewables. Dechezleprere and Sata (2017) [3] also noted that increased environmental regulation and declining costs for renewable energy are contributing factors. In contrast, data from British Petroleum (2024) [4] reveal that coal consumption in the rest of the world has reached record levels. Even though US coal producers face high costs exporting coal, there are a few US producers who serve these markets.

One of these producers is Signal Peak Energy, which operates a coal mine near Roundup, Montana, in Musselshell County just north of Billings Montana. This mine produces high-quality thermal coal for export to East Asian markets. This facility is the single largest employer in Musselshell County supporting 11.6 percent of the work force and generating 27.4 percent of total employee and proprietor compensation. This income along with spending on local goods and services contributes to the regional economy, generating tax revenues that support schools, fire protection, and a wide array of other social services. The objective of this paper is to quantify these fiscal and economic contributions of Signal Peak Energy.

These contributions arise from the \$245.1 million Signal Peak spent to produce coal during 2022. This spending affects the regional economies in Musselshell and surrounding counties in Montana that define the study region in this report. For example, a portion of private royalties are spent on local goods and services. This study recognizes Signal Peak's state and federal royalty payments, but they are not considered as an economic stimulus because it is unlikely that they would affect discretionary government spending. This leaves business-to-business spending and expenditures on wages, salaries, and contract labor as the primary sources of direct spending by Signal Peak affecting the regional economy.

This spending contributes to the economy in three ways. First, there are direct economic contributions already mentioned, such as taxes and royalties paid, wages and salaries, and business-to-business spending. The second channel includes the indirect or supply chain impacts that arise from the purchase of goods and services which support activity at the mine. The third and final economic contributions are induced by the spending of wages and salaries paid by the mine and by supporting supply chain industries. The total economic contributions are the sum of these direct, indirect, and induced impacts. This study uses the input-output model developed by IMPLAN, Inc. (2024) [5] to model these impacts. This approach is common in the regional science literature.

The economic impacts of coal mining have been studied in the regional science and economic development literature including studies by Black *et al.* (2005) [6], Ivanova and Rolfe (2011) [7] and Lobo *et al.* (2016) [8]. There are also several related academic studies on the economic impacts of resource extraction, such as Deaton and Niman (2012) [9], Deller (2014) [10], Dedler and Schreiber (2012) [11] and Douglas and Walker (2017) [12].

This report describes the methods used to estimate Signal Peak's economic impacts. Of particular concern is over-estimating the economic and fiscal contributions due to swings in the price of coal. For example, coal prices were nearly three-times higher during 2022 than they were in 2021. This study avoids possible over-estimation by carefully measured direct spending by Signal Peak in the regional economy.

Signal Peak's spending on wages, supplies, taxes, and royalties is presented in the following section. This information provides the input data for the economic

impact model used to estimate the economic contributions from the mine to the regional economy including Musselshell and Yellowstone Counties and the rest of Montana. Economic contribution analysis is like economic impact analysis, the distinction between the two and specific methods employed in this study are briefly described in section three. The economic contributions including employment, labor compensation, and value added are presented and discussed in section four. Fiscal contributions directly generated by the mine and through its effects on the regional economy appear in section five. The report concludes with a synopsis of the main findings and their implications for regional economic development, environmental policy, and international trade.

2. Signal Peak's Spending, Taxes, and Royalties

The Bull Mountain mine No. 1 coal mine operated by Signal Peak Energy LLC in Roundup, Montana is 30 miles north of Billings, Montana. The mine produced approximately 7.2 millions tons of bituminous coal during 2022. Hanson *et al.* (2015) [13] note that the mine made longwall recovery history with the widest predeveloped full-face recovery entry of 42 feet surpassing the previous record of 36 feet by Alliance Resource Partners' Mettiki mine in Tucker County, West Virginia. This technological advance improves efficiency and provides the mine with a competitive advantage. In addition, as **Figure 1** illustrates, the proximity of the mine to rail access provides additional advantages shipping its coal from the west coast of North America to customers in the Far East. The Bull Mountain mine is the only underground coal mine operating in Montana.



Figure 1. Signal Peak Energy coal mine.

Coal mining is the single largest employer in Musselshell County supporting 259 full and part-time positions and \$31.3 million in employee and proprietor compensation, according to data from IMPLAN, Inc. The next largest employer is local government with 136 positions and a payroll of \$6.5 million. Many of these positions are supported by tax revenues paid by coal mining. Coal mining

also has the second highest compensation per employee at \$121,132. Electric power is the only other sector with higher compensation per employee but supports only 12 positions within the county. These data on employment and compensation are from an economic impact analysis firm called IMPLAN (2023) [5] based upon extrapolations of national and regional data to state, county, and congressional districts. As a result, there is some level of error around their estimates.

In contrast, for the economic contributions reported here, we rely on detailed accounting records from Signal Peak Energy. Based upon this information, Signal Peak spent \$245.1 million Signal Peak to produce coal during 2022. Of this amount, \$79.6 million included business-to-business spending, see **Figure 2**. Expenditures on wages and contract labor were \$39.8 million. The company also spent \$32.1 million on non-income related taxes including property and severance taxes. Finally, the company paid \$93.6 million in royalties during 2022 with \$58.7 million to private parties, \$3.8 million to the State of Montana, and \$31.1 million to the federal government, see **Figure 2**.

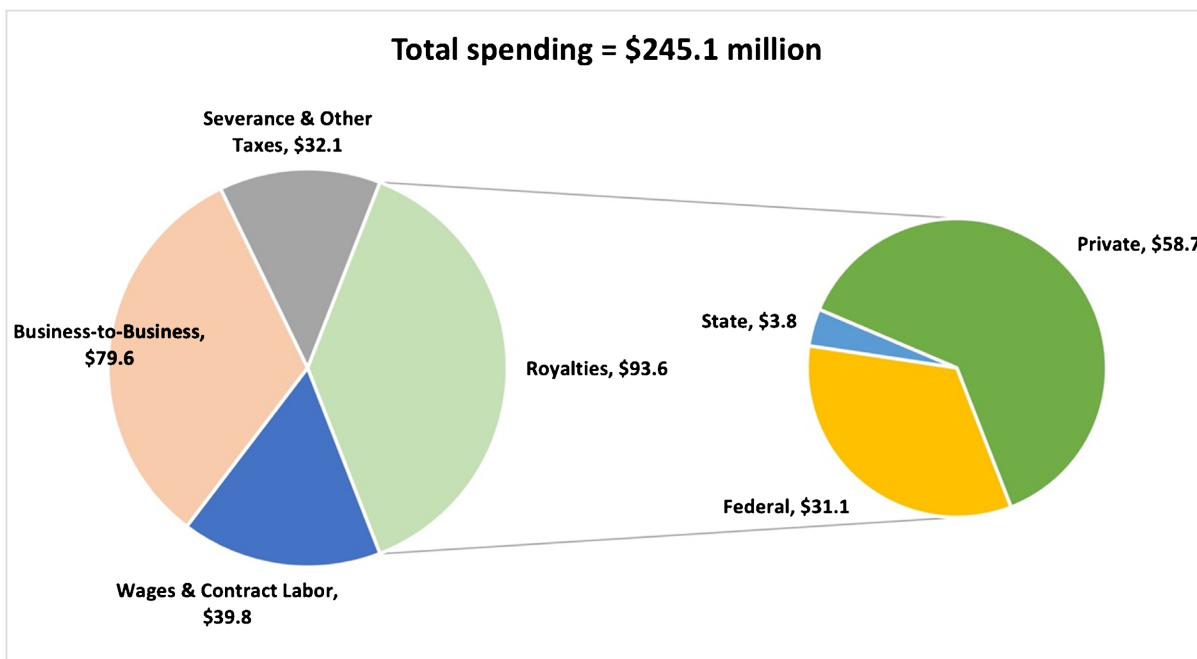


Figure 2. Spending by Signal Peak in million dollars during 2022.

3. Measuring Economic Contributions

Spending by Signal Peak generates indirect and induced contributions to the local economy. This study employs input-output analysis to estimate these contributions, which is an analytical framework developed by Professor Wassily Leontief in the late 1930s, for which he received the Nobel Prize in Economic Science in 1973. This framework is also known as interindustry analysis, since the fundamental purpose of the input-output framework is to analyze the interdependence of industries in an economy, according to Miller and Blair (2009)

[14]. This framework is ideal for estimating how purchases by coal mining affect other industries.

This modeling framework has been implemented by IMPLAN (2023) [5] in an online platform that combines extensive databases, economic factors, and multipliers with a refined modeling system that is customizable. IMPLAN provides complete sets of economic accounts for every county and zip code in the United States. These accounts form the backbone for each regional input-output model. This model balances industry inputs with outputs and can be used to determine the contributions of specific industries to regional economies. The IMPLAN modelling framework also allows us to define the scope of the study region to include Musselshell, Yellowstone, and the remaining counties in Montana.

There are two options for estimating the economic contributions from coal mining: industry contribution analysis and industry impact analysis. The industry contribution analysis is designed to estimate the contributions of an industry while avoiding potential double counting of interindustry sales within a sector under study, which in this case is coal mining. Industry impact analysis on the other hand is typically used for estimating the economic impacts of new projects, such as the construction of the sports stadium or a carbon sequestration project. The choice depends upon data availability and accuracy. This study conducts both type of analysis and compares the estimated employment and gross output contributions.

The industry contribution analysis tool in IMPLAN allows two options; one using IMPLAN data and another using a user supplied estimate of gross sales or output for the industry under study. A comparison of estimated total employment and gross output for these two methods appears in **Table 1**. Using IMPLAN data, coal mining contributes 524 jobs while using an estimate of gross output based upon Signal Peak's accounting data contributes 677 jobs during 2022, see columns two and three in **Table 1**.

Table 1. Comparison of employment and gross output impacts.

| | Total Employment* (Direct, Indirect, & Induced) | | | |
|---|---|---------------------------------------|---------------------------|------------------------|
| | Industry Contribution Analysis | | Industry Impact Analysis | |
| | With IMPLAN Data | Using Signal Peak Direct Gross Output | Without Private Royalties | With Private Royalties |
| 2021 | 524 | 652 | 588 | 625 |
| 2022 | 524 | 677 | 596 | 678 |
| Total Impacts on Gross Output in Millions of 2023 Dollars | | | | |
| 2021 | \$179.5 | \$223.3 | \$219.6 | \$225.6 |
| 2022 | \$179.5 | \$231.8 | \$231.6 | \$244.9 |

*Average of full and part-time employment.

Our estimate of gross output is equal to the sum of employee compensation,

contract labor, business-to-business spending, property, gross proceeds, other taxes, and depreciation, depletion, and amortization. The classic definition of gross output equal to gross sales based upon accounting records is much larger and includes profits and royalties that are paid to entities outside the study region.

Unlike industry contribution analysis that only allows the input of Signal Peak's gross output, the industry impact analysis tool in IMPLAN allows the input of several parameters. For this study, we use accounting data from Signal Peak to input employee compensation, contract labor and trucking, interindustry purchases, and the number of wage and salary employees and contract workers.

In this case, the IMPLAN model estimates that Signal Peak contributed 596 jobs to the study region in 2022, more than the 524-estimate using IMPLAN data (see column two in **Table 1**) but less than the 677-estimate using Signal Peak's estimate of gross output (see column three in **Table 1**). We also checked to determine if there was any double counting within the coal sector and it was de minimis. This finding eliminates the need to use the industry contribution analysis tool and instead adopt industry impact analysis because it allows the input of several parameters based upon actual accounting data.

There remained the puzzle of why the employment contribution was lower using the industry impact analysis (596) than the industry contribution analysis tool (677). The industry contribution analysis in column four of **Table 1** does not include royalties, which raises the question of how royalties should be modeled in the industry impact analysis.

There are two issues to address in modeling the economic impacts from royalty payments. The first is what royalty payments should be considered. Since royalty payments to state and federal governments are unlikely to affect discretionary government spending, we do not include them. The second issue is how to model the remaining \$58.66 million in royalties paid to private concerns. Since these payments go to landowners or owners of sub-surface mineral property rights, we assume they accrue to the top household income bracket. When endowed with a windfall gain, these households save most of the gains in royalty income.

Accordingly, when we conduct the industry impact analysis including private royalty payments, we find the employment contribution is 678 (see column five in **Table 1**), which is almost exactly equal to the estimated 677 using the industry contribution analysis tool with our estimate of Signal Peak's gross output. Since there is some uncertainty concerning our estimate of gross output based upon Signal Peak's accounting data and whether it conforms with the regional economic data in IMPLAN, we feel that the industry impact analysis is more accurate, especially since it is based upon actual spending data from Signal Peak. The findings reported below, therefore, are generated using the industry impact analysis tools from IMPLAN.

4. Estimated Economic Contributions

This section estimates Signal Peak's economic contributions to the study region.

The total economic impacts are the sum of the direct, indirect, and induced impacts. The direct impacts are essentially those reported in section 2. The indirect impacts include the rounds of supply-chain spending attributed to Signal Peak's spending. Finally, the induced impacts capture spending on local goods and services that results from the household and business income generated by the direct and indirect impacts. This analysis assumes that prices for local goods and services are unaffected by Signal Peak's spending.

There are two possible metrics of overall economic contribution. The first is gross output, which is equivalent to gross sales and includes purchases of intermediate inputs. Adding changes in gross output across industries due to an industry event, therefore, would double count economic inputs. Value added does not have this problem and is defined as the difference between gross output and the cost of intermediate inputs, which are purchases from other industries or imports. Value added includes employee compensation, proprietor income, taxes on production and imports, and other property income. In short, value added for an industry is its net contribution to gross domestic product of a regional economy.

Signal Peak directly contributed to \$66.2 million in value added during 2022, see [Figure 3](#). Another \$25.5 million in value added was generated indirectly by the supply chain and \$20.1 millions was induced by the spending of income generated directly and indirectly by Signal Peak. Hence, Signal Peak contributed \$111.7 million in total value added during 2022, see [Figure 3](#).



Figure 3. Signal Peak impacts on value added and labor income during 2022.

A regional disaggregation of Signal Peak's contribution to value added, labor

income, and employment to the study region during 2022 appears **Table 2**. The direct contribution of \$66.22 million in value added occurs where the mine is in Musselshell County. Another \$10.25 million of value added is generated indirectly through the supply chain within Musselshell County, \$11.61 million in Yellowstone County, and \$3.62 million in the rest of Montana. The spending of wages and salaries generated directly and indirectly induce an additional \$11.94 million of value added in Musselshell County, \$6.79 million in Yellowstone County, and \$1.28 million in the rest of the state. In total, Signal Peak Energy contributes \$88.40 million of value added in Musselshell County, \$18.4 million in Yellowstone County, and \$4.91 million of value added for the rest of Montana. Bottomline, Signal Peak contributed \$111.71 million in value added to the State of Montana during 2022.

The Type I value added multipliers, defined as the ratio of the sum of direct and indirect impacts (\$66.22 & \$25.48 million respectively) to direct impacts is 1.38. The Type II multiplier, which is defined as the total impacts divided by direct impacts (\$111.71 million), is 1.69. Jolly *et al.* (2018) [15] observe that most economic impact studies of coal mining estimate multipliers in the 2.0 - 3.0 range. Hence, our estimates are quite conservative and cannot be alleged to be over-estimated. Our estimated multipliers are lower because we are basing them upon actual spending data and not gross output that can be affected by swings in coal prices.

Table 2. Regional economic contributions of Signal Peak Energy in 2022.

| Region | Direct | Indirect | Induced | Total |
|--|---|----------|---------|----------|
| | Value Added in Millions of 2023 Dollars | | | |
| Musselshell | \$66.22 | \$10.25 | \$11.94 | \$88.40 |
| Yellowstone | | \$11.61 | \$6.79 | \$18.40 |
| Other Montana | | \$3.62 | \$1.28 | \$4.91 |
| Total | \$66.22 | \$25.48 | \$20.01 | \$111.71 |
| Labor Income in Millions of 2023 Dollars | | | | |
| Musselshell | \$39.83 | \$4.84 | \$5.01 | \$49.68 |
| Yellowstone | | \$6.55 | \$3.93 | \$10.48 |
| Other Montana | | \$1.42 | \$0.74 | \$2.16 |
| Total | \$39.83 | \$12.80 | \$9.69 | \$62.32 |
| Employment in Number of Jobs* | | | | |
| Musselshell | 247 | 99 | 145 | 491 |
| Yellowstone | | 79 | 74 | 153 |
| Other Montana | | 19 | 15 | 34 |
| Total | 247 | 197 | 234 | 678 |

*Full & part-time annual average.

The contributions to labor income, which includes wages and salaries and proprietor income, also appear in **Table 2**. Signal Peak contributes a total of \$49.68 million in labor income in Musselshell County, which includes direct, indirect, and induced impacts of \$39.83, \$4.84, and \$5.01 million respectively. Another \$10.48 and \$2.16 million of labor income are generated in Yellowstone County and the rest of Montana. In total, Signal Peak contributes \$62.32 million of labor income in Montana.

The geographical origin and source of the employment impacts also appear in **Table 2**. Of the 678 total jobs attributed to Signal Peak's coal mining, 491 occur in Musselshell County, 247 directly, 99 indirectly through the supply chain, and another 145 induced by the spending of income generated by the mine and its supporting supply chain. Another 153 jobs are supported in Yellowstone County, with 79 indirectly via the supply chain and 74 induced by households spending their income earned at the mine and in supporting industries. Finally, 34 jobs are supported in other Montana counties. Notice that there are no direct impacts in Yellowstone and other counties of Montana because there is no direct spending by Signal Peak in those counties, just indirectly through the supply chain and induced household spending.

IMPLAN reports industry impacts for 546 sectors of the economy. This study aggregates these sectors into the two-digit aggregate industries defined by the North American Industry Classification System (NAICS).

Most of the indirect or supply chain contributions from Signal Peak are distributed across several industries that in order of importance are wholesale trade, transportation, utilities, mining, finance and insurance, real estate and rentals, technical and scientific professional services, manufacturing, and administrative services and waste management, see **Figure 4**. This is a classic finding that demonstrates the economic importance of mining.

The industry distribution of the induced impacts is quite different, reflecting the composition of household spending. The largest induced impact is for real estate and rentals, health care and social assistance followed by retail trade, finance and insurance, other services, and accommodation and food services, see **Figure 5**.

5. Fiscal Contributions

The direct, indirect, and induced impacts discussed above generate significant tax revenues. These fiscal contributions appear in **Table 3**. Federal tax revenues are \$13.92 million with \$9.01 in direct impacts, \$2.79 million indirectly, and \$2.12 million of induced tax revenues. These revenues are primarily from income and social security taxes.

The total impacts on state and local taxes are considerably larger than federal taxes. The total state and local contribution is \$41.74 million. Nearly \$36 million is paid directly to these governments with \$24 million for Montana's severance tax, \$4.34 million for the gross proceeds tax, \$3.0 million in real estate and

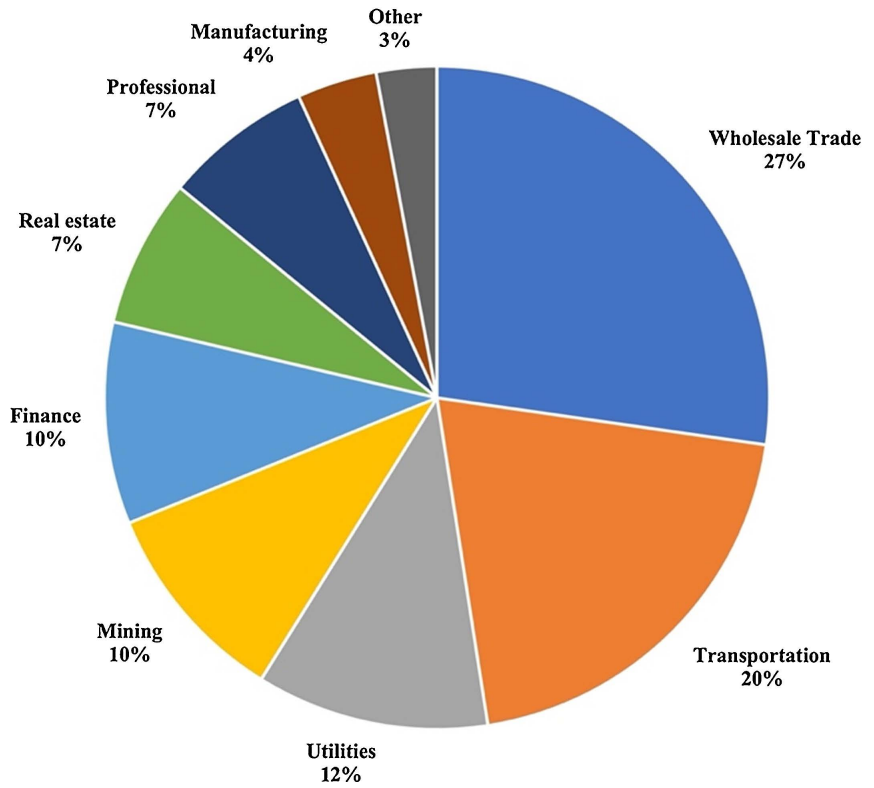


Figure 4. Composition of indirect impacts on value added by Signal Peak during 2022.

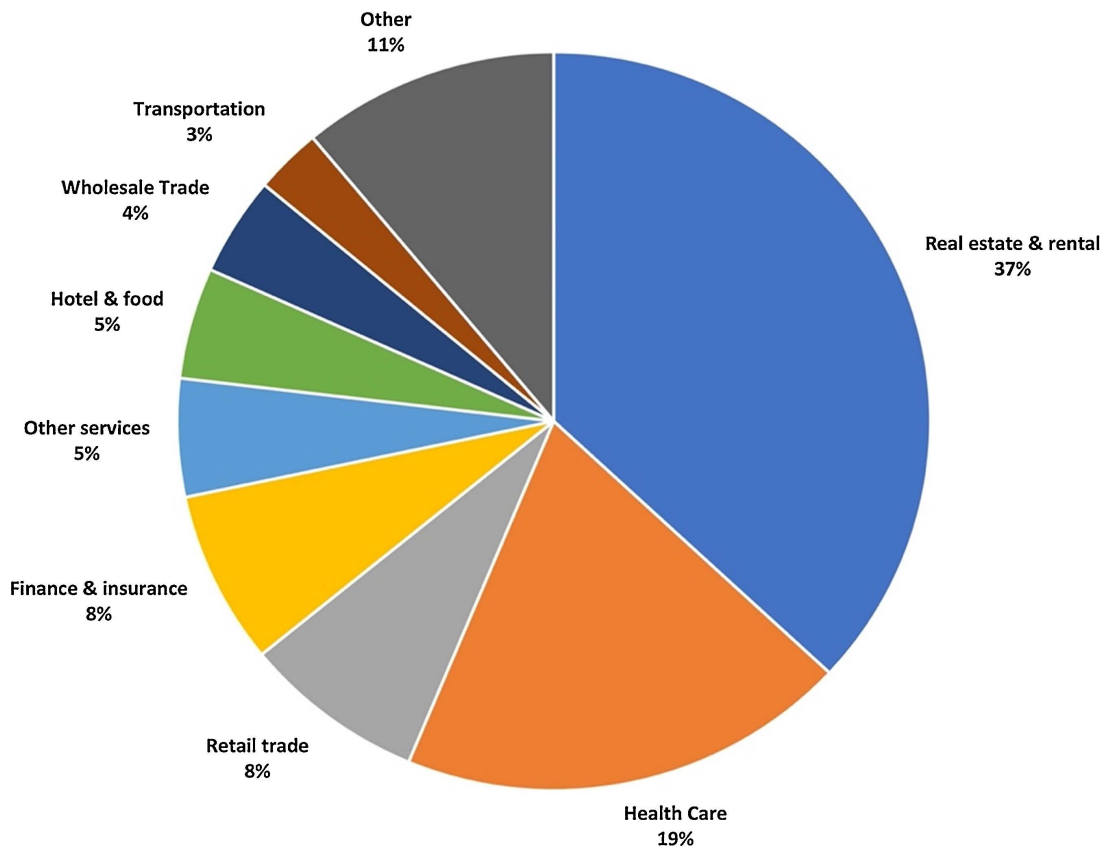


Figure 5. Composition of indirect impacts on value added by Signal Peak during 2022.

Table 3. Signal peak contributions to tax revenues during 2022.

| Federal | Direct | Indirect | Induced | Total |
|----------------------|---------|----------|---------|---------|
| Income & Profits | \$2.63 | \$1.23 | \$0.94 | \$4.80 |
| Social Security | \$5.27 | \$1.56 | \$1.18 | \$8.01 |
| Other | \$1.11 | | | \$1.11 |
| Sub-total | \$9.01 | \$2.79 | \$2.12 | \$13.92 |
| State & Local | | | | |
| Sales | \$2.14 | \$0.44 | \$0.21 | \$2.80 |
| Property | \$3.02 | \$2.65 | \$1.14 | \$6.80 |
| Severance | \$24.00 | \$0.15 | \$0.07 | \$24.22 |
| Gross proceeds | \$4.34 | \$0.00 | \$0.00 | \$4.34 |
| Water Assessment Tax | \$0.84 | \$0.00 | \$0.00 | \$0.84 |
| Other | \$1.65 | \$0.63 | \$0.47 | \$2.75 |
| Sub-total | \$35.99 | \$3.88 | \$1.88 | \$41.74 |
| Total Taxes | \$45.00 | \$6.67 | \$4.00 | \$55.66 |

property taxes and \$2.14 million in sales taxes that together constitute 93% of direct state and local tax contributions. Indirect and induced impacts contribute another \$3.88 and \$1.88 million respectively to state and local governments.

Signal Peak contributes \$45 million in direct federal, state, and local tax payments, \$6.67 indirectly, and another \$4 million of induced impacts. Total federal, state, and local tax revenues are \$55.66 million. Like the economic contributions, the operation of the Bull Mountain coal mine by Signal Peak generates significant fiscal contributions to local governments in Musselshell and Yellowstone Counties and to the State of Montana.

6. Summary and Conclusions

Signal Peak LLC operates a coal mine near Roundup, Montana that is the single largest employer in Musselshell County supporting 11.6 percent of the work force and generating 27.4 percent of total employee and proprietor compensation. This income along with spending on local goods and services and taxes contributes to the regional economy, generating tax revenues that support schools, fire protection, and a wide array of other social services. This study quantifies these fiscal and economic contributions.

These contributions arise from the \$245.1 million Signal Peak spent in Musselshell County including \$79.6 million on business-to-business spending, \$39.8 million on wages and contract labor, \$32.1 million on non-income related taxes including property and severance taxes, and \$93.6 million in royalties during 2022.

This spending generates indirect or supply chain impacts that arise from

business spending on the provision of goods and services that support activity at the mine. In addition, there is additional stimulus induced by the spending of wages and salaries paid by the mine and by supporting supply chain industries. The direct spending by Signal Peak along with the indirect and induced impacts constitutes the total economic and fiscal contributions of Signal Peak Energy, LLC.

During 2022, Signal Peak contributed \$111.7 million in total value added or net economic output, \$62.3 million in labor income, and 678 jobs. This economic activity generated more than \$55 million in tax revenues with \$45 million accruing to state and local governments.

From a national perspective, Signal Peak's coal mine is a valuable source of primary energy and depending upon the price of coal a significant source of income for the mineral property rights owners. The economic contributions from these profits to state and federal corporate tax revenues and to the financing of capital investment lies outside the scope of this study but should not be dismissed in considering the socio-economic contributions of Signal Peak LLC.

Environmental groups have sought to either stop or limit production at the mine, arguing that the environmental costs exceed the economic and fiscal benefits. These environmental costs, however, depend upon the social cost of carbon, which is highly uncertain.

Moreover, any hypothetical reduction in environmental costs assumes that emissions actually fall if Signal Peak production is curtailed. Such an outcome is unlikely because the international coal market is highly competitive and other coal mines around the world would replace any lost coal production from Signal Peak. Hence, any effort to restrict Signal Peak's coal production would not result in any meaningful reduction in greenhouse gas emissions. In contrast, lost economic and fiscal contributions from curtailing or halting Signal Peak's coal production would be certain. Adopting policies to address global climate change should consider these opportunity costs and should not come at the expense of people's livelihoods and the fiscal health of local communities.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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